ORAL ARGUMENT SCHEDULED FOR NOVEMBER 21, 2014

No. 13-1311

IN THE UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

NATURAL RESOURCES DEFENSE COUNCIL, INC.

Petitioner,

v.

UNITED STATES OF AMERICA AND
NUCLEAR REGULATORY COMMISSION,

Respondents.

PETITION FOR REVIEW OF FINAL ORDER OF THE UNITED STATES
NUCLEAR REGULATORY COMMISSION

JOINT APPENDIX

Geoffrey H. Fettus
Natural Resources Defense Council, Inc.
1152 15th Street, NW, Suite 300
Washington, D.C. 20005
(202) 289-2371

Howard M. Crystal
Eric R. Glitzenstein
MEYER GLITZENSTEIN & CRYSTAL
1601 Connecticut Ave., N.W., Suite 700
Washington, D.C. 20009
(202) 588-5206
(202) 588-5049 (facsimile)

TABLE OF CONTENTS

Other Cited Materials

CERTIFIED INDEX OF THE RECORD

NATURAL RESOURCES DEFENSE COUNCIL, INC.

VS.

U.S. NUCLEAR REGULATORY COMMISSION

Docket Nos. 13-1311

Thursday, February 06, 2014

ID NO.	PLANT NAME	DESCRIPTION	DOCUMENT DATE	ACCESSION NUMBER
1	LIMERICK	NRDC REQUEST FOR 30 DAY EXTENSION OF TIME FOR OPPORTUNITY TO REQUEST A HEARING AND PETITION FOR LEAVE TO INTERVENE IN THE NRC'S NOTICE OF OPPORTUNITY FOR HEARING REGARDING RENEWAL OF FACILITY OPERATING LICENSE NOS. NPF-39 AND NPF-85	09/22/2011	ML11266A083
2	LIMERICK	NOTICES OF APPEARANCE OF J. BRADLEY FEWELL, KATHRYN M. SUTTON, ALEX S. POLONSKY	09/26/2011	ML11269A113
3	LIMERICK	EXELON ANSWER TO NRDC REQUEST FOR EXTENSION OF TIME	09/26/2011	ML11269A134
4	LIMERICK	NOTICE OF APPEARANCE OF CATHERINE KANATAS	09/30/2011	ML11273A004

ID NO.	PLANT NAME	DESCRIPTION	DOCUMENT DATE	ACCESSION NUMBER
5	LIMERICK	NRC STAFF'S RESPONSE TO NRDC'S AND EXELON'S REQUESTS FOR EXTENSIONS TO FILE PETITIONS FOR HEARING AND ANSWERS TO PETITIONS	09/30/2011	ML11273A005
6	LIMERICK	NOTICE OF APPEARANCE OF BROOKE LEACH	10/05/2011	ML11278A106
7	LIMERICK	EXELON'S RESPONSE IN SUPPORT OF NRC STAFF'S RESPONSE TO NRDC'S REQUEST FOR EXTENSION OF TIME	10/05/2011	ML11278A111
8	LIMERICK	ORDER OF THE SECRETARY GRANTING NRDC AN EXTENSION OF 30 DAYS TO FILE A PETITION TO INTERVENE REGARDING LICENSE RENEWAL OF LIMERICK, UNITS 1 & 2	10/17/2011	ML11290A233
9	LIMERICK	NATURAL RESOURCES DEFENSE COUNCIL PETITION TO INTERVENE AND NOTICE OF INTENTION TO PARTICIPATE [PACKAGE - ML11326A319]	11/22/2011	ML11326A320
10	LIMERICK	DECLARATION OF THOMAS B. COCHRAN, PH.D.; MATTHEW G. MCKINZIE, PH.D.; AND CHRISTOPHER J. WEAVER, PH.D., ON BEHALF OF THE NATURAL RESOURCES DEFENSE COUNCIL [PACKAGE - ML11326A319]	11/22/2011	ML11326A322

ID NO.	PLANT NAME	DESCRIPTION	DOCUMENT DATE	ACCESSION NUMBER
11	LIMERICK	DECLARATIONS OF SUZANNE DAY, CHARLES ELLIOTT, LINDA LOPEZ AND WILLIAM WHITE [PACKAGE - ML11326A319]	11/18/2011	ML11326A323
12	LIMERICK	NOTICE OF APPEARANCE OF ANTHONLY Z. ROISMAN AND GEOFFREY FETTUS [PACKAGE - ML11326A319]	11/22/2011	ML11326A321
13	LIMERICK	NATURAL RESOURCES DEFENSE COUNCIL UNOPPOSED MOTION FOR EXTENSION OF TIME	11/30/2011	ML11334A039
14	LIMERICK	REFERRAL MEMORANDUM OF THE SECRETARY	12/14/2011	ML11348A259
15	LIMERICK	ESTABLISHMENT OF ATOMIC SAFETY AND LICENSING BOARD - SERVED	12/15/2011	ML11349A433
16	LIMERICK	EXELON ANSWER OPPOSING NRDC PETITION TO INTERVENE	12/20/2011	ML11354A451
17	LIMERICK	NRC STAFF'S ANSWER TO NRDC'S HEARING REQUEST	12/21/2011	ML11355A174
18	LIMERICK	ORDER - GRANTING MOTION FOR EXTENSION OF TIME - SERVED	12/22/2011	ML11356A122

ID NO.	PLANT NAME	DESCRIPTION	DOCUMENT DATE	ACCESSION NUMBER
19	LIMERICK	NATURAL RESOURCES DEFENSE COUNCIL ("NRDC") COMBINED REPLY TO EXELON AND NRC STAFF	01/06/2012	ML12006A224
20	LIMERICK	NRC STAFF'S MOTION TO STRIKE IMPERMISSIBLE NEW CLAIMS IN NATURAL RESOURCES DEFENSE COUNCIL'S REPLY BRIEF	01/17/2012	ML12017A202
21	LIMERICK	EXELON'S MOTION TO STRIKE PORTIONS OF NRDC REPLY [PACKAGE - ML12017A256)	01/17/2012	ML12017A258
22	LIMERICK	NRDC COMBINED OPPOSITION TO MOTIONS TO STRIKE	01/27/2012	ML12027A234
23	LIMERICK	NOTICE AND ORDER (SCHEDULING ORAL ARGUMENT)	01/31/2012	ML12031A206
24	LIMERICK	NOTICE OF APPEARANCE FOR LAUREN WOODALL	02/06/2012	ML12037A205
25	LIMERICK	NOTICE OF APPEARANCE FOR MAXWELL SMITH	02/06/2012	ML12037A206
26	LIMERICK	OFFICIAL TRANSCRIPT (LIMERICK GENERATING STATION ORAL ARGUMENTS) NORRISTOWN, PA PAGES 1-269	02/21/2012	ML12060A235

ID NO.	PLANT NAME	DESCRIPTION	DOCUMENT DATE	ACCESSION NUMBER
27	LIMERICK	NRC STAFF'S UNOPPOSED MOTION TO CORRECT THE TRANSCRIPT OF THE ORAL ARGUMENT HELD ON FEBRUARY 21, 2010	03/08/2012	ML12068A404
28	LIMERICK	EXELON'S UNOPPOSED MOTION TO CORRECT THE TRANSCRIPT OF THE ORAL ARGUMENT HELD ON FEBRUARY 21, 2012	03/12/2012	ML12072A414
29	LIMERICK	ORDER (ADOPTING PROPOSED TRANSCRIPT CORRECTIONS)	03/13/2012	ML12073A244
30	LIMERICK	MEMORANDUM AND ORDER LBP-12-08 (RULING ON PETITION TO INTERVENE AND REQUEST FOR HEARING)	04/04/2012	ML12095A239
31	LIMERICK	NOTICE AND ORDER (SETTING TELEPHONIC INITIAL SCHEDULING CONFERENCE)	04/16/2012	ML12107A140
32	LIMERICK	NRC STAFF'S NOTICE OF APPEAL OF THE ATOMIC SAFETY AND LICENSING BOARD DECISION LBP-12-08	04/16/2012	ML12107A406
33	LIMERICK	NOTICE OF APPEARANCE FOR ANNA VINSON JONES, MORGAN, LEWIS & BOCKIUS, LLP REPRESENTING EXELON GENERATION COMPANY, LLC	04/16/2012	ML12107A411
34	LIMERICK	EXELON APPEAL OF ATOMIC SAFETY AND LICENSING BOARD DECISION LBP-12-08	04/16/2012	ML12107A417

ID NO.	PLANT NAME	DESCRIPTION	DOCUMENT DATE	ACCESSION NUMBER
35	LIMERICK	EXELON'S UNOPPOSED MOTION TO DEFER INITIAL DISCLOSURES	04/19/2012	ML12110A468
36	LIMERICK	TRANSCRIPT OF TELEPHONE CONFERENCE - LIMERICK GENERATING STATION ON THURSDAY, APRIL 26, 2012, PAGES 270-317	04/26/2012	ML12125A124
37	LIMERICK	AGREEMENT OF THE PARTIES REGARDING THE HEARING SCHEDULE, MANDATORY DISCLOSURES, AND THE HEARING FILE, SUBMITTED BY THE APPLICANT'S LEGAL COUNSEL	04/25/2012	ML12116A210
38	LIMERICK	NATURAL RESOURCES DEFENSE COUNCIL'S RESPONSE TO APPEALS BY EXELON, INC. AND NRC STAFF OF LBP-12-08	04/26/2012	ML12117A452
39	LIMERICK	NOTICE OF HEARING	05/03/2012	ML12124A189
40	LIMERICK	NRC STAFF NOTICE OF INTENT TO PARTICIPATE AS A PARTY	05/04/2012	ML12125A293
41	LIMERICK	INITIAL SCHEDULING ORDER	05/07/2012	ML12128A295
42	LIMERICK	NOTICE OF WITHDRAWAL OF LAUREN WOODALL, LEGAL COUNSEL FOR NRC STAFF.	05/07/2012	ML12128A397

ID NO.	PLANT NAME	DESCRIPTION	DOCUMENT DATE	ACCESSION NUMBER
43	LIMERICK	EXHIBIT 1 TO EXELON'S MOTION TO STRIKE PORTIONS OF NRDC'S REPLY [PACKAGE - ML12017A256]	01/17/2012	ML12017A257
44	LIMERICK	EXELON'S INITIAL DISCLOSURES AND SUPPORTING AFFIDAVIT OF NANCY L. RANEK	07/02/2012	ML12184A245
45	LIMERICK	NATURAL RESOURCES DEFENSE COUNCIL INITIAL DISCLOSURES FILED PURSUANT TO 10 C.F.R. § 2.336(A) [PACKAGE # ML12184A239]	07/02/2012	ML12184A240
46	LIMERICK	ATTACHMENT A TO NATURAL RESOURCES DEFENSE COUNCIL INITIAL DISCLOSURES FILED PURSUANT TO 10 C.F.R. § 2.336(A) (POTENTIAL EXPERT WITNESSES CONTENTION E-1)	07/02/2012	ML12184A242
47	LIMERICK	ATTACHMENT B TO NATURAL RESOURCES DEFENSE COUNCIL INITIAL DISCLOSURES FILED PURSUANT TO 10 C.F.R. § 2.336(A) (DOCUMENTS RELEVANT TO CONTENTION E-	07/02/2012	ML12184A241
48	LIMERICK	NRC STAFF LETTER PROVIDING INITIAL DISCLOSURES PURSUANT TO 10 C.F.R. 2.336 [PACKAGE # ML12184A310]	07/02/2012	ML12184A316

ID NO.	PLANT NAME	DESCRIPTION	DOCUMENT DATE	ACCESSION NUMBER
49	LIMERICK	ATTACHMENT 1 TO NRC STAFF HEARING FILE AND MANDATORY DISCLOSURES HEARING FILE INDEX - INITIAL DISCLOSURES [PACKAGE # ML12184A310]	07/02/2012	ML12184A314
50	LIMERICK	ATTACHMENT 2 TO NRC STAFF HEARING FILE AND MANDATORY DISCLOSURES HEARING FILE INDEX - GENERIC GUIDANCE FOR LICENSE RENEWAL [PACKAGE # ML12184A310]	07/02/2012	ML12184A313
51	LIMERICK	ATTACHMENT 3 TO NRC STAFF HEARING FILE AND MANDATORY DISCLOSURES - DELIBERATIVE PROCESS PRIVILEGE LOG - INITIAL DISCLOSURES [PACKAGE # ML12184A310]	07/02/2012	ML12184A315
52	LIMERICK	NRC STAFF - AFFIDAVIT OF LESLIE PERKINS CONCERNING MANDATORY DISCLOSURE REQUIREMENT OF 10 C.F.R. § 2.336(B) [PACKAGE # ML12184A310]	07/02/2012	ML12184A312
53	LIMERICK	NRC STAFF - DECLARATION OF BRIAN HOLIAN CONCERNING MANDATORY DISCLOSURE REQUIREMENT OF 10 C.F.R. § 2.336(B) [PACKAGE # ML12184A310]	07/02/2012	ML12184A311
54	LIMERICK	ATTACHMENT C TO NATURAL RESOURCES DEFENSE COUNCIL INITIAL DISCLOSURES FILED PURSUANT TO 10 C.F.R. § 2.336(A) (AFFIDAVIT OF	07/05/2012	ML12187A251

ID NO.	PLANT NAME	DESCRIPTION	DOCUMENT DATE	ACCESSION NUMBER
55	LIMERICK	CORRECTED ATTACHMENT C TO NATURAL RESOURCES DEFENSE COUNCIL INITIAL DISCLOSURES FILED PURSUANT TO 10 C.F.R. § 2.336(A) (AFFIDAVIT OF CHRISTOPHER J. WEAVER)	07/06/2012	ML12188A021
56	LIMERICK	NRDC'S MOTION FOR LEAVE TO FILE A NEW CONTENTION CONCERNING TEMPORARY STORAGE AND ULTIMATE DISPOSAL OF NUCLEAR WASTE AT LIMERICK [PACKAGE # ML12191A406]	07/09/2012	ML12191A408
57	LIMERICK	NRCD'S SUBMISSION OF US COURT OF APPEALS WASTE CONFIDENCE DECISION [PACKAGE # ML12191A406]	06/08/2012	ML12191A407
58	LIMERICK	NRDC'S WASTE CONFIDENCE CONTENTION [PACKAGE # ML12191A406]	07/09/2012	ML12191A409
59	LIMERICK	NRDC'S ERRATA NOTICE FOR 7/9/12 WASTE CONFIDENCE CONTENTION [PACKAGE # ML12192A240]	07/09/2012	ML12192A242
60	LIMERICK	NRDC'S CORRECTED WASTE CONFIDENCE CONTENTION [PACKAGE # ML12192A240]	07/09/2012	ML12192A241
61	LIMERICK	NRDC'S 2ND ERRATA NOTICE FOR WASTE CONFIDENCE CONTENTION [PACKAGE # ML12192A369]	07/09/2012	ML12192A371

ID NO.	PLANT NAME	DESCRIPTION	DOCUMENT DATE	ACCESSION NUMBER
62	LIMERICK	NRDC'S 2ND CORRECTED WASTE CONFIDENCE CONTENTION [PACKAGE # ML12192A369]	07/09/2012	ML12192A370
63	LIMERICK	NRDC JULY 2012 DISCLOSURE / AFFIDAVIT OF CHRISTOPHER J. WEAVER	07/31/2012	ML12213A290
64	LIMERICK	EXELON'S FIRST SUPPLEMENTAL DISCLOSURES	08/01/2012	ML12214A467
65	LIMERICK	NRC HEARING FILE INDEX INITIAL, UPDATE 1; HEARING FILE DELIBERATIVE PROCESS PRIVILEGE LOG; PROPRIETARY PRIVILEGE LOG; AFFIDAVIT OF LESLIE PERKINS RE: MANDATORY DISCLOSURE REQUIREMENT OF 10 C.F.R. § 2.336(B); DECLARATION OF BRIAN E. HOLIAN	08/01/2012	ML12214A520
66	LIMERICK	NOTICE OF APPEARANCE FOR JOSEPH LINDELL ON BEHALF OF THE NRC STAFF	08/01/2012	ML12214A514
67	LIMERICK	NRC STAFF'S RESPONSE TO NRDC'S MOTION FOR LEAVE TO FILE A NEW CONTENTION CONCERNING TEMPORARY STORAGE AND ULTIMATE DISPOSAL OF NUCLEAR WASTE AT LIMERICK AND NRDC'S WASTE CONFIDENCE CONTENTION	08/02/2012	ML12215A457

ID NO.	PLANT NAME	DESCRIPTION	DOCUMENT DATE	ACCESSION NUMBER
68	LIMERICK	EXELON'S ANSWER OPPOSING NRDC'S NEW WASTE CONFIDENCE CONTENTION	08/02/2012	ML12215A571
69	LIMERICK	COMMISSION MEMORANDUM AND ORDER (CLI-12-16)	08/07/2012	ML12220A100
70	LIMERICK	ORDER (SUSPENDING PROCEDURAL DATE RELATED TO PROPOSED WASTE CONFIDENCE CONTENTION)	08/08/2012	ML12221A277
71	LIMERICK	NOTICE (ADVISING PARTIES OF AMENDMENTS TO 10 C.F.R. PART 2)	08/22/2012	ML12235A265
72	LIMERICK	LETTER REGARDING CHANGE TO THE SCHEDULE FOR THE SITE-SPECIFIC ENVIRONMENTAL IMPACT STATEMENT	08/24/2012	ML12237A123
73	LIMERICK	NRC STAFF'S UNOPPOSED RESPONSE TO THE BOARD'S NOTICE OF 8/22/12 REGARDING AMENDMENT TO PART 2 REGULATIONS	08/29/2012	ML12242A416
74	LIMERICK	UPDATED DISCLOSURES OF NATURAL RESOURCES DEFENSE COUNCIL FILED PURSUANT TO 10 C.F.R. § 2.336(A) AND AFFIDAVIT OF CHRISTOPHER J. WEAVER	08/31/2012	ML12244A401
75	LIMERICK	REVISED SCHEDULING ORDER	09/04/2012	ML12248A195

ID NO.	PLANT NAME	DESCRIPTION	DOCUMENT DATE	ACCESSION NUMBER
76	LIMERICK	APPLICANT'S SECOND SUPPLEMENTAL DISCLOSURES PURSUANT TO 10 C.F.R. § 2.336	09/04/2012	ML12248A223
77	LIMERICK	NRC STAFF'S HEARING FILE INDEX INITIAL UPDATE 2 AND AFFIDAVIT OF LESLIE PERKINS	09/04/2012	ML12248A394
78	LIMERICK	EXELON'S THIRD SUPPLEMENTAL DISCLOSURES AND AFFIDAVIT OF NANCY L. RANEK	10/01/2012	ML12275A081
79	LIMERICK	HEARING FILE INDEX INITIAL, UPDATE 3; ATTACHMENT 2 - AFFIDAVIT OF LESLIE PERKINS CONCERNING MANDATORY DISCLOSURE REQUIREMENT OF 10 C.F.R. § 2.336(B)	10/01/2012	ML12275A173
80	LIMERICK	NRDC'S MANDATORY DISCLOSURE NOTICE / AFFIDAVIT OF CHRISTOPHER J. WEAVER [PACKAGE # ML12275A462]	10/01/2012	ML12275A466
81	LIMERICK	CERTIFICATE OF SERVICE FOR NRDC'S MANDATORY DISCLOSURE NOTICE / AFFIDAVIT OF CHRISTOPHER J. WEAVER [PACKAGE # ML12275A462]	10/01/2012	ML12275A464
82	LIMERICK	COMMISSION MEMORANDUM AND ORDER (CLI-12-19)	10/23/2012	ML12297A103
83	LIMERICK	NRC STAFF'S HEARING FILE UPDATE 4 - NOVEMER, 2013	11/01/2012	ML12306A502

ID NO.	PLANT NAME	DESCRIPTION	DOCUMENT DATE	ACCESSION NUMBER
84	LIMERICK	EXELON MOTION FOR ORDER ESTABLISHING DEADLINE TO FILE RESPONSES TO NRDC'S ANTICIPATED NOVEMBER 27, 2012 WAIVER PETITION	11/16/2012	ML12321A229
85	LIMERICK	NOTICE OF APPEARANCE OF HOWARD M. CRYSTAL ON BEHALF OF NRDC [PKG # ML12326A972]	11/21/2012	ML12326A973
86	LIMERICK	DECLARATION OF CHRISTOPHER J. WEAVER, PH.D., ON BEHALF OF THE NATURAL RESOURCES DEFENSE COUNCIL IN SUPPORT OF MOTION FOR WAIVER [PKG # ML12326A972]	11/21/2012	ML12326A974
87	LIMERICK	DECLARATION OF GEOFFREY H. FETTUS, COUNSEL FOR NRDC, REGARDING WAIVER OF 10 C.F.R. § 51.53(C)(3)(II)(L) AS APPLIED TO APPLICATION FOR RENEWAL OF LICENSES FOR LIMERICK UNITS 1 AND 2 [PKG # ML12326A972]	11/21/2012	ML12326A975
88	LIMERICK	NATURAL RESOURCES DEFENSE COUNCIL'S PETITION, BY WAY OF MOTION, FOR WAIVER OF 10 C.F.R. § 51.53(C)(3)(II)(L) AS APPLIED TO APPLICATION FOR RENEWAL OF LICENSES FOR LIMERICK UNITS 1 AND 2 [PKG # ML12326A972]	11/21/2012	ML12326A976

ID NO.	PLANT NAME	DESCRIPTION	DOCUMENT DATE	ACCESSION NUMBER
89	LIMERICK	NATURAL RESOURCES DEFENSE COUNCIL PETITION TO INTERVENE AND NOTICE OF INTENTION TO PARTICIPATE (ORIGINALLY FILED NOVEMBER 22, 2011) FILED WITH MOTION FOR WAIVER [PKG # ML12326A972]	11/22/2011	ML12326A977
90	LIMERICK	NRDC'S RESPONSE TO EXELON'S MOTION FOR ORDER ESTABLISHING DEADLINE FOR RESPONSE TO NRDC'S REQUEST FOR WAIVER [PKG # ML12331A349]	11/26/2012	ML12331A351
91	LIMERICK	ATTACHMENT 1 TO NRDC'S RESPONSE TO EXELON'S MOTION FOR ORDER ESTABLISHING DEADLINE FOR RESPONSE TO NRDC'S REQUEST FOR WAIVER [PKG # ML12331A349]	11/16/2012	ML12331A350
92	LIMERICK	ATTACHMENT 2 TO NRDC'S RESPONSE TO EXELON'S MOTION FOR ORDER ESTABLISHING DEADLINE FOR RESPONSE TO NRDC'S REQUEST FOR WAIVER [PKG # ML12331A349]	11/14/2012	ML12331A352
93	LIMERICK	ORDER (ESTABLISHING DEADLINES FOR RESPONSES TO NRDC WAIVER PETITION)	11/27/2012	ML12332A259
94	LIMERICK	NRC STAFF HEARING FILE UPDATE 5	12/03/2012	ML12338A352

ID NO.	PLANT NAME	DESCRIPTION	DOCUMENT DATE	ACCESSION NUMBER
95	LIMERICK	EXELON'S RESPONSE OPPOSING NRDC'S PETITION FOR WAIVER OF 10 CFR SECTION 51.53 (C) (3)(II)(L) (PACKAGE ML12349A326)	12/14/2012	ML12349A327
96	LIMERICK	EXELON'S COUNTER AFFIDAVIT SUPPORTING EXELON'S RESPONSE OPPOSING NRDC'S PETITION FOR WAIVER OF 10 CFR SECTION 51.53(C)(3)(II)(L) (PACKAGE ML12349A326)	12/14/2012	ML12349A328
97	LIMERICK	EXHIBIT A - DECLARATION OF CHRISTOPHER J. WEAVER, PH.D., ON BEHALF OF THE NATURAL RESOURCES DEFENSE COUNCIL (PACKAGE ML12349A326)	12/14/2012	ML12349A329
98	LIMERICK	NRC STAFF ANSWER TO NATURAL RESOURCES DEFENSE COUNCIL PETITION FOR WAIVER OF 10 CFR SECTION 51.53 (C) (3)(II)(L)	12/14/2012	ML12349A384
99	LIMERICK	REPLY OF NATURAL RESOURCES DEFENSE COUNCIL IN SUPPORT OF PETITION, BY WAY OF MOTION, FOR WAIVER OF 10 C.F.R. § 51.53(C)(3)(II)(L) AS APPLIED TO APPLICATION FOR RENEWAL OF LICENSES FOR LIMERICK UNITS 1 AND 2.	12/21/2012	ML12356A493
100	LIMERICK	NRC STAFF'S HEARING FILE UPDATE 6 - JANUARY, 2013	01/02/2013	ML13002A373

ID NO.	PLANT NAME	DESCRIPTION	DOCUMENT DATE	ACCESSION NUMBER
101	LIMERICK	NRC STAFF'S HEARING FILE UPDATE 7 - FEBRUARY, 2013	02/01/2013	ML13032A556
102	LIMERICK	ORDER (DENYING PETITION FOR WAIVER OF 10 C.F.R. § 51.53(C)(3)(II)(L) AND REFERRING THIS DECISION TO THE COMMISSION)	02/06/2013	ML13037A477
103	LIMERICK	NOTICE OF WITHDRAWAL OF JOSEPH LINDELL, NRC STAFF COUNSEL	02/13/2013	ML13044A457
104	LIMERICK	UNOPPOSED MOTION REQUESTING BRIEFING	02/19/2013	ML13050A357
105	LIMERICK	ORDER OF THE SECRETARY (GRANTING MOTION REQUESTING BRIEFING AND ESTABLISHING BRIEFING SCHEDULE)	02/26/2013	ML13057A822
106	LIMERICK	NRC STAFF'S MANDATORY DISCLOSURES - MARCH 2013	03/01/2013	ML13060A243
107	LIMERICK	NRC STAFF'S MARCH 2013 STATUS LETTER RE CHANGE TO THE SCHEDULE FOR THE SITE-SPECIFIC ENRIVONMENTAL IMPACT STATEMENT	03/08/2013	ML13067A226
108	LIMERICK	AMENDED NOTICE OF APPEARANCE OF BROOKE MCGLINN ON BEHALF OF MORGAN LEWIS FOR LICENSEE	03/13/2013	ML13072A516

ID NO.	PLANT NAME	DESCRIPTION	DOCUMENT DATE	ACCESSION NUMBER
109	LIMERICK	NRC STAFF'S BRIEF ON ASLB REFERRED RULING IN LBP-13-1	03/13/2013	ML13072A804
110	LIMERICK	NRDC'S BRIEF IN SUPPORT OF WAIVER [PKG # ML13072B035]	03/13/2013	ML13072B038
111	LIMERICK	EXHIBIT A TO NRDC'S BRIEF IN SUPPORT OF WAIVER [PKG # ML13072B035]	03/13/2013	ML13072B039
112	LIMERICK	EXHIBIT B TO NRDC'S BRIEF IN SUPPORT OF WAIVER [PKG # ML13072B035]	03/13/2013	ML13072B036
113	LIMERICK	EXELON'S INITIAL BRIEF IN RESPONSE TO THE REFERRAL OF LBP-13-1 TO THE COMMISSION	03/13/2013	ML13072B433
114	LIMERICK	NRC STAFF'S REPLY ON THE BOARD'S REFERRED RULING IN LBP-13-1	03/20/2013	ML13079A501
115	LIMERICK	NATURAL RESOURCES DEFENSE COUNCIL'S RESPONSE BRIEF IN SUPPORT OF WAIVER OF 10 C.F.R. § 51.53©(3)(II)(L) AS APPLIED TO APPLICATION FOR RENEWAL OF LICENSES FOR LIMERICK UNITS 1 AND 2	03/20/2013	ML13079A551
116	LIMERICK	EXELON'S REPLY BRIEF IN RESPONSE TO THE REFERRAL OF LBP-13-1 TO THE COMMISSION	03/20/2013	ML13079A662

ID NO.	PLANT NAME	DESCRIPTION	DOCUMENT DATE	ACCESSION NUMBER
117	LIMERICK	NRC STAFF'S MANDATORY DISCLOSURES - APRIL 2013	04/01/2013	ML13091A162
118	LIMERICK	NRC STAFF'S HEARING FILE UPDATE 10 AND NOTIFICATION OF DSEIS	05/01/2013	ML13121A133
119	LIMERICK	NOTICE OF WITHDRAWAL OF MAXWELL SMITH	05/10/2013	ML13130A369
120	LIMERICK	NATURAL RESOURCES DEFENSE COUNCIL'S RESUBMISSION OF CONTENTIONS IN RESPONSE TO STAFF'S SUPPLEMENTAL DRAFT ENVIRONMENTAL IMPACT STATEMENT	05/30/2013	ML13150A420
121	LIMERICK	LETTER FROM NRC STAFF TO BOARD; ATTACHMENT 1 - HEARING FILE INDEX INITIAL, UPDATE 11; ATTACHMENT 2 - AFFIDAVIT OF LESLIE PERKINS CONCERNING MANDATORY DISCLOSURE REQUIREMENT OF 10 C.F.R. § 2.336(B) - JUNE, 2013	06/03/2013	ML13154A391
122	LIMERICK	NRC STAFF'S ANSWER TO THE NATURAL RESOURCES DEFENSE COUNCIL'S RESUBMISSION OF CONTENTIONS IN RESPONSE TO STAFF'S SUPPLEMENTAL DRAFT ENVIRONMENTAL IMPACT STATEMENT	06/24/2013	ML13175A214

ID NO.	PLANT NAME	DESCRIPTION	DOCUMENT DATE	ACCESSION NUMBER
123	LIMERICK	EXELON ANSWER OPPOSING NATURAL RESOURCES DEFENSE COUNCIL'S RESUBMISSION OF CONTENTIONS IN RESPONSE TO STAFF'S SUPPLEMENTAL DRAFT ENVIRONMENTAL IMPACT STATEMENT	06/24/2013	ML13175A250
124	LIMERICK	NRC STAFF'S HEARING FILE UPDATE 12 - JULY, 2013	07/01/2013	ML13182A171
125	LIMERICK	NATURAL RESOURCES DEFENSE COUNCIL'S REPLY IN SUPPORT OF RESUBMISSION OF CONTENTIONS	07/08/2013	ML13189A305
126	LIMERICK	MEMORANDUM AND ORDER (RULING ON RESUBMISSION OF CONTENTIONS)	07/12/2013	ML13193A050
127	LIMERICK	EXELON'S MOTION FOR CLARIFICATION OR IN THE ALTERNATIVE, FOR LEAVE TO REQUEST PARTIAL RECONSIDERATION OF THE BOARD'S JULY 12 ORDER, RULING ON RESUBMISSION OF CONTENTIONS	07/22/2013	ML13203A162
128	LIMERICK	NATURAL RESOURCES DEFENSE COUNCIL'S OPPOSITION TO EXELON'S MOTION FOR CLARIFICATION, OR, IN THE ALTERNATIVE, FOR LEAVE TO REQUEST PARTIAL RECONSIDERATION OF THE BOARD'S JULY 12 ORDER.	07/31/2013	ML13212A383

ID NO.	PLANT NAME	DESCRIPTION	DOCUMENT DATE	ACCESSION NUMBER
129	LIMERICK	NRC STAFF'S HEARING FILE UPDATE 13 - AUGUST, 2013	08/01/2013	ML13213A065
130	LIMERICK	MEMORANDUM (CLARIFYING THE BOARD'S JULY 12, 2013 ORDER)	08/06/2013	ML13218A297
131	LIMERICK	NOTICE OF WITHDRAWAL OF LLOYD SUBIN	08/19/2013	ML13231A252
132	LIMERICK	LETTER TO THE BOARD FROM NRC STAFF RE: CHANGE TO THE SCHEDULE FOR THE SITE-SPECIFIC ENVIRONMENTAL IMPACT STATEMENT	08/26/2013	ML13238A055
133	LIMERICK	NRC STAFF'S HEARING FILE UPDATE 14 - SEPTEMBER, 2013	08/30/2013	ML13242A039
134	LIMERICK	NRC STAFF'S HEARING FILE UPDATE 15 - OCTOBER, 2013	10/01/2013	ML13274A048
135	LIMERICK	NOTICE OF THE SECRETARY (REGARDING AGENCY SHUTDOWN)	10/10/2013	ML13283A112
136	LIMERICK	NOTICE OF THE SECRETARY LIFTING SUSPENSION OF ADJUDICATORY ACTIVITY	10/17/2013	ML13290A466

ID NO.	PLANT NAME	DESCRIPTION	DOCUMENT DATE	ACCESSION NUMBER
137	LIMERICK	NRC STAFF HEARING FILE UPDATE 16	10/31/2013	ML13304A522
138	LIMERICK	COMMISSION MEMORANDUM AND ORDER (CLI-13-07)	10/31/2013	ML13304B417
139	LIMERICK	EXELON’S PETITION FOR CERTIFICATION OF WASTE CONFIDENCE-RELATED QUESTION TO THE COMMISSION PURSUANT TO 10 C.F.R. § 2.323(F)(2)	11/12/2013	ML13316C421
140	LIMERICK	ORDER (SUSPENDING ANSWERS FROM PARTIES)	11/13/2013	ML13317B225
141	LIMERICK	ORDER (DENYING EXELON'S PETITION FOR CERTIFICATION OF WASTE CONFIDENCE-RELATED QUESTION TO THE COMMISSION)	11/18/2013	ML13322B257
142	LIMERICK	LETTER REGARDING CHANGE TO THE SCHEDULE FOR THE SITE-SPECIFIC ENVIRONMENTAL IMPACT STATEMENT	01/27/2014	ML14027A014

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:	)	
	)	
EXELON GENERATION COMPANY, LLC	)	**Docket No. 50-352-LR**
	)	**Docket No. 50-353-LR**
(Limerick Generating Station, Units 1 and 2)	)	
		November 22, 2011
(License Renewal Application)		

NATURAL RESOURCES DEFENSE COUNCIL
PETITION TO INTERVENE AND
NOTICE OF INTENTION TO PARTICIPATE

PRELIMINARY STATEMENT

The Natural Resources Defense Council ("NRDC") respectfully submits this petition to intervene in the Nuclear Regulatory Commission ("NRC") relicensing proceeding that will determine the future of the two Limerick nuclear power reactors, located in Limerick, Pennsylvania. The Limerick Generating Station, Units 1 and 2 ("LGS"), have 13 years and 18 years, respectively, of operation remaining on their initial 40 year operating licenses. However, in the initial 27 and 22 years of operation, a lot of changes have occurred that bear directly on whether, when these licenses expire, Exelon Generating Company, LLC ("Exelon"), the current owner of Limerick, should be licensed to continue to operate the reactors for an additional 20 years. In addition, between now and when the current licenses will expire, significant changes are likely to occur that bear directly on the wisdom of allowing further operation of two reactors that will have reached 40 years of age and that may require substantial additional safety measures to qualify for an additional 20 years of operation.

The following Contentions allege that Exelon has failed to conduct a legally adequate environmental analysis because 1) it fails to properly identify and evaluate all new information and ignores or distorts the significance of this new information; 2) the 1989 Supplemental FES upon which it relies to meet its obligation to evaluate severe accident mitigation alternatives is deficient in several significant ways; 3) the 1989 Supplemental FES does not qualify as a legally sufficient severe accident mitigation alternatives analysis within the meaning of 10 C.F.R. § 51.53(c)(3)(ii)(L); and 4) it fails to properly evaluate the alternatives of "No Action" and compare its consequences with those of the proposed action.

In its Environmental Report, Exelon acknowledges some of the new information that bears on the current application. License Renewal Application ("LRA"), Appendix E, Environmental Report ("ER") at 5-4 to 5-9. Exelon focuses on new information that it concedes is directly relevant to a previous analysis conducted by NRC Staff in 1989 which was called a "severe accident mitigation design alternatives ("SAMDA") analysis. The ER, §§ 4.20 and 5.3, incorporates and adopts the NRC Staff's SAMDA analysis as Exelon's analysis of alternatives to mitigate the adverse impacts of severe accidents at Limerick. *See* NUREG-0974 Supplement, Final Environmental Statement Related to the Operation of Limerick Generating Station, Units 1 and 2 Docket Nos. 50-352 and 50-353 Philadelphia Electric Company (August 1989) ("SAMDA"). The SAMDA was prepared as the result of a successful court challenge by a previous intervenor, Limerick Ecology Action ("LEA"). *Limerick Ecology Action, Inc. v. NRC*, 869 F.2d 719 (3rd Cir. 1989). Because of a settlement between LEA and the then owner of Limerick (*see Philadelphia Electric Company* (Limerick Generating Station, Units 1 and 2), LBP-89-24, 30 N.R.C. 152 (1989)) the final SAMDAs analysis issued by NRC Staff was never evaluated for accuracy, completeness or compliance with the requirements of the National Environmental Policy Act ("NEPA") by the ASLB, the Commission or a federal court. Exelon now relies on that SAMDA analysis, unmodified, to meet its NRC regulatory obligation to fully consider alternatives to the proposed action. *See* 10 C.F.R. §§ 51.45(c), 51.53(c)(2) and 51.53(c)(3)(iii).

Exelon is also required to consider any "new and significant" information that may alter previous environmental conclusions. 10 C.F.R. § 51.53(c)(3)(iv). In its analysis of new and significant information Exelon ignores several additional pieces of new information that bear directly on the previously conducted SAMDA analysis and it dismisses as insignificant the new information it does acknowledge exists without providing a defensible basis for its conclusions. When the full extent of the new and significant information is included, it demonstrates that the SAMDA analysis upon which Exelon relies is inadequate and fails to fulfill its obligations under NRC regulations to fully develop, evaluate and weigh alternatives to the proposed action that would result in mitigating the consequences of a severe accident.

In addition, Exelon fails to fully and properly evaluate the No Action alternative. Exelon ignores the reasonably foreseeable outcome that in the next 13-18 years substantial changes in available electricity system resources may reduce any putative adverse impacts from denying renewed licenses for Limerick. The ER impermissibly restricts its detailed consideration of the possible consequences of license denial to an analysis of new generating capacity. The type of analysis required for appropriate consideration of the environmental consequences of the No Action alternative is substantially different from that used in the ER to evaluate a specific generation alternative.

Limerick presents a major risk to the environment and its extended operation demands the most scrupulous and exacting review by NRC. The facility is sited within a 50 mile radius of nearly 10 million people, including all of Philadelphia, Pennsylvania, Camden and Trenton, New Jersey and Wilmington, Delaware, and on the banks of the Schulykill River, one of Pennsylvania's major scenic rivers, supplying both drinking water and recreation and flowing through the center of Philadelphia, where it becomes the largest tributary of the Delaware River, and eventually flowing into one of the richest water resources in America, the Chesapeake Bay. Exelon's ER fails to provide the basis for that review. Absent substantial improvements by Exelon made as a result of NRC Staff insisting on compliance with NRC regulations, NRC Staff will itself be saddled with carrying out a thorough and accurate review of alternatives to mitigate severe accidents and to properly evaluate the No Action alternative in order to complete the required supplemental environmental impact statement.

STANDING

NRDC is a national non-profit environmental organization with offices in Washington, D.C., New York City, San Francisco, Chicago, Santa Monica, and Beijing. NRDC has a nationwide membership of over 350,000 (plus hundreds of thousands of online activists), including 15,787 members in Pennsylvania, at least 2,894 members living within 50 miles of LGS and approximately 62 members living within 10 miles of the facility. Declaration of Linda Lopez at 4, Nov. 17, 2011. Among its missions, NRDC seeks to maintain and enhance environmental quality, to safeguard the natural world for present and future generations, and to foster the fundamental right of all people to have a voice in the decisions that affect their environment. *Id*. at 5. Since its inception in 1970, NRDC has sought to improve the environmental, health, and safety conditions at the nuclear facilities operated by the Department of Energy and the civil nuclear facilities licensed by the NRC and their predecessor agencies. Id. at 6. To that end, NRDC utilizes its institutional resources, including legislative advocacy, litigation, and public outreach and education, to minimize the risks that nuclear facilities pose to its members and to the general public. *Id*.

Under the AEA, the Commission must grant a hearing on a license application upon "the request of any person whose interest may be affected by the proceeding, and shall admit any such person as a party to such proceeding." 42 U.S.C. § 2239(a)(1)(A). To that end, a petitioner must provide the Commission with information regarding "(1) the nature of the petitioner's right under the governing statutes to be made a party; (2) the nature of the petitioner's property, financial, or other interest in the proceeding; and (3) the possible effect of any decision or order on the petitioner's interest." *Entergy Nuclear Vermont Yankee, L.L.C., and Entergy Nuclear Operations, Inc.* (Vermont Yankee Nuclear Power Station), 60 N.R.C. 548, 552 (2004) *(citing* 10 C.F.R. § 2.309(d)(1)). "The NRC generally uses judicial concepts of standing in interpreting this regulation." *Entergy Nuclear Vermont Yankee*, 60 N.R.C. at 552. Thus, a petitioner may intervene if it can specify facts showing "that (1) it has suffered or will suffer a distinct and palpable harm constituting injury-in-fact within the zone of interests arguably protected by the governing statutes, (2) the injury is fairly traceable to the action being challenged, and (3) the injury will likely be redressed by a favorable determination." *Id*. at 552-53. In determining whether a petitioner has met the requirements for establishing standing, this Board "construe[s] the petition in favor of the petitioner." *Id*. at 553.

Member organizations such as NRDC may intervene on behalf of their members if they can "demonstrate that the licensing action will affect at least one of [their] members, . . . identify that member by name and address, and . . . show that [they are] authorized by that member to request a hearing on his or her behalf." *Id*. NRDC members Mr. Charles W. Elliott, Ms. Suzanne Day, and Mr. William White all reside within 50 miles of the LGS and all describe the economic, aesthetic, and environmental interests they wish to safeguard and the harms that the relicensing of LGS without full compliance with the law will pose to those interests. *See*, Declarations of Mr. Charles W. Elliott, Ms. Suzanne Day, and Mr. William White (collectively referenced "NRDC members," and individually referenced by "____ Decl.at __."). The November 22, 2011 Declaration of Drs. Cochran, McKinzie and Weaver ("NRDC Expert Decl.") and the November 22, 2011 Declaration of Christopher E. Paine ("Paine Expert Decl.") affirm the scientific basis for NRDC members' concerns. *See* Attachments 5 and 6 to this Notice and Petition. All of these NRDC's members support this Petition, and have authorized NRDC to intervene in this proceeding and request a hearing on their behalf. *See*, Elliott Decl. at 13, Day Decl. at 10, and White Decl. at 11.

Mr. Charles W. Elliott lives at 604 Cattell Street, in Easton, Northampton County, Pennsylvania, approximately 38 miles from the LGS. Elliott Decl. at 3, 4. Mr. Elliott has been a NRDC member since 1981. *Id*. at 2. One of the reasons Mr. Elliott describes for joining NRDC so long ago was because of his concerns about nuclear energy and the risks of nuclear power reactor accidents following the Three Mile Island accident in 1979. *Id.* Mr. Elliott is personally familiar with LGS in his capacity as counsel for the citizen organization Limerick Ecology Action, Inc., in the original operating license proceedings for Limerick Units 1 and 2 before the NRC and in the petition for review in the related appeal proceedings before the U.S. Court of

Appeals for the Third Circuit. *Id*. at 5, *see also, Limerick Ecology Action v. U.S. NRC*, 869 F.2d 719 (3rd. Cir. 1989). While involved in the prior Limerick proceeding, Mr. Elliott physically toured the facility with members of the Atomic Safety and Licensing Board and other parties during construction, reviewed licensing documents and other material related to safety issues and severe accident risks posed by the Limerick facility, and consulted with experts in nuclear safety and risk assessment concerning the risks of operation of LGS. *Id*. In particular, one of his areas of special concern was to ensure that the Limerick facility ultimately be required to employ cost-effective, state of the art measures to prevent and to mitigate the risks of severe accidents as part of the licensing process. *Id*. Mr. Elliott, who remains unconvinced that the Limerick facility is as safe as it reasonably could be, also notes that the region where he lives has become increasingly populated and urbanized since the time of the original licensing of the facility. *Id*. at 6, 7. Mr. Elliott states that the Lehigh Valley Planning Commission projects significantly increased population growth through 2030. *Id.* at 7. Thus, Mr. Elliott, an informed individual, is concerned that in the event of a severe accident, travel in his area may be impaired, "particularly where the severity, dynamics and consequences of a nuclear reactor accident can be unclear, fast-moving and unpredictable and in light of the fact that nuclear reactor accidents can cause spontaneous and voluntary evacuations for distances of 100 miles or more." *Id*. (citations omitted). And finally, Mr. Elliott is concerned to understand that as part of this relicensing the LGS has not produced an updated study of severe accident consequences at the facility and ways to prevent such an accident and to mitigate its consequences. *Id.* at 9.

Ms. Suzanne Day resides at 3 Taylors Lane in Cinnaminson, New Jersey, an organic family farm that borders the Delaware River, from the windows of her farm she can see the intake system for the public water supply for three counties, and is 35 miles downwind from the LGS. Day Decl. at 2, 3. Ms. Day has been a NRDC member for approximately 20 years. *Id*. Ms. Day expresses concern that there could be a serious accident at the facility and radiation from the nuclear power plants or that the stored nuclear waste could harm her family, the public health of her community, and the surrounding environment in Pennsylvania and New Jersey. *Id* at 5. Specifically, Ms. Day notes that the "Delaware Valley has grown in population and land use … our roadways are choked routinely just on ordinary weekdays." *Id*. at 7. The failure of the LGS to update its SAMA analysis or the NRC to require such an updated analysis concern her and, if LGS is allowed to operate an additional 20 years past its current license, she would "like to be sure that… they are using the most up to date equipment and strategies to prevent a nuclear accident, to mitigate against bad environmental consequences, and to plan evacuations that would be feasible." *Id*.

Mr. William White lives at 135 Pennsylvania Avenue in Bryn Mawr, Pennsylvania, has been a NRDC member for nearly 40 years. White Decl. at 2,3. His home is approximately 30 miles from the LGS and he is concerned for the potential for an aging nuclear facility to accidently cause leakages of radioactivity. *Id.* at 4. Specifically, he notes that as part of this relicensing he is aware that "the LGS has not produced an updated study of severe accident consequences and ways to prevent such an accident and to mitigate its consequences." *Id*. at 8. Mr. White notes that the area surrounding LGS has changed a great deal since the time LGS performed an analysis of a severe accident, "especially along the Route 422 corridor, with more people and businesses locating there annually." *Id*. The failure of LGS to produce updated studies and plans concerns him and, like the other NRDC standing members, wants to be sure that if the LGS reactors are allowed to operate for an additional 20 years, they use "the most up-to-date equipment and strategies to prevent a nuclear accident and to mitigate against its environmental consequences." *Id*.

Petitioners' experts discuss in their declarations the inadequacies in the applicant's analysis of potential adverse environmental consequences of LGS relicensing, including inadequate analysis of the consequences of a severe accident. These inadequacies impact NRDC members' right to a complete and accurate assessment of the costs and benefits of the proposed action and alternatives to the proposed action.

As NRDC members explain, they will suffer (or will be under threat of suffering) concrete and particularized injuries from the continued operations of LGS operations without adequate analysis of severe accident mitigation alternatives.[1] Petitioners' experts confirm the science behind these concerns: if LGS is not relicensed, the potential harms will not occur; and even if LGS is relicensed, the potential adverse consequences of a severe accident can be substantially mitigated if cost beneficial mitigation measures are identified and implemented. LGS may not continue operations without a license from the Commission. 42 U.S.C. §2133. Accordingly, LGS and the NRC will have caused these injuries if the proposed new operating license is issued as currently proposed.

By granting Petitioners the relief they request and rejecting LGS's relicensing application or requiring that a SAMA analysis be performed, NRDC's members will obtain redress for their injuries, since the reactor operations will continue beyond the term of their current license or

[1] So long as a Petitioner falls within the zone of interests protected by the statute, and alleges harm that is "concrete and particularized," rather than "conjectural" or "hypothetical," the "requisite injury may either be actual *or threatened*." *Crow Butte Res., Inc*. (License Amendment for the North Trend Expansion), 67 N.R.C. 241, 271 (2008) (emphasis added).

such a renewed license, if issued, will benefit from a properly conducted SAMA analysis. Even if LGS chooses to revise its ER to provide a legally sufficient SAMA analysis, NRDC members will still have obtained redress: NEPA, in its implementing regulation at 10 C.F.R. Part 51 and 10 C.F.R. Part 2, accord procedural rights to those such as NRDC members whose concrete interests may be harmed by the project. By requiring LGS and the NRC staff to comply with these authorities' requirements, our members' procedural rights will have been vindicated. *See Lujan v. Defenders of Wildlife*, 504 U.S. 555, 572 n.7 (1992) ("[P]rocedural rights are special: The person who has been accorded a procedural right to protect his concrete interests can assert that right without meeting all the normal standards for redressability and immediacy.") (internal quotations omitted); *see also Duke Energy Corporation* (McGuire, Units 1 and 2; Catawba, Units 1 and 2) CLI-02-17, 56 N.R.C. 1 (July 23, 2002) at 10, emphasizing the NEPA obligation to fully develop the record with regard to any SAMA analysis is required "to ensure that the agency does not act upon incomplete information, only to regret its decision after it is too late to correct."

Finally, our members have expressed concerns that fall within the zone of interests protected by NEPA and its implementing regulations. *See, e.g., Ouachita Watch League v. Jacobs*, 463 F.3d 1163, 1173 (11th Cir. 2006) ("[S]ince the injury alleged is environmental, it falls within the zone of interests protected by NEPA . . . ."); *Sabine River Auth. v. U.S. Dep't of Interior*, 951 F.2d 669, 675 (5th Cir. 1992) (plaintiffs' concerns about impacts on water quality and quantity fell within NEPA's zone of interests). Their concerns also fall within the zone of interests protected by the AEA and its implementing regulations. *Sequoyah Fuels Corp. and General Atomics* (Gore, Oklahoma Site), 39 N.R.C. 54, 75 (1994) (membership organization granted standing by showing that "the health and safety interests of its members are within the AEA-protected zone of interests"); *Babcock and Wilcox* (Apollo, Pennsylvania Fuel Fabrication Facility), 37 N.R.C. 72, 80 (1993) (holding that specified "health, safety, and environmental concerns . . . clearly come within the zone of interests safeguarded by the AEA and NEPA").

NRDC members therefore have standing to intervene in their own right: they have met the requirements for injury-in-fact, causation, and redressability, and their concerns fall within the zone of interests protected by NEPA, the AEA, and their implementing regulations. They will be affected by LGS's proposed relicensing and failure to provide a legally adequate SAMA analysis, have provided their names and addresses, and have authorized NRDC, of which they are members, to intervene in this proceeding on their behalf. Thus, Petitioners have standing to pursue this action. *Entergy Nuclear Vermont Yankee*, 60 N.R.C. at 553.

NOTICE OF INTENT TO PARTICIPATE

Pursuant to 10 C.F.R. § 2.309 and the Notice of Acceptance for Docketing of the Application and Notice of Opportunity for Hearing Regarding Renewal of Facility Operating License Nos. NPF–39 and NPF–85 for an Additional 20-Year Period, Exelon Generation Company, LLC, Limerick Generating Station (76 Fed. Reg. 52992, Aug.24, 2011), Petitioner NRDC hereby submits contentions regarding Exelon's application for renewal of its licenses to operate Limerick Units 1 and 2 for an additional 20 years, or until 2044 and 2049, respectively. As demonstrated below, these contentions should be admitted because they satisfy the NRC's admissibility requirements in 10 C.F.R. § 2.309.[2]

As noted above, several members of NRDC live within 50 miles of the Limerick reactors,

[2] By Order of the Commission dated October 17, 2011, the time for filing a Petition to Intervene by NRDC was extended to November 22, 2011.

have authorized NRDC to represent their interests in environmental protection in this proceeding and, thus, pursuant to 10 C.F.R. § 2.309(d)(1), NRDC has standing for purposes of raising its concerns in this proceeding.

PETITION TO INTERVENE

I. APPLICABLE LEGAL STANDARDS

A. Standards of Admissibility

Proffered contentions must put "other parties in the proceeding on notice of the petitioners' specific grievances" in order to "give [] them a good idea of the claims they will be either supporting or opposing." *Duke Energy Corp.*, (Oconee Nuclear Station, Units 1, 2 and 3) 49 NRC 328, 333 (1999). Accordingly, in order to ensure "a clearer and more focused record for decision," 69 Fed. Reg. 2182, 2202 (Jan. 14, 2004), an admissible contention will provide (1) a specific statement of the legal or factual issue proposed; (2) a brief explanation of its basis; (3) a demonstration that the issue is within the scope of the proceeding; (4) a demonstration that the issue is material to the findings the NRC must make to support the action involved in the proceeding; (5) a concise statement of the alleged facts or expert opinions, including references to specific sources and documents that support the petitioners' position and upon which the petitioner intends to rely at hearing; and (6) sufficient information to show that a genuine dispute exists with regard to a material issue of law or fact, including references to specific portions of the application that the petitioner disputes or, when the application is alleged to be deficient, the identification of such deficiencies and supporting reasons for this belief. *See* 10 C.F.R. § 2.309(f).

The contention rule has not become a "fortress to deny intervention" despite its 1989 fortification. *Duke Energy Corp.* (Oconee Nuclear Power Plant), 49 NRC at 335 (*quoting Philadelphia Elec. Co.* (Peach Bottom Atomic Power Sta., Units 2 and 3), 8 AEC 13, 20-21 (1974), *rev'd in part*, CLI-74-32, 8 AEC 217 (1974), *rev'd in part*, *York Committee for a Safe Environment v. N.R.C.*, 527 F.2d 812 (D.C. Cir. 1975)). Indeed, "[t]he Commission and its Boards regularly continue to admit for litigation and hearing contentions that are material and supported by reasonably specific factual and legal allegations." *Duke Energy*, 49 NRC at 333. Nor have more recent revisions materially changed the admissibility standard for contentions. *PPL Susquehanna, LLC*, 65 NRC 281, 303 (2007). *See also Entergy Nuclear Operations, Inc.*, LBP-03-08, 68 N.R.C. 43, 60 *et. seq.* (2008).

Although an intervenor cannot use discovery or cross-examination as a "fishing expedition" in hopes of turning up supporting facts, there is also no requirement that the substantive case be made at the contention stage. *Entergy Nuclear Generation Co. et al.* (Pilgrim Nuclear Power Station), ASLB Oct. 16, 2006, 2006 WL 4801142 at slip op. 85 (*quoting Oconee*, 49 NRC at 342)).

> The Commission has also, however, explained that the requirement at § 2.309(f)(1)(v) "does not call upon the intervenor to make its case at [the contention] stage of the proceeding, but rather to indicate what facts or expert opinions, be it one fact or opinion or many, of which it is aware at that point in time which provide the basis for its contention. A petitioner does not have to provide a complete or final list of its experts or evidence or prove the merits of its contention at the admissibility stage. And, as with a summary disposition motion, the support for a contention may be viewed in a light that is favorable to the petitioner so long as the admissibility requirements are found to have been met. The requirement "generally is fulfilled when the sponsor of an otherwise acceptable contention provides a brief recitation of the factors underlying the contention or references to documents and texts that provide such reasons.

Id. at 84 (*quotations and citations omitted*). "A contention may be plausible enough to meet the admission standards even if it is ultimately denied on the merits." *Entergy Nuclear Vermont*

Yankee, LLC (Vermont Yankee), LBP-06-20, 64 N.R.C. 131, 160 (2006).

In addition, a contention of "omission" that focuses on the absence of a required analysis in the application is admissible and not deemed speculative because of any lack of detail regarding the potential content of the missing information. *See Entergy Nuclear Operations, Inc.* (Indian Point Nuclear Generating Units 2 and 3), LBP-08-13, 64 N.R.C. 43, 86, n. 194 (2008).

B. Specific Statement of the Issue of Law or Fact to be Raised or Controverted

First, a petitioner must clearly identify the issue of law or fact that it will raise or dispute. 10 C.F.R. § 2.309(f)(1)(i).

C. Brief Explanation of the Basis of the Contention

Next "a petitioner must provide some sort of *minimal* basis indicating the *potential* validity of the contention." Final Rule, *Rules of Practice for Domestic Licensing Proceedings - Procedural Changes in the Hearing Process*, 54 Fed. Reg. 33,168, 33,170 (Aug. 11, 1989) (emphasis added). This minimal basis need not be "an exhaustive list of possible bases, but simply enough to provide the alleged factual or legal bases in support of the contention." *Vermont Yankee*, 64 N.R.C. at 147 (*quoting Louisiana Energy Serv., LP* (National Enrichment Facility), 60 NRC 619, 623 (2004)).

D. Showing that the Contention is Material to Findings that the NRC Must Make in Support of the Proposed Action

A proposed contention must concern an issue that is "material" to the findings the NRC must make. 10 C.F.R. § 2.309(f)(1)(iv). A "material" issue is one that would make a difference in the outcome of the proceeding. 54 Fed. Red. at 33,172. "This means that there should be some significant link between the claimed deficiency and either the health and safety of the public or the environment." *Vermont Yankee,* 60 NRC 548, 557 (Nov. 22, 2004).

E. Concise Statement of the Alleged Facts or Expert Opinions in Support of Petitioners' Position

A petitioner must also demonstrate that each proposed contention is supported by "a concise statement of the alleged facts or expert opinions which support the . . . petitioner's position on the issue . . . together with references to the specific sources and documents on which [it] intends to rely." 10 C.F.R. § 2.309(f)(1)(v). This does not mean, though, that a petitioner must "make its case at this stage of the proceeding." 54 Fed. Reg. at 33,170. Rather, the petitioner must simply "indicate what facts or expert opinions, be it one fact or opinion or many, of which it is aware at that point in time which provide the basis for its contention." *Id.* Moreover, "a 'Board may appropriately view Petitioners' support for its contention in a light that is favorable to the Petitioner.'" *Vermont Yankee*, 60 NRC at 555 *(quoting Arizona Public Service Co.* (Palo Verde Nuclear Station), 34 NRC, 149, 155 (Aug. 16, 1991)).

F. Sufficient Information to Show that a Genuine Dispute Exists with the Applicant or Licensee on a Material Issue of Law or Fact

NRC set forth factors relevant to determining if a genuine dispute exists when it adopted the current version of 10 C.F.R. § 2.309(f)(1):

> This will require the intervenor to read the pertinent portions of the license application, including the Safety Analysis Report and the Environmental Report, state the applicant's position and the petitioner's opposing view. Where the intervenor believes the application and supporting material do not address a relevant matter, it will be sufficient for the intervenor to explain why the application is deficient.

54 Fed. Reg. at 33,170.

As set forth in detail in the following contentions, NRDC easily satisfies the admissibility standard with respect to each contention. Further, as set forth below and as required by 10 C.F.R. § 2.309(f)(1)(iii), NRDC will show that each contention is within the scope of the proceeding.

II. NRDC CONTENTIONS

CONTENTION 1-E[3]

APPLICANT'S ENVIRONMENTAL REPORT (§ 5.3) ERRONEOUSLY CONCLUDES THAT NEW INFORMATION RELATED TO ITS SEVERE ACCIDENT MITIGATION DESIGN ALTERNATIVES ("SAMDA") ANALYSIS IS NOT SIGNIFICANT, IN VIOLATION OF 10 C.F.R. § 51.53(c)(3)(iv), AND THUS THE ER FAILS TO PRESENT A LEGALLY SUFFICIENT ANALYSIS OF SEVERE ACCIDENT MITIGATION ALTERNATIVES

<u>BASES</u>

1. Applicant's Environmental Report -Operating License Renewal Stage, Limerick Generating Station, Units 1 and 2 ("ER") misinterprets and/or misuses new information regarding increased population in the area within 10 miles of the plant and thus fails to account for the significant increase in total person-rems of exposure that could occur in the event of a severe accident. ER at 5-7. This population was substantially underestimated in the 1989 SAMDA analysis upon which the Applicant continues to rely[4], and thus the ER substantially understates or fails to analyze the potential adverse impact in terms of person-rems of collective exposure from a severe accident at Limerick and the potential benefits of mitigation measures that would avoid those exposures.

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[3] "E" indicates the contention is environmental.

[4] The ER, § 5.3, incorporates and adopts as Exelon's analysis of alternatives to mitigate the adverse impacts of severe accidents at Limerick, an analysis done by NRC Staff in 1989 known as a severe accident mitigation design alternatives ("SAMDAs") analysis. *See* NUREG-0974 Supplement, Final Environmental Statement Related to the Operation of Limerick Generating Station, Units 1 and 2 Docket Nos. 50-352 and 50-353 Philadelphia Electric Company (August 1989)("SAMDA").

NRDC Expert Decl. ¶¶ 22-30.

2. The ER misinterprets and/or misuses new information regarding increased population in the area within 50 miles of the plant and thus fails to account for the significant increase in total person rems of exposure that will occur in the event of a severe accident. ER at 5-7. This population was substantially underestimated in the 1989 SAMDA analysis upon which the Applicant continues to rely, and thus the ER substantially understates the potential adverse impact, in terms of person-rems of collective exposure, from a severe accident at Limerick and the potential benefits of mitigation measures that would avoid those exposures. NRDC Expert Decl. ¶¶ 22-30

3. The ER fails to analyze the significance of radiation exposure to an increased population following a severe accident and fails to consider more than a very narrow group of mitigation measures identified in the 1989 SAMDA analysis. It ignores new and significant information regarding potential mitigation alternatives that have been considered for other BWR Mark II containment reactors that were not considered in the original SAMDA analysis and ignores new and significant information regarding additional plausible severe accident scenarios. ER at § 5.3. Thus the ER fails to demonstrate that with the accurate distribution and number of persons who will be exposed in the event of a severe accident and all reasonable mitigation alternatives considered, there will be no significant change in the SAMDA analysis and there will be no cost beneficial mitigation alternatives.[5] NRDC Expert Decl. ¶¶ 7-17 and 22-30.

[5] The original SAMDA analysis identified "several candidate SAMDAs [that] might be cost effective" but dismissed them because of reliance on a PRA analysis by the then owner of Limerick that Staff conceded "staff has not verified." SAMDA at 15.

4. The ER analysis of the significance of exposure of an increased population to harmful radionuclides following a severe accident ignores new and significant information based on an analysis of actual core damage events at light water reactors in general, and BWRs in particular. Such an action demonstrates that the CDF probability for Limerick is likely higher than the estimate relied upon in the 1989 SAMDA analysis and updated CDF probabilities on which applicant continues to rely (ER at 5-6). Thus the ER conclusion that the new information regarding the population at risk from a severe accident does not constitute significant information is based on non-conservative assumptions that understate the likely damage from a severe accident at Limerick. NRDC Expert Decl. ¶¶ 18-30.

5. The ER analysis of the significance of including information regarding the potential economic impact of a severe accident at Limerick erroneously relies on data from an analysis done at TMI, a site that involves a markedly different and less economically developed area than the area within 50 miles of Limerick, which includes the densely populated urban environments of Philadelphia, PA, Camden and Trenton, NJ and Wilmington, DE. The ER thus fails to evaluate the impact of a properly conducted economic analysis on the assessment of the environmental consequences of a severe accident at Limerick. NRDC Expert Decl. ¶¶ 31-39.

6. The ER ignores new and significant information regarding the likely cost of cleanup from a severe accident in a metropolitan area like Philadelphia and thus understates the impact of a properly conducted economic analysis on the environmental consequences of a severe accident at Limerick. NRDC Expert Decl. ¶ 39.

7. The ER fails to include an analysis of the impacts to the quality of the human environment that were not discussed in the ER, for example, loss of family homestead, possessions, abandonment of livestock and domestic animals, pain and suffering, including that associated with loss of one's job or possessions, and uncertainties associated with the safety of the food supply.

SUPPORTING EVIDENCE

8. This Contention is supported by the Attached NRDC Expert Declaration and the References attached thereto. Specific paragraphs of the Declaration that support each basis are identified following each basis and the Declaration as a whole is also generally supportive of the Contention.

CONTENTION 2-E

APPLICANT'S ENVIRONMENTAL REPORT (§ 5.3) IN RELYING ON A SAMDA[6] ANALYSIS FROM 1989 FAILS TO COMPLY WITH 10 C.F.R. §§ 51.45, 51.53(c)(2) AND 51.53(c)(3)(iii) BECAUSE IT DOES NOT INCLUDE AN ACCURATE OR COMPLETE ANALYSIS OF "ALTERNATIVES AVAILABLE FOR REDUCING OR AVOIDING ADVERSE ENVIRONMENTAL EFFECTS," DOES NOT "CONTAIN SUFFICIENT DATA TO AID THE COMMISSION IN ITS DEVELOPMENT OF AN INDEPENDENT ANALYSIS" OF ALTERNATIVES AND DOES NOT CONTAIN AN ADEQUATE "CONSIDERATION OF ALTERNATIVES FOR REDUCING ADVERSE IMPACTS . . . FOR ALL CATEGORY 2 LICENSE RENEWAL ISSUES."

BASES

1. The ER relies on an arbitrarily limited and outdated list of SAMDA candidates for

[6] The ER, § 5.3 incorporates and adopts as Exelon's analysis of alternatives to mitigate the adverse impacts of severe accidents at Limerick, the SAMDA analysis done by NRC Staff in 1989. This contention focuses on the numerous deficiencies in that SAMDA analysis and, because Exelon chooses to adopt it as the SAMA analysis for this license renewal proceeding, it is referred to here as the "SAMA" analysis.

evaluation. Thus the ER fails to demonstrate any support for the proposition that it cannot identify any severe accident mitigation measures that would be cost-effective to implement. NRDC Expert Decl. ¶¶ 7-15.

2. The ER analysis of SAMDAs relies on an inaccurate analysis of the population that could be exposed in the event of a severe accident within both 10 miles and 50 miles of Limerick, thus understating the adverse environmental impacts from a severe accident and failing to provide a reliable basis for the conclusion that there are no cost beneficial SAMAs. NRDC Expert Decl. ¶¶ 22-30.

3. As a result of using inadequate and outdated meteorological data, the ER analysis of SAMAs relies on an inaccurate analysis of the dispersion of harmful radionuclides from the site in the event of a severe accident, thus potentially understating the adverse environmental impacts from a severe accident and failing to provide a reliable basis for the conclusion that there are no cost-beneficial SAMAs. NRDC Expert Decl. ¶¶ 45-48.

4. The ER analysis of SAMDAs relies on an inaccurate estimate of the core damage frequency for these reactors, thus understating the adverse environmental impacts from a severe accident and failing to provide a reliable basis for the conclusion that there are no cost-beneficial SAMAs. NRDC Expert Decl. ¶¶ 18-21.

5. The ER analysis of SAMDAs relies on inaccurate analyses of the evacuation time that would be required in the event of a severe accident, thus understating the adverse environmental impacts from a severe accident and failing to provide a reliable basis for the conclusion that there are no cost beneficial SAMAs. NRDC Expert Decl. ¶¶ 40-44.

6. The ER analysis of SAMDAs contains no analysis of the economic impact of a severe

accident on areas within 50 miles of the reactors, thus understating the adverse environmental impacts from a severe accident and failing to provide a reliable basis for the conclusion that there are no cost beneficial SAMAs. NRDC Expert Decl. ¶¶ 31-39

7. The ER analysis of SAMDAs relies on inaccurate and unreliable methodologies to attempt to evaluate the impact on the SAMDA analysis of new information regarding increased population exposed in the event of a severe accident, consideration of the economic cost of a severe accident, a limited and outdated list of SAMA candidates, and increased dollar value assigned to person-rems of exposure averted. As a consequence the ER thus understates the significance of this new information and fails to provide a reliable basis for the conclusion that there are no cost-beneficial SAMAs. NRDC Expert Decl. ¶¶ 7-48.

SUPPORTING EVIDENCE

8. This Contention is supported by the Attached NRDC Expert Declaration and the References attached thereto. Specific paragraphs of the Declaration that support each basis are identified following each basis and the Declaration as a whole is also generally supportive of the Contention.

CONTENTION 3-E

APPLICANT'S ENVIRONMENTAL REPORT ERRONEOUSLY CONCLUDES THAT THE SAMDA ANALYSIS CONDUCTED IN 1989 IS A SAMA ANALYSIS WITHIN THE MEANING OF 10 C.F.R. § 51.53(c)(3)(ii)(L) AND THUS THE ER IS DEFICIENT FOR ITS FAILURE TO INCLUDE A SAMA ANALYSIS.

BASES

1. NRC Staff has identified factors that must be included for a legally adequate SAMA

analysis by adopting NEI-05-01 Rev. A (Severe Accident Mitigation Alternatives (SAMA) Analysis Guidance Document (Nov. 2005)). *See* 72 Fed. Reg. 45466, 45467 ("The staff finds that NEI 05-01, Revision A, describes existing NRC regulations, and facilitates complete preparation of SAMA analysis submittals").

2. The 1989 SAMDA analysis fails to include many of these factors including:

a.no analysis of the economic consequences of a severe accident; NRDC Expert Decl. ¶¶ 31-39.

b. inaccurate population projections for the 50 mile EPZ; NRDC Expert Decl. ¶¶ 22-30.

c. inadequate range of alternatives to mitigate the consequences of a severe accident; NRDC Expert Decl. ¶¶ 7-15.

d. inaccurate CDF calculations; NRDC Expert Decl. ¶¶ 18-21.

e. inaccurate meteorological data; NRDC Expert Decl. ¶¶ 45-48;

f. incomplete analyses of plausible severe accident scenarios; NRDC Expert Decl. ¶¶ 16-17; and

g. inaccurate calculation of evacuation times in the event of an accident. NRDC Expert Decl. ¶¶ 40-44.

3. The 1989 SAMDA analysis fails to assess the impact of all relevant factors, including those enumerated in 2 above, using MELCOR Accident Consequence Code Systems ("MACCS")2 or an equally capable NRC approved up-to-date probabilistic safety assessment severe accident consequences code system.

4. Thus, the 1989 SAMDA analysis is not sufficient to excuse Exelon from conducting a full SAMA analysis as required by 10 C.F.R. § 51.53(c)(3)(ii)(L).

SUPPORTING EVIDENCE

5. This Contention is supported by the Attached NRDC Expert Declaration and the References attached thereto. Specific paragraphs of the Declaration that support each basis are identified following each basis and the Declaration as a whole is also generally supportive of the Contention.

CONTENTION 4-E

APPLICANT'S ENVIRONMENTAL REPORT (§ 7.2) FAILS TO ADEQUATELY CONSIDER THE NO ACTION ALTERNATIVE IN VIOLATION OF 10 C.F.R. §§ 51.45 (c), 51.53(c)(2) AND 51.53(c)(iii).

BASES

1. The ER violates 10 C.F.R. § 51.45(c) because it omits an analysis that "considers and balances the environmental effects of the proposed action" and the alternative of No Action. Paine Expert Decl. at ¶¶ 4-7.

2. The ER violates 10 C.F.R. § 51.45(c) because it unreasonably and arbitrarily limits its analysis of the No Action alternative in a manner that fails, "to the fullest extent practicable, [to] quantify the various factors considered" and neglects discussion of "important qualitative considerations or factors that cannot be quantified." Paine Expert Decl. at ¶¶ 4-10.

3. The ER violates 40 C.F.R. § 1502.14(d) and 10 C.F.R. Part 51, Subpart A, Appendix A, § 4, by improperly and illogically narrowing discussion of the No Action alternative to consideration of (1) decommissioning impacts and (2) power generation alternatives that would "equivalently satisfy the purpose and need for the proposed action" by "replacing

the generating capacity of LGS" with "single discrete generation sources." Paine Expert Decl. at ¶¶ 5-7.

4. The ER violates 10 C.F.R. § 51.53(c) by failing to thoroughly consider the environmental impacts and likely consequences under the No Action alternative of denying relicensing now, 13 years before the existing license for Limerick 1will expire and 18 years before the existing license for Limerick 2 will expire, including the expected growth in demand side management and renewable energy sources, and fails to quantify and balance the environmental costs of those consequences against the environmental costs of relicensing the Limerick reactors, including the properly analyzed cost of a severe accident. Paine Expert Decl. at ¶¶ 4-10.

SUPPORTING EVIDENCE

5. The bases for this contention are support by the Declaration of Christopher E. Paine, which is Attachment 6 to this Notice and Petition.

III. NRDC'S CONTENTIONS ARE WITHIN THE SCOPE OF THE PROCEEDING

Each of NRDC's contentions is within the scope of this license renewal proceeding, which is described in Parts 51 and 54. *See Florida Power & Light Co.* (Turkey Point Nuclear Power Plant), CLI-01-17, 54 NRC 3, 6-13 (Jul. 19, 2001); Nuclear Power Plant License Renewal, 60 Fed. Reg. 22,461 (May 8, 1995). A license renewal application review typically implicates issues that fall into one of two broad areas: safety/aging management issues, and environmental impacts. NRDC's contentions are focused on environmental impacts.

The scope of the environmental review is defined by 10 C.F.R. Part 51, the NRC's

"Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (NUREG-1437 (May 1996)), and the initial hearing notice and order. *See, e.g., Vermont Yankee*, 64 N.R.C. at 148-49. Some environmental issues that might otherwise be germane in a license renewal proceeding have been resolved generically for all plants and are normally, therefore, "beyond the scope of a license renewal hearing." *Turkey Point*, 54 NRC at 15; *see* 10 C.F.R. § 51.53(c)(3)(i). These "Category 1" issues are classified in 10 C.F.R. Part 51, Subpart A, Appendix B. Category 1 issues may be raised when a petitioner (1) demonstrates that there is new and significant information subsequent to the preparation of the Generic Environmental Impact Statement for License Renewal of Nuclear Plants (NUREG-1437) ("GEIS") regarding the environmental impacts of license renewal; (2) files a petition for a rulemaking with the NRC; or (3) seeks a waiver pursuant to 10 C.F.R. § 2.335.[7] *See Turkey Point*, 54 NRC at 10-12; *see also* 10 C.F.R. § 51.53(c)(3)(iv) (new and significant information).

NRDC's environmental contentions primarily relate to a Category 2 issue, *i.e.* whether the ER has appropriately addressed the issue of mitigation alternatives for severe accidents. *See* 10 C.F.R. Part 51, Subpart A, Appendix B. NRDC's contentions focus on 1) the failure of the ER to identify all of the new information relative to an analysis of mitigation alternatives for severe accidents and the failure of the ER to justify its conclusion that the new information recognized by Exelon is not significant; 2) the failure of the ER to provide a legally sufficient SAMA analysis because of the obvious deficiencies in the SAMDA analysis upon which Exelon relies to meet its obligations to thoroughly evaluate mitigation alternatives for severe accidents;

[7] Because NRC regulations specifically provide that only a "party to an adjudicatory proceeding" can seek a waiver,10 C.F.R. § 2.335, any determination that a regulation precludes any of NRDC's contentions must be held in abeyance until NRDC has been admitted to the proceeding as a "party" and has had an opportunity to pursue any necessary waiver petition.

and 3) the ER's mistaken conclusion that NRC "staff has . . . previously considered severe accident mitigation alternatives for the applicant's plant" (10 C.F.R. § 51.53(c)(3)(ii)(L)) by conducting the 1989 SAMDA analysis.

A. New and Significant Information (Contention 1-E)

The National Environmental Policy Act (NEPA), 42 U.S.C. §§ 4321-37, requires all federal agencies to examine environmental impacts that could be caused by their discretionary actions. The Supreme Court has identified NEPA's twin aims as (1) obligating a federal agency to consider every significant aspect of the environmental impact of a proposed action and (2) ensuring that the federal agency will inform the public that it has indeed considered environmental concerns in its decision-making process. *Baltimore Gas & Elec. Co. v. Natural Resources Defense Council*, 462 U.S. 87, 97 (1983); *see also* 42 U.S.C. § 4332(2)(c) (identifying requirements of an EIS). As a federal agency, the NRC must comply with NEPA. *Calvert Cliffs Coordinating Comm. v. United States Atomic Energy Commission*, 449 F.2d 1109 (D.C. Cir. 1971) (NEPA applies to NRC predecessor). NEPA requires that NRC take a "hard look" at alternatives, including SAMAs, and to provide a rational basis for rejecting alternatives that are decidedly cost-effective. *Robertson v. Methow Valley Citizens Council*, 490 U.S. 332, 350 (1989); *accord Limerick Ecology*, 869 F.2d at 737 and *Bowman Transp., Inc. v. Arkansas-Best Freight System, Inc*. 419 U.S. 281, 285-286; *see also Entergy Nuclear Operations, Inc.* (Indian Point Nuclear Generating Units 2 and 3), LBP-11-17, __N.R.C. __ (July 17, 2011) *petition for interlocutory review pending*.

Moreover, NEPA imposes continuing obligations on NRC after it completes an environmental analysis. An agency that receives new and significant information casting doubt upon a previous environmental analysis must reevaluate the prior analysis. *Marsh v. Oregon Natural Resources Council*, 490 U.S. 360, 374 (1989). This requirement is codified in the NRC's own regulations. *See* 10 C.F.R. §§ 51.53(c)(iv) and 51.92(a)(2).

Exelon incorporates the SAMDA analysis performed during the operating license process as its SAMA analysis for purposes of this request for a new operating license. ER at §§ 4.20 and 5.3. However, 10 C.F.R. Part 51, Subpt. A, Appendix A, § 1(b) provides that the techniques of incorporation by reference and adoption described respectively in 40 CFR §§ 1502.21 and 1506.3 of CEQ's NEPA regulations may only be used as appropriate to aid in the presentation of issues, eliminate repetition or reduce the size of an environmental impact statement and the use of such adoption is not allowed except where the prior information "meets the standards for an adequate statement under these regulations." 40 C.F.R. § 1506.3(a).

A key requirement of NEPA is that the information upon which an environmental impact statement is based must be based on "accurate scientific analysis, expert agency comments, and public scrutiny [which] are essential to implementing NEPA." *Native Ecosystems Council v. U.S. Forest Svc*., 418 F.3d 953, 964, 965 (9th Cir. 2005). If the ER relies on, or adopts, environmental analyses that are outdated, inaccurate or incomplete, NRC cannot rely on the ER because, by doing so, it would not have taken the requisite "hard look" by simply relying on the incorrect assumptions or data provided by the licensee. 40 C.F.R. § 1501(b). Accordingly, NEPA requires that an EIS must contain "high quality" information and "accurate scientific analysis," and furthermore obligates Staff to "independently evaluate and be responsible for the reliability of all information used in the draft environmental impact statement." 10 C.F.R. § 51.70(b); *see also* 10 C.F.R. § 51.92(a); 40 C.F.R. § 1502.24 (Staff must ensure "the professional integrity, including scientific integrity, of the discussions and analyses in environmental impact statements.") Since NRC Staff relies on the ER for much of its NEPA analysis, particularly the SAMA analysis, if, as here, the SAMA analysis is defective, absent diligent enforcement of its own regulations and guidance by NRC Staff, the FSEIS will be similarly deficient. Thus, Exelon's inadequate analysis of severe accident mitigation alternatives will necessarily have a profound impact on this licensing proceeding and the ability of the NRC to comply with its NEPA obligations.

In its decisions, the Commission has emphasized that the SAMA process is designed to assist the NRC in making decisions. *Duke Energy Corporation* (McGuire, Units 1 and 2; Catawba, Units 1 and 2) CLI-02-17, 56 N.R.C. 1 (July 23, 2002) at 10, emphasizing that even though NEPA does not require implementation of any particular SAMA, the obligation to fully develop the record with regard to any SAMA is required "to ensure that the agency does not act upon incomplete information, only to regret its decision after it is too late to correct." *Id.* Thus, the ER as written will not fulfill the goal of providing NRC Staff with the information needed for its SAMA analysis unless the information upon which the analysis offered by Exelon is based on accurate, current and complete information.

Not surprisingly, the NRC's license renewal application regulations also reiterate this obligation. 10 C.F.R. § 51.53(c)(3)(iv) provides that an ER must contain "any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware." Exelon accepts this obligation but, as the preceding contentions demonstrate, Exelon's ER is deficient in its attempt to meet this obligation both because it ignores new information and because it incorrectly assesses the significance of the information it concedes is new.

The Commission recently reiterated the criteria that should be applied in determining whether new information is significant. It held "[t]he new information must present 'a seriously different picture of the environmental impact of the proposed project from what was previously envisioned.'" *Union Elec. Co. et al.*, CLI-11-05, 2011 NRC LEXIS 6, 50 (Sept. 9, 2011). As the attached Declaration of Drs. Cochran, McKinzie and Weaver amply demonstrates the new information that is dismissed by Exelon as insignificant and the additional new information ignored by Exelon would, if properly analyzed, present a "seriously different picture of the environmental impacts" of the proposed license renewal by substantially expanding the number of potential mitigation measures and substantially increasing the environmental impact of a severe accident and the benefits to be gained by mitigating those impacts. In addition, disputes about whether new information is "significant" are inherently factual and not appropriate for resolution at the contention admissibility stage. *See Entergy Nuclear Operations, Inc*. (Indian Point Energy Center), LBP-08-13, 68 N.R.C. 43, 190-191 (N.R.C. 2008).

In this case Exelon, while recognizing that changes to the previous analysis of severe accident mitigation alternatives might be warranted if new information were significant (ER at § 5.3), undertakes, at best, a breezy analysis of the significance of new information, even using a SAMA analysis at a plant that was markedly different than Limerick – a different type of reactor, a different environmental setting - rather than run its own technically competent sensitivity analyses to determine how new information might alter both the scope and viability of mitigation alternatives.

B. The Adequacy of Exelon's Analysis of Severe Accident Mitigation Alternatives (Contention 2-E)

In order to meet the requirements of 10 C.F.R. § 51.53(c)(3)(ii)(L) and to comply with the mandate of the Federal Court in *Limerick Ecology Action*, Exelon asserts that severe accident mitigation alternatives have already been considered for Limerick. ER at § 4.20. In order to meet its burden of proof, Exelon must demonstrate that the previous analysis, which it asserts meets its NEPA and NRC obligations contains "high quality" information and "accurate scientific analysis," and that all the information contained in that analysis reliable. *See* 10 C.F.R. § 51.70(b); *see also* 10 C.F.R. § 51.92(a); 40 C.F.R. § 1502.24 (Staff must ensure "the professional integrity, including scientific integrity, of the discussions and analyses in environmental impact statements.").[8] In numerous respects, as identified in the bases for Contention 2-E, the analysis which Exelon offers as meeting the obligations to conduct a thorough severe accident mitigation alternatives analysis is deficient. Challenges to the adequacy of a SAMA analysis are well within the scope of a license renewal proceeding. *See e.g. Duke Energy Corporation* (McGuire, Units 1 and 2; Catawba, Units 1 and 2) CLI-02-17, 56 N.R.C. 1.

C. The 1989 SAMDA Is Not A SAMA (Contention 3-E)

Exelon asserts that the 1989 Supplemental FES is the "previously considered severe accident mitigation alternatives for the applicant's plant" contemplated by 10 C.F.R. § 51.53(c)(3)(ii)(L)). However, that concept does not bless any analysis, regardless of how deficient it may be, merely because NRC Staff calls it a "severe accident mitigation alternatives

[8] Since it is a Staff analysis that Exelon asserts meets its SAMA obligations, the standards applicable to the Staff in preparing such an analysis should be used to judge the legal sufficiency of the document.

[analysis] for the applicant's plant". First, the standard against which the analysis must be measured is NEPA since it was NEPA that the Third Circuit enforced when it found the previous efforts to consider mitigation alternatives at Limerick were deficient. *Limerick Ecology Action*, 869 F. 2d at 741. The deficiencies identified in Contention 2-E, coupled with the total failure to consider critical factors that are essential for a valid consideration of mitigation alternatives, as set forth in Contention 3-E, provide ample basis to reject the 1989 FES Supplement as meeting the NEPA standards. Second, Exelon's assertion that the 1989 FES Supplement meets the NEPA mitigation alternative evaluation standard is no substitute for a demonstration by Exelon that its assertion is correct. As the Commission observed, in a different context, "[w]e do not simply take the applicant at its word." *Entergy Nuclear Vt. Yankee, LLC* (Vt. Yankee Nuclear Power Station), CLI-10-17, 72 N.R.C. __, slip op. at 45 (July 8, 2010). Exelon must provide some evidence and analysis to support its assertion that the 1989 FES Supplement is in fact a SAMA analysis within the meaning of the NRC Regulation. Exelon has not done that. Third, the adequacy of the 1989 FES Supplement has never been tested or independently evaluated because the Petitioner in that case reached a settlement with the then-owner of Limerick before the ASLB could consider the adequacy of Staff's analysis.[9] *Philadelphia Electric Company* (Limerick Generating Station, Units 1 and 2), LBP-89-24, 30 N.R.C. 152 (1989).

D. Failure to Consider No Action Alternative (Contention 4-E)

Contention 4 is a contention of omission and the Commission has recognized that

[9] The Statement of Consideration that accompanied the GEIS issuance in 1996 included a statement that the 1989 FES Supplement met that standard for 10 C.F.R. § 51.53(c)(3)(ii)(L). 61 Fed. Reg. 28467, 28481 (June 5, 1996). However, that was not a determination by the Commission, did not occur in the context in which the adequacy of the Supplement was at issue and, of course, is not a binding determination by the Commission.

Contentions of Omission are appropriate and within the scope of a relicensing proceeding. *See Entergy Nuclear Operations, Inc.* (Indian Point Nuclear Generating Units 2 and 3), LBP-08-13, 64 N.R.C. 43, 86, n. 194 (2008). The applicant's ER is required to adequately consider the No Action alternative to comply with 10 C.F.R. §§51.45(c), 51.53.(c)(2) and 51.53(c)(iii).

IV. NRDC'S CONTENTIONS MEET ALL OTHER ADMISSIBILITY REQUIREMENTS OF 10 C.F.R. § 2.309(f)(1)

The four contentions offered by NRDC specifically state issues of law or fact that are in dispute and are supported by a brief explanation of the bases for the contentions, which are supported by sufficient information to demonstrate that there is a material issue of law or fact in dispute between Exelon and NRDC. In addition to numerous references to documents that provide support for the contentions, NRDC has also provided a detailed declaration from three highly qualified nuclear experts, all of whom have extensive experience with nuclear issues in general and environmentally related nuclear issues in particular. They provide specific evidence of many flaws in the ER as it relates to severe accident mitigation alternatives, identifying information that Exelon should have included in its ER and explaining the relevance of that information to the ultimate task assigned to it -- *i.e.*, to present a fair assessment of the environmental costs and benefits of the proposed action. In presenting information regarding severe accident mitigation alternatives, Exelon has not met its obligation to submit information that is not only "supporting the proposed action but should also include adverse information." 10 C.F.R. § 51.45(e). Rather, its analysis is decidedly one-sided, stretching credulity in an effort to turn a 22 year old FES Supplement that took a limited look at mitigation alternatives into a thorough evaluation of severe accident mitigation alternatives for Limerick when it must have known of the vastly more comprehensive analyses being conducted for similar reactors.

CONCLUSION

For all the reasons stated above NRDC should be admitted as a party to the proceeding to pursue the four admissible contentions it has presented.

Respectfully Submitted,

s/ (electronically signed)
Anthony Z. Roisman
National Legal Scholars Law Firm, P.C.
241 Poverty Lane, Unit 1
Lebanon, NH 03766
603-443-4162
aroisman@nationallegalscholars.com

s/(electronically signed)
Geoffrey H. Fettus
Natural Resources Defense Council
1152 15th Street, NW, Suite 300
Washington, D.C. 20005
202-289-2371
gfettus@nrdc.org

Filed this date of November 22, 2011

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of	)	Docket Nos. 50-352-LR
	)	50-353-LR
Exelon Generation Company, LLC	)	
	)	
Limerick Generating Station, Units 1 & 2	)	November 18, 2011
	)	

DECLARATION OF SUZANNE DAY

I, Suzanne Day, declare as follows:

1. I make this declaration of my own personal knowledge. If called to testify as a witness, I could and would testify competently regarding its contents.

2. I am a current member of the Natural Resources Defense Council ("NRDC"). I have been a member for approximately 20 years. I joined NRDC because I care about the environment and feel that it is not being properly protected. I live on an organic family farm that borders the Delaware River. We can see from our windows the intake system for the public water supply for three counties (Gloucester, Camden, and Burlington Counties). We are also downwind from the nuclear power plants of the Limerick Generating Stations ("LGS"). A good portion of our farm is in a conservation easement with the New Jersey Natural Lands Trust because wildlife and native vegetation is threatened by intense development. These are some of the reasons I am personally concerned that we protect our natural world from contamination. For the public's health as well as for a sustainable future, our air, water, and land need

vigilance by regulatory agencies to prevent contamination before problems have to be remediated, a much more costly process than prevention.

3. I live at 3 Taylors Lane in Cinnaminson, New Jersey. I have lived at this address for 20 years this coming May.

4. My home is approximately 35 miles from the Limerick nuclear plants in Pennsylvania. I have been informed that this nuclear facility is seeking to have its operating license renewed for another 20 years by the Nuclear Regulatory Commission ("NRC").

5. I know that LGS operates nuclear power reactors near the area where I live with my family. I also know that LGS stores nuclear waste at the site. Both of these activities concern me. One of my significant concerns about the LGS is that there could be a serious accident at the facility and radiation from the nuclear power plants or the stored nuclear waste could harm my family, the public health of my community, and the surrounding environment in Pennsylvania and New Jersey. The recent events with nuclear reactors in Japan have made it clear to me that that LGS should take all available measures to prevent an accident at its nuclear reactors and to mitigate the environmental consequences of any such accident at its reactors. And just as important, the NRC should require LGS to take such steps.

6. A great many people live near us and it would be difficult for me and my family to evacuate in the event of a crisis. Although there is a warning system in place, we understand that it is outdated. This does not ease my fears about the operating reactors

and the nuclear waste. I worry we would have trouble escaping harm if a serious problem arises.

7. I know that the operator and the NRC must undertake an environmental review when nuclear power plants are relicensed. However, I am aware that as part of this relicensing the LGS has not produced an updated study of severe accident consequences and ways to prevent such an accident and to mitigate its consequences. The last plan the applicant or the NRC studied regarding what could and should happen in the event of a serious accident at LGS was in 1989. The Delaware Valley has grown in population and land use has dispersed built-up areas enormously in the interim. Our roadways are choked routinely just on ordinary weekdays. The failure to require full environmental impact studies and plans concerns me very much. I would like to be sure that if the LGS reactors are allowed to operate for an additional 20 years they are using the most up to date equipment and strategies to prevent a nuclear accident, to mitigate against bad environmental consequences, and to plan evacuations that would be feasible.

8. If the applicant updates its analysis of a severe accident and the appropriate mitigation measures are put in place in the event some sort of accident does happen, I would pay attention. It would help me feel safer and more informed about the risks that we face as nearby residents. It would also help me determine what steps I need to take now to protect myself and my family in the event of an accident. But because no such analysis has been conducted on this issue for decades, my worries remain.

9. The NRC has a duty to protect the American people, not to protect the nuclear industry. They also have a duty to keep us informed about the risks inherent in

nuclear energy, including those related to aging plants and aging materials that could operate for 60 years.

10. I support NRDC's intervention in this case and authorize them to act on my behalf because I believe with their participation, the Nuclear Regulatory Commission will be better positioned to fully review the possible impacts of the applicant's proposed relicensing for an additional 20 years. And based on the Council's and their experts' information, this action may address some of my concerns and mitigate impacts to our water, land, and other resources in the event of a serious accident.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge, information and belief and that this declaration was executed on November 18, 2011 in Cinnaminson, New Jersey.

/s/ (electronic signature approved)
Suzanne Day

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of	)	Docket Nos. 50-352-LR
	)	50-353-LR
Exelon Generation Company, LLC	)	
	)	
Limerick Generating Station, Units 1 & 2	)	November 17, 2011
	)	

DECLARATION OF CHARLES W. ELLIOTT

I, Charles W. Elliott, Esquire, declare as follows:

1. I make this declaration of my own personal knowledge. If called to testify as a witness, I could and would testify competently regarding its contents.

2. I am a current member of the Natural Resources Defense Council ("NRDC"). I have been a member since 1981. I joined NRDC because I care about the environment, and believe that it is not being adequately protected. In general, I am concerned about contamination of air, water, soil and food, and the consequent potential impacts on human health and on the natural world. In particular, one of the reasons I originally joined NRDC was because of my concerns about nuclear energy and the risks of nuclear power reactor accidents following the Three Mile Island accident in 1979.

3. I live at 604 Cattell Street, in Easton, Northampton County, Pennsylvania. I have lived at this address for about 16 years.

4. My home is approximately 38 miles from the Limerick Nuclear Generating Stations ("LGS") in Limerick Township, Pennsylvania. I have been informed

that this nuclear facility is seeking to have its operating license renewed for another 20 years by the Nuclear Regulatory Commission ("NRC").

5. I became personally familiar with LGS in my capacity as counsel for the citizen organization Limerick Ecology Action, Inc., Intervenor in the original operating license proceedings for Limerick Units 1 and 2 before the NRC and petitioner for review in the related appeal proceedings before the U.S. Court of Appeals for the Third Circuit. See, http://ftp.resource.org/courts.gov/c/F2/869/869.F2d.719.html. My participation in these matters spanned nearly a decade. In the course of that participation, I physically toured the Limerick facility with members of the Atomic Safety Licensing Board and other parties to the proceeding during construction, reviewed licensing documents and other material related to safety issues and severe accident risks posed by the Limerick facility, and consulted with experts in nuclear safety and risk assessment concerning the risks of operation of LGS. In particular, one of my areas of special concern was to ensure that the Limerick facility employed cost-effective, state of the art measures to prevent and to mitigate the risks of severe accidents. In that regard, I took steps to require that the NRC consider severe accident mitigation alternatives as part of the licensing process.

6. I remain unconvinced that the Limerick facility is as safe as it reasonably could be and I remain concerned with the risks of nuclear reactor operation and with the increasingly dense on-site storage of spent nuclear fuel rods. I am also unconvinced that the NRC has adequately assessed the full-scale long-term consequences of a severe accident at LGS. Recent events at the Fukushima nuclear reactors in Japan have caused me increased concern about the vulnerabilities of nuclear power reactors to external events whose frequency and magnitude have been inadequately assessed. I want to make

certain that LGS takes all available measures to prevent a severe accident at its nuclear reactors and to mitigate the environmental and human health consequences of any nuclear accident at its reactors.

7. The region where I live has become increasingly populated and urbanized since the time of the original licensing of the Limerick Generating Station. The Lehigh Valley Planning Commission (the regional planning commission for the Allentown-Bethlehem-Easton, PA Metropolitan Statistical Area (MSA)) of which I am a member, projects significantly increased population growth through 2030, the approximate period of the proposed relicensing. I am concerned that in the event of a severe accident, travel in my area may be impaired or disrupted, particularly where the severity, dynamics and consequences of a nuclear reactor accident can be unclear, fast-moving and unpredictable and in light of the fact that nuclear reactor accidents can cause spontaneous and voluntary evacuations for distances of 100 miles or more. See, e.g., Ziegler, D. & Johnson, J., *Evacuation Behavior In Response To Nuclear Power Plant Accidents*," Professional Geographer, May, 1984; Cutter, S. & Barnes, K., Evacuation behavior at Three Mile Island. *Disasters, 6*, 116-124 (1982)**;** Flynn, C., *Three Mile Island Telephone Survey - NUREG/CR-1093*. Washington, DC: U.S. Nuclear Regulatory Commission, 1979) (evacuees traveled an average distance of 100 miles). I am therefore concerned that in the event of a severe accident it might be difficult for me and my family to evacuate in the event of a crisis to minimize our exposure to radiological contaminants.

8. Moreover, because my home is well within the 50-mile emergency planning zone for the ingestion pathway, I am concerned that a severe accident at the LGS may result in the contamination of food, milk, and water in the area where I live and

travel, or that protective action measures taken to interdict, destroy or otherwise prevent the consumption of contaminated food, milk or water may cause a disruption of supplies.

9. I know that the NRC must undertake an environmental review when it grants relicensing permits to nuclear power plants like the Limerick plants. However, I am advised that as part of this relicensing the LGS has not produced an updated study of severe accident consequences and ways to prevent such an accident and to mitigate its consequences. It is my understanding that the last plan the applicant or the NRC studied regarding what could and should happen in the event of a serious accident at LGS was during the original operating licensing proceedings in the late 1980s. Our area has changed dramatically since that time. There are more people, there is more economic activity, and making appropriate plans for the surrounding communities must be very different than what it was two decades ago.

10. This failure to require updated studies and plans concerns me. I would like to be sure that if the LGS reactors are allowed to operate for an additional 20 years they are using the most up to date equipment and strategies to prevent a nuclear accident and to mitigate its environmental consequences.

11. If the NRC were to require the applicant to update its analysis of severe accidents and appropriate mitigation measures I would certainly pay close attention. It would help me feel safer and more informed about the risks that I face as a nearby resident. It would also help me determine what steps I need to take now to protect myself in the event of an accident. But because no such analysis has been conducted on this issue for decades, I remain concerned.

12. The NRC has a duty to protect the American people, not to protect the nuclear industry. It also has a duty to keep us informed about the risks inherent in nuclear energy, including those related to aging plants and aging materials that could operate for 60 years.

13. I support NRDC's intervention in this case and authorize them to act on my behalf because I believe with their participation, the Nuclear Regulatory Commission will be better positioned to fully review the possible impacts of the applicant's proposed relicensing for an additional 20 years and based on NRDC's and its experts' information, may address concerns and mitigate impacts to human health, and our water, land, and other resources in the event of a serious accident.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge, information and belief and that this declaration was executed on November 17, 2011 in Easton, Pennsylvania.

/s/ Charles W. Elliott______________
Charles W. Elliott

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of	)	Docket Nos. 50-352-LR 50-353-LR
Exelon Generation Company, LLC	)	
Limerick Generating Station, Units 1 & 2	)	November 17, 2011

DECLARATION OF LINDA LOPEZ

I, Linda Lopez, declare as follows:

1. I am the director of membership at the Natural Resources Defense Council, Inc. (NRDC). I have been the director of membership for twenty-three years.

2. My duties include supervising the preparation of materials that NRDC distributes to members and prospective members. Those materials describe NRDC and identify its mission.

3. NRDC is a membership organization incorporated under the laws of the State of New York. It is recognized as a not-for-profit corporation under section 501(c)(3) of the United States Internal Revenue Code.

4. NRDC currently has approximately 357,000 members. There are NRDC members residing in each of the fifty United States and in the District of Columbia. NRDC has 15,787 members in Pennsylvania. There are at least 2,894 members living within 50 miles of the Limerick Nuclear Generating Stations and at least 62 members live within 10 miles of the facility.

5. NRDC's mission statement declares that "The Natural Resources Defense Council's purpose is to safeguard the Earth: its people, its plants and animals, and the natural systems on which all life depends." Furthermore, NRDC "strive[s] to protect nature in ways that advance the long-term welfare of present and future generations," and "work[s] to foster the fundamental right of all people to have a voice in decisions that affect their environment."

6. Since its inception in 1970, NRDC has, as one of its organizational goals, sought to improve the environmental, health, and safety conditions at the nuclear facilities operated by the Department of Energy and the civil nuclear facilities licensed by the Nuclear Regulatory Commission and their predecessor agencies. To that end, NRDC utilizes its institutional resources (such as its capacities for legislative advocacy, public outreach and education, and litigation) to minimize the risks that nuclear facilities pose to its members and to the general public.

I declare under penalty of perjury that the foregoing is true and correct, to the best of my knowledge, information, and belief.

Dated: November 17, 2011

s/(electronically signature approved)
Linda Lopez

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of	)	Docket Nos. 50-352-LR
	)	50-353-LR
Exelon Generation Company, LLC	)	
	)	
Limerick Generating Station, Units 1 & 2	)	November 16, 2011
	)	

DECLARATION OF WILLIAM P. WHITE

I, William P. White, declare as follows:

1. I make this declaration of my own personal knowledge. If called to testify as a witness, I could and would testify competently regarding its contents.

2. I am a current member of the Natural Resources Defense Council ("NRDC"). I have been a member for approximately 40 years. I joined NRDC because I care about the environment, and feel that it is not being properly protected. I am also a former Branch Chief in the Policy Office of the EPA in Washington, and I served for one year on a task force in the Department of Energy charged with implementing the 1984 Nuclear Waste Policy Act. That Act was passed by Congress with the intent of solving the issue of spent nuclear waste, "once and for all."

3. I live at 135 Pennsylvania Avenue in Bryn Mawr, Pennsylvania. I have lived at this address for about 25 years.

4. My home is approximately 30 miles from the Limerick Nuclear Generating Stations ("LGS") in Pennsylvania. I understand that this nuclear facility is

seeking to have its operating license renewed for another 20 years by the Nuclear Regulatory Commission ("NRC").

5. I know that LGS operates nuclear power reactors in the area where I live with my family. I also know that LGS stores nuclear waste at the site. Both of these activities concern me. As a reasonably informed citizen, I am worried about the potential for an aging nuclear facility to accidently cause leakages of radioactivity into the air as occurred not so long ago at the Three Mile Island facility near Harrisburg. Fortunately, the downwind plume from that accident wafted primarily over farmland before encountering the Philadelphia area. At Limerick, the downwind population is much more dense than in past years. The recent events with nuclear reactors in Japan demand that we make certain that LGS takes all the available measures to prevent an accident at its nuclear reactors and to mitigate the environmental consequences of any such accident at its reactors.

6. I am also concerned that the utility's plans for nuclear waste disposal be opened again to public scrutiny. The back end of the fuel cycle remains an un-solved problem facing the industry since its inception. Again, the Japanese accident proved the folly of ignoring this issue, hoping that it will go away.

7. A great many people live near us, and it would be difficult for me and my family to evacuate in the event of a crisis. Although there is a warning system in place, I've read that it is outdated. This does not ease my fears about the operating reactors and their nuclear waste. I worry we would have trouble escaping harm if a serious problem arises.

8. I know that the operator and the NRC must undertake an environmental review when its nuclear power plants are relicensed. However, I am aware that as part of this relicensing the LGS has not produced an updated study of severe accident consequences and ways to prevent such an accident and to mitigate its consequences. The last plan the applicant or the NRC studied regarding what could and should happen in the event of a serious accident at LGS was in the late 1980s. Our area has changed a great deal since that time, especially along the Route 422 corridor, with more people and businesses locating there annually. The failure of LGS to produce updated studies and plans concerns me very much. I would like to be sure that if the LGS reactors are allowed to operate for an additional 20 years, they are using the most up-to-date equipment and strategies to prevent a nuclear accident and to mitigate against its environmental consequences.

9. If the applicant updates its analysis of a severe accident and the appropriate mitigation measures are put in place in the event some sort of accident does happen, I would pay close attention. I would feel safer and more informed about the risks that I face as a nearby resident. It would also help me determine what steps I need to take now to protect myself in the event of an accident. But because no such analysis has been conducted on this issue for decades, my worries remain.

10. The NRC has a duty to protect the American people, not to protect the nuclear industry. They also have a duty to keep us informed about the risks inherent in nuclear energy, including those related to aging plants and aging materials that could operate for 60 years.

11. I support NRDCís intervention in this case and authorize them to act on my behalf because I believe with their participation, the Nuclear Regulatory Commission will be better positioned to fully review the possible impacts of the applicantís proposed relicensing for an additional 20 years and based on the Councilís and their expertsí information, may address concerns and mitigate impacts to our water, land, and other resources in the event of a serious accident.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge, information and belief and that this declaration was executed on November 16, 2011 in Bryn Mawr, Pennsylvania.

William P. White

William P. White

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter Of	)	
	)	
EXELON GENERATION COMPANY, LLC,	)	**Docket No. 50-352-LR**
	)	**Docket No. 50-353-LR**
(Limerick Generating Station)	)	

(License Renewal Application)

DECLARATION OF THOMAS B. COCHRAN, Ph.D., MATTHEW G. MCKINZIE, Ph.D. AND CHRISTOPHER J. WEAVER, Ph.D., ON BEHALF OF THE NATURAL RESOURCES DEFENSE COUNCIL

INTRODUCTION

We, Thomas B. Cochran (TBC), Matthew G. McKinzie (MGM), and Christopher J. Weaver (CJW), declare that the following statements are true and correct to the best of our knowledge.[1]

1. (TBC) My name is Thomas B. Cochran. I received my Ph.D. in Physics from Vanderbilt University in 1967. I am currently a consultant to the Natural Resources Defense Council (NRDC) at its Washington, D.C. office. Prior to retiring from NRDC in 2011, I was a senior scientist and held the Wade Greene Chair for Nuclear Policy at NRDC, and was director of its Nuclear Program until 2007. My curriculum vitae is provided in Attachment A.

2. (MGM) My name is Matthew G. McKinzie. I received my Ph.D. in Physics from the University of Pennsylvania in 1995. I am a Senior Scientist in the Nuclear Program and

[1] This Declaration is presented jointly by all three of us but in some instances discrete points are offered by only one or two of us. Each paragraph is preceded by the initials of the Declarant(s) who are offering the information contained in that paragraph.

the Lands and Wildlife Program at NRDC at its Washington, D.C. office. My curriculum vitae is provided in Attachment B.

3. (CJW) My name is Christopher J. Weaver. I received my Ph.D. in Nuclear Engineering from the University of Texas at Austin in May 2011. I am a Project Scientist in the Nuclear Program and Science Center Fellow at NRDC at its Washington, D.C. office. My curriculum vitae is provided in Attachment C.

4. (TBC, MGM, CJW) On June 22, 2011, the Nuclear Regulatory Commission (NRC) received a License Renewal Application (Exelon, 2011a) for Limerick Generating Station (LGS or "Limerick") Unit 1 and Unit 2 from the licensee, Exelon Generation Company, LLC ("Exelon"). The operating license for Unit 1 currently expires on October 26, 2024, and the operating license for Unit 2 currently expires on June 22, 2029 (Exelon, 2011a). The two nuclear power plant units at Limerick are General Electric Type 4 Boiling Water Reactors (BWR) with Mark II containment structures (Exelon, 2011a). Exelon seeks to extend the operating license of Unit 1 until the year 2044, and Unit 2 until the year 2049 (Exelon, 2011a).

5. (TBC, MGM, CJW) Exelon has submitted an Environmental Report (Exelon, 2011b) in conjunction with its License Renewal Application that does not include a Severe Accident Mitigation Alternatives (SAMA) analysis for Limerick. Exelon, citing 10 CFR 51.53(c)(3)(ii)(L) (Exelon, 2011b), claims that it is not required to prepare a SAMA analysis for License Renewal because the NRC staff had previously considered a Severe Accident Mitigation Design Alternatives (SAMDA) analysis in a Supplement (NRC, 1989) to the Limerick Final Environmental Statement (NRC, 1984). The Limerick Final Environmental Statement (FES) is dated April, 1984, and the Supplement to the Limerick

FES (FES Supplement) is dated August 1989. Exelon adopts the 1989 SAMDA analysis as its SAMA analysis. Nonetheless, in its Environmental Report Exelon does recognize that at least four items of new information bear directly on the validity of the previous SAMDA analysis and offers their view as to why this new information is not significant – i.e. why it does not warrant modifying the 1989 SAMDA analysis results (Exelon, 2011b).

6. (TBC, MGM, CJW) In the context of the environmental review for License Renewal conducted consistent with the National Environmental Policy Act (NEPA), the NRC considers new information significant if it presents a seriously different picture of the environmental impact of the proposed project from what was previously envisioned. We have found that new information in seven areas is plausibly significant: 1) additional SAMA candidates analyzed for BWRs; 2) additional accident scenarios analyzed for BWRs; 3) real world information regarding reactor core damage frequency; 4) population within 50 miles Limerick; 5) economic consequences from accident scenarios at Limerick; 6) evacuation speed assumed during accident scenarios at Limerick; and 7) meteorology at Limerick. Taken individually and especially in combination, this new information would plausibly cause a materially different result in the SAMA analysis for Limerick and render the SAMDA analysis upon which Exelon relies incomplete.

THE LIMERICK FES SUPPLEMENT AND LICENSE RENEWAL APPLICATION ENVIRONMENTAL REPORT DO NOT CONSIDER A REASONABLY SUFFICIENT SET OF SAMA CANDIDATES

7. (MGM) In 1989, in Limerick Ecology Action v. NRC, the 3rd Circuit ruled that in the absence of an NRC finding that severe accidents are remote and speculative, the cost-

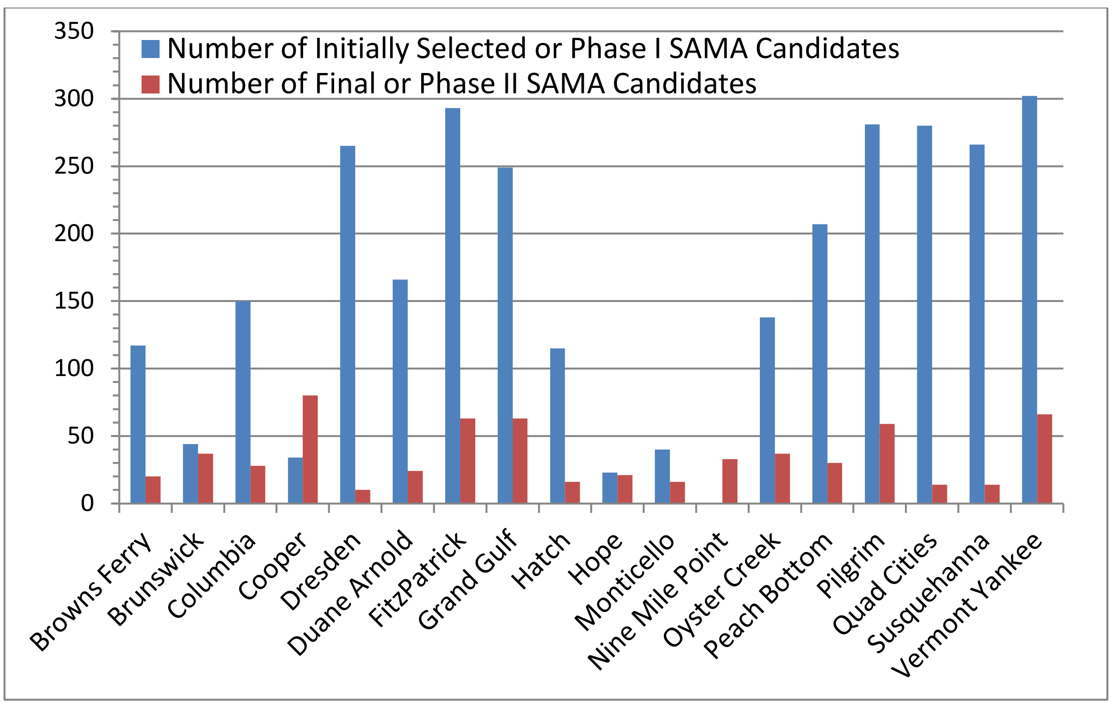
benefits of severe accident mitigation design alternatives (SAMDAs, currently termed SAMAs) should be considered as part of the NEPA analysis. As a direct consequence of this ruling, eight SAMDA candidates were initially considered in the Limerick FES Supplement, and seven final SAMDA candidates given a cost-benefit analysis with respect to person-rem averted (NRC, 1989). However two of these SAMDA candidates had already been implemented at Limerick at that time – the "Decay Heat Sized Vent Without Filter" and the "Low Pressure Reactor Makeup Capability" – and therefore in the FES Supplement the NRC noted that its staff "has not quantified the effectiveness of these SAMDAs in reducing risk." (NRC, 1989). Therefore the Limerick FES Supplement in effect considered only five SAMDA candidates.

8. (MGM) In the Limerick FES Supplement, the NRC staff determined that "while the screening cost/benefit analysis performed above indicates that several candidate SAMDAs might be cost effective, based on a criterion of $1000 per person-rem averted a more recent utility PRA presents lower risk estimates which indicate that SAMDAs are not justified. While the staff has not verified the utility estimates, the staff is convinced that risk is now lower for Limerick than the estimates used in our cost/benefit study." (NRC, 1989). In making this determination, the NRC staff in effect disregarded the SAMDA analysis in the FES Supplement due to forthcoming new and significant information: information which the NRC had not verified, and information for which the impacts on NRC's calculations were not precisely determined.

9. (MGM) Subsequent to the 1989 Limerick FES Supplement, industry lessons learned and NRC studies have produced a large set of SAMA candidates that have been analyzed for License Renewal applications in accordance with NEPA. In contrast to the Limerick FES

Supplement, the cohort of 27 U.S. BWR units at 18 sites undergoing license renewal reviews, or that have recently been granted license renewal, have on average considered 175 Phase I SAMA candidates and 35 Phase II SAMA candidates (Constellation Energy, 2004; Energy Northwest, 2010; Entergy 2006a; Entergy 2006b; Entergy 2006c; Entergy, 2011; Exelon, 2001; Exelon, 2003a; Exelon, 2003b; Exelon, 2005; Florida Power and Light, 2008; Nebraska Public Power District, 2008; Progress Energy, 2004; PSEG Nuclear, 2009; Southern Nuclear Operating Company, 2000; Susquehanna, 2006; Tennessee Valley Authority. 2003; Xcel Energy Corporation, 2005). This data is displayed graphically in Figure 1 for these BWR SAMA analyses.

10. Figure 1: A chart of the numbers of Initially-Selected or Phase I, and Final or Phase II SAMA candidates analyzed with respect to License Renewal for U.S. BWRs .



11. (MGM) In my review of these 18 SAMA analyses conducted for BWR License Renewal Applications, the list of initial or Phase I SAMA candidates were developed by applicants both through examining industry documents and by considering plant-specific

enhancements. These industry documents were a product of industry lessons learned covering the time period subsequent to the 1989 Limerick FES, and in addition include SAMA candidates from the Individual Plant Examination (IPE) and Individual Plant Examination of External Events (IPEEE) processes. These resources constitute new and significant information post-dating the Limerick FES Supplement.

12. (MGM) The 18 SAMA analyses conducted for BWR License Renewal Applications which I reviewed include numerous examples of SAMA candidates for BWR technology that have been determined to be cost-beneficial or potentially cost-beneficial in Phase II of the SAMA candidate evaluations. Table 1 lists cost-beneficial or potentially cost-beneficial SAMA candidates from my review. Examples of or cost-beneficial SAMA candidates for Susquehanna, a GE Type 4 BWR with Mark II containment similar to Limerick Unit 1 and Unit 2, include: “Improve Cross-Tie Capability Between 4kV AC Emergency Buses (A-D, B-C)” and “Procure Spare 480V AC Portable Station Generator” (Susquehanna, 2006). These SAMA candidates were not considered in the Limerick FES Supplement (NRC, 1989). Of the SAMA analyses I surveyed for BWRs, on average four cost-beneficial or potentially cost-beneficial SAMAs were found for each site, with a maximum of 11 cost-beneficial or potentially cost-beneficial SAMAs. Browns Ferry, Nine Mile Point and Peach Bottom had no cost-beneficial or potentially cost-beneficial SAMA candidates identified.

13. (MGM) Table 1: SAMA candidates that were found to be cost- beneficial or potentially cost-beneficial in BWR applications for license renewal. (Constellation Energy, 2004; Energy Northwest, 2010; Entergy 2006a; Entergy 2006b; Entergy 2006c; Entergy, 2011; Exelon, 2001; Exelon, 2003a; Exelon, 2003b; Exelon, 2005; Florida Power and Light,

2008; Nebraska Public Power District, 2008; Progress Energy, 2004; PSEG Nuclear, 2009; Southern Nuclear Operating Company, 2000; Susquehanna, 2006; Tennessee Valley Authority. 2003; Xcel Energy Corporation, 2005).

Nuclear Power Plant	**Number of Cost-Beneficial or Potentially Cost-Beneficial SAMAs and List of Titles of SAMAs Found to be Cost-Beneficial or Potentially Cost-Beneficial**	
Brunswick	7	Portable DC generator; Diverse EDG HVAC logic; Provide alternate feeds to panels supplied only by DC bus 2A-1; Provide an alternate means of supplying the instrument air header; Proceduralize battery charger high voltage shutdown circuit inhibit; Portable EDG fuel oil transfer pump; Use fire water as a backup for containment spray
Columbia	3	Reduce CCFs between EDG-3 and EDG1/2; Improve the fire resistance of cables to the containment vent valve; Improve the fire resistance of cables to transformer E-TR-S
Cooper	11	Portable generator for DC power to supply the individual panels; Revise procedure to allow bypass of RCIC turbine exhaust pressure trip; Improve training on alternate injection via FPS; Revise procedures to allow manual alignment of the fire water system to RHR heat exchangers; Proceduralize the ability to crossconnect the circulating water pumps and the service water going to the TEC heat exchangers; Create ability for emergency connection of existing or new water sources to feedwater and condensate systems; Operator procedure revisions to provide additional space cooling to the EDG room via the use of portable equipment; Provide an alternate means of supplying the instrument air header; Proceduralize the use of a fire pumper truck to pressurize the fire water system; Generation Risk Assessment implementation into plant activities; Modify procedures to allow use of the RHRSW system without a SWBP
Duane Arnold	2	Provide an alternate source of water for the RHRSW/ESW pit; Increase the reliability of the low pressure ECCS RPV low pressure permissive circuitry. Install manual bypass of low pressure permissive
Grand Gulf	3	Procedural change to cross-tie open cycle cooling system to enhance containment spray system; Enhance procedures to refill CST from demineralized water or service wather system; Increase operator training for alternating operation of the low pressure ECCS pumps (LPCI and LPCS) for loss of SSW scenarios.
Monticello	6	Enhanced DC Power Availability (provide cables from DG-13, the security diesel, or another source to directly power division II 250V battery chargers or other required loads); Enhance Alternate Injection Reliability (include the RHRSW and FSW valves in the maintenance testing program); Additional Diesel Fire Pump for FSW system (proceduralize the use of a fire truck to pressurize and provide flow to the fire main for RPV injection); Refill CST (develop emergency procedures and ensure viability of refilling the CSTs with FSW); Divert Water from Turbine Building 931-foot elevation; Manual RCIC Operation
Oyster Creek	7	Allow 4160 VAC bus IC and ID crosstie; Provide an alternate method for IC shell level determination; Portable DC battery charger to preserve IC and EMRV operability along with adequate instrumentation; Reduce fire impact in dominant fire areas; Operator Training; Protect Combustion Turbines; Upgrade Fire Pump House structural integrity

Nuclear Power Plant	Number of Cost-Beneficial or Potentially Cost-Beneficial SAMAs and List of Titles of SAMAs Found to be Cost-Beneficial or Potentially Cost-Beneficial	
Pilgrim	5	Enhance procedures to make use of AC bus cross-ties; Enhance procedures to make use of DC bus cross-ties; Provide redundant DC power supplies to DTV valves; Proceduralize use of the diesel fire pump hydro turbine in the event of EDG A failure or unavailability; Proceduralize the operator action t feed B1 loads via B3 When A5 is unavailable posttrip Similarly, feed B2 loads via B4 when A6 is unavailable post trip
Susquehanna	2	Improve Cross-Tie Capability Between 4kV AC Emergency Buses (A-D, B-C); Procure Spare 480V AC Portable Station Generator
Vermont Yankee	3	Shield injection system electrical equipment from potential water spray; Improve operator action: Defeat low reactor pressure interlocks to open LPCI or core spray injection valves during transients with stuck open SRVs or LOCAs in which random failures prevent all low pressure injection valves from opening; Install a bypass switch to bypass the low reactor pressure interlocks of LPCI or core spray injection valve

14. (CJW) In addition to these currently-documented SAMAs, there are technological options that should plausibly be reviewed as SAMA candidates due to the fact that they address issues related to prolonged station blackout (SBO) and improvement to safety-related systems. One possible SAMA candidate is to replace the emergency DC-powered valve actuators and speed controls for the steam-driven Safety-Related Turbines with a self-powered digital speed control and electrically-actuated valve-control system. This SAMA candidate would allow critical emergency core cooling pumps to run for days under SBO conditions. Another plausible SAMA candidate for Limerick relates to a concern raised in a recent Government Accountability Office report, that industry has limited ability to measure changes in safety-related pipe wall thickness caused by corrosion and located underground without costly excavation (GAO, 2011). To address this issue, nuclear plant operators could employ the use of non-destructive inspection techniques such as robotic crawlers that can navigate complex geometries to perform in-line pipe inspection. This SAMA candidate can potentially provide quantitative analysis without the need for expensive surface preparations.

15. (MGM) The Limerick Environmental Report for its License Renewal Application does not remedy the absence of SAMA candidates analyzed in the FES Supplement. Foremost this is because a new SAMA analysis for Limerick was not performed in support of license renewal using a set of SAMA candidates derived from new and significant information acquired by industry and by the NRC since 1989.

THE LIMERICK FES SUPPLEMENT AND LICENSE RENEWAL APPLICATION ENVIRONMENTAL REPORT DO NOT CONSIDER ADDITIONAL ACCIDENT SCENARIOS FOR BWRS THAT COULD ALTER PREVIOUSLY ASSUMED ACCIDENT CONSEQUENCES

16. (CJW) The Limerick FES Supplement does not consider accident scenarios involving: prolonged SBO events, multiunit events, seismically-induced fire events, or seismically-induced flooding events. In *The Near-Term Task Force Review of Insights from the Fukushima Dai-Ichi Accident*, the NRC staff noted that "prolonged SBO and multiunit events present new challenges to EP facilities that were not considered when the NRC issued NUREG-0696. The accident at Fukushima has clearly shown that these events are a reality." (NRC, 2011a) With respect to seismically-induced fire and flooding events, the NRC Generic Safety Issue 172 (GSI-172) was closed in 2002 based on IPEEE results, and as a result the NRC established no new requirements to prevent or mitigate seismically induced fires or floods (NRC, 2002). However the NRC Near-Term Task Force concludes that the NRC should re-evaluate the closure of GSI-172 in light of plant experience in Japan and the potential for common-mode failures of plant safety equipment as the result of seismically induced fires and floods (NRC, 2011a).

17. (TBC, MGM, CJW) The Limerick Environmental Report for License Renewal Application does not remedy the absence of additional accident scenarios for BWRs that could plausibly alter previously assumed accident consequences. The Limerick Environmental Report fails to consider extended SBO events, multiunit events, seismically-induced fire events, or seismically-induced flooding events.

THE LIMERICK FES SUPPLEMENT AND LICENSE RENEWAL APPLICATION ENVIRONMENTAL REPORT DO NOT INCLUDE OR ASSESS REAL WORLD INFORMATION REGARDING CORE DAMAGE FREQUENCY, WHICH INDICATES THAT THE CORE DAMAGE FREQUENCY USED IN THE SAMDA ANALYSIS IS LIKELY IN ERROR AND NOT CONSERVATIVE

18. (TBC) The Limerick SAMDA analysis relies on a Core Damage Frequency (CDF) of 4.2×10^{-5} per year (NRC, 1989) and the Environmental Report submitted by the applicant cites an estimate of CDF, which only includes internal events, for Limerick Units 1 and 2 of 3.2×10^{-6} per year based on a Probabilistic Risk Assessment (PRA) (Exelon, 2011b). In a recent update to the licensee's IPEEE model to include internal fire risks as well as internal events in its PRA, the license calculated a total CDF of 1.8×10^{-5} per year for these hazard groups (NRC, 2011b). Because the PRA is based on modeling assumptions that contain a large number approximations, large uncertainties and omissions, the absolute value of a CDF calculated using PRA is not a reliable predictor of the actual CDF value.
19. (TBC) Worldwide, I calculate that there have been approximately 429 light water reactors (LWR) that have operated approximately 11,500 reactor-years, and that five of these LWRs (Three Mile Island Unit 2, Greifswald Unit 5, Fukushima Daiichi Units 1, 2,

and 3) have experienced core damage as CDF is defined in NUREG-1150 Vol. 1, pg 2-3. Thus, for this class of nuclear power reactors, LWRs, the CDF is approximately 4.3×10^{-4} per reactor-year based on the historical record. I calculate that in the United States there have been approximately 116 LWRs that have operated approximately 4,100 reactor years. One of these LWRs (Three Mile Island Unit 2) experienced core damage as defined by NUREG-1150. Thus, for this class of nuclear power reactors the CDF is approximately 2.4×10^{-4} per reactor-year based on the historical record. The Limerick reactors, BWRs with Mark 2 containments, are similar in many respects to Fukushima Daiichi Units 1, 2 and 3, BWRs with Mark 1 containments. While no U.S. BWRs have experienced core damage as defined by NUREG-1150, I calculate that worldwide there have been approximately 117 BWRs that have operated approximately 3,300 reactor-years. Three of these BWRs (Fukushima Daiichi Units 1, 2, and 3) have experienced core damage as defined by NUREG-1150. Thus, for this class of nuclear power reactors worldwide the CDF is approximately 9×10^{-4} per reactor-year based on the historical record.

20. (TBC) In sum, the global CDFs for all LWRs and the subset of BWRs based on historical data are much greater than the theoretical value calculated by the applicant for Limerick Units 1 and 2, as is the U.S. historical CDF for LWRs. If a larger CDF is assumed in a PRA, then the calculated cost of severe accidents within a SAMA analysis would be increased proportionally, and thus it would be more likely that the economic viability of the measures to mitigate such accidents would be cost-beneficial.

21. (TBC, MGM, CJW) We do not argue that any of the above CDF estimates based on the historical evidence represent the most accurate CDFs for Limerick Units 1 and 2. In our

judgment the most accurate values of CDF probably lie somewhere between the theoretical values calculated by the applicant and one or more of the U.S. or global values based on the historical record. However, the CDFs used in a Limerick SAMA analysis should be evidence based. The applicant's estimates of CDF are non-conservative and a Limerick SAMA analysis would benefit from a sensitivity analysis in which higher core damage frequencies are assumed. Given the historical operating record of similar reactors, we assert that it is simply not credible to assume the CDF for older BWR reactors in the United States, such as Limerick Units 1 and 2, to be as low as 1.8×10^{-5} per reactor year, i.e., about one core damage event per 55,000 reactor-years of operation. A range of CDF values including values close to those estimated from the global historical evidence should be used in the SAMA analyses for Limerick Units 1 and 2. This issue should be analyzed and discussed in the Limerick environmental report and the final environmental impact statement.

THE LIMERICK FES SUPPLEMENT AND LICENSE RENEWAL APPLICATION ENVIRONMENTAL REPORT RELY ON INCORRECT DEMOGRAPHIC DATA

22. (MGM) The cost- benefit ratios calculated in the 1989 SAMDA analysis rely on population data for the 50-mile zone around Limerick derived from 1980 census data (Exelon, 2011b). The 1984 FES stated that the area within 10 miles of Limerick experienced a decrease in population of 4.2% from 1970 to 1980, and the area with within 50 miles experienced a decrease in population of less than 0.2% between 1970 and 1980. Noting this trend, the NRC staff remarked that "…the area has not experienced—nor is it likely to experience—the growth anticipated." (NRC, 1984).

23. (MGM) By contrast, data from the 1990 Census, the 2000 Census, and the 2010 Census does show a substantial growth in population in the 10-mile and in the 50-mile zones around Limerick over the last thirty years. Census data for 1990, 2000 and 2010 were analyzed using ESRI ArcGIS 10 Geographic Information Systems (GIS) software, summing the total population in each census tract intersecting the 10-mile or 50-mile zones around Limerick (Census Bureau, 1990; Census Bureau, 2000; Census Bureau, 2011). The results of this GIS analysis can be seen in Table 2. By 1990, the Census population within the 10-mile zone already exceeded the year 2000 projection in the Limerick Final Environmental Statement by 40 percent. The 2010 Census population within the 10-mile zone is more than 200 percent of the 1980 value used in the Limerick SAMDA study. The 2010 Census population within the 50-mile zone around Limerick is 21 percent larger than the 1980 population used in the Limerick SAMDA analysis.

24. (MGM) Table 2: Census population data for 1990, 2000 and 2010 analyzed for the 10-mile and 50-mile zones around Limerick (Census Bureau, 1990; Census Bureau, 2000; Census Bureau, 2011) and projected to the years 2030 and 2049, and population data used in the 1984 Final Environmental Impact Statement (NRC, 1984).

	10-Mile Zone around Limerick	**50-Mile Zone around Limerick**
1980 Population (1984 Limerick FES)	156,354 People	6,863,983 People
2000 Population (1984 Limerick FES)	158,607 People	7,253,880 People
1990 Population (U.S. Census)	221,701 People	7,334,214 People
2000 Population (U.S. Census)	251,287 People	7,751,181 People
2010 Population (U.S. Census)	318,582 People	8,300,122 People
Calculated Average Annual Population Growth Rate (1990-2010)	*4,844 People per Year*	*48,295 People per Year*
2030 Projected Population	415,463 People	9,266,030 People
2049 Projected Population	507,500 People	10,183,643 People

25. (MGM) This large discrepancy between the population data used for the 1989 SAMDA analysis and the subsequent Census data represents new information. This new information could plausibly cause materially different results in the assessment of impacts of an accident at Limerick, and materially different benefit/cost results in a new SAMA analysis for Limerick. Radiation doses resulting from an accident at Limerick have not been calculated for over 1.4 million people now living within 50 miles of these reactors.

26. (MGM) The Limerick Environmental Report for its License Renewal Application does not remedy the population errors in the 1989 Limerick SAMDA analysis. Foremost this is because a new SAMA analysis for Limerick was not performed in support of license renewal with revised population data. But in addition, Exelon commits errors in the 2011 Environmental Report in an effort to claim that the population data is not significant new information.

27. (MGM) First, the licensee states that the 50-mile zone population in 2030 is projected to be 9,499,925, and 2030 was the latest year out in time considered because: “this was the farthest future year to which population data for most counties within the 50-mile radius were projected.” (Exelon, 2011b). By contrast, SAMA analyses for nearly all other BWR license extensions relied on projected populations out to the end of the extended license, for example: Browns Ferry cited population projections to the year 2036 (Tennessee Valley Authority, 2003), Brunswick to 2036 (Progress Energy, 2004), Columbia to 2040 (Energy Northwest, 2010), Cooper to 2034 (Nebraska Public Power District, 2008), Dresden to 2031 (Exelon, 2003a), Fitzpatrick to 2034 (Entergy, 2006a), Grand Gulf to 2044 (Entergy, 2011), Hope Creek to 2046 (PSEG Nuclear, 2009), Monticello to 2030

(Xcel Energy Corporation, 2005), Oyster Creek to 2029 (Exelon, 2005), Peach Bottom to 2034 (Exelon, 2001), Quad Cities to 2032 (Exelon, 2003b), Susquehanna to 2044 (Susquehanna, 2006), and Vermont Yankee to 2032 (Entergy, 2006c). Populations were extrapolated out to the end of the renewed license terms in these SAMA studies in order to calculate person-rem of radiation exposure with respect to the maximum potential population within the 50-mile zones around the units during the re-licensing period. As shown in Table 2, the year 2030 population within the Limerick 10-mile zone is projected to be 415,463, and the year 2049 projected population in the 10-mile zone is projected to be 507,500. As also shown in Table 2, the year 2030 population within the Limerick 50-mile zone is projected to be 9,266,030, and the year 2049 population in the 50-mile zone is projected to be 10,183643. Under Exelon's current License Renewal Application, Limerick Unit 2 would be operating in the year 2049 while relying on a SAMDA analysis performed with population data obtained 69 years earlier.

28. (MGM) Second, the licensee states that the "relationship between the population surrounding a nuclear plant and the estimated dose following a severe accident is approximately linear" and therefore "increase in population within 50 miles of the LGS site would yield an approximate 39% increase in dose values over those calculated in the LGS June 1989 Update." (Exelon, 2011b). My examination of SAMA analyses performed for other BWR license renewals shows that the relationship between population surrounding a reactor and the estimated dose from a severe accident is not necessarily linear. For example, the Oyster Creek BWR (619 MWe) has a 50-mile population of 5.4 million, and the SAMA frequency-weighted total dose risk is 36 person-rem per year (Exelon, 2005). The Pilgrim BWR (685 MWe) has a greater 50-mile

population of 7.5 million, but the SAMA frequency-weighted total dose risk is calculated to be three times less: 13.6 person-rem per year (Entergy, 2006b). The estimated dose from a severe accident depends not just on the total population but also through prevailing winds on the geographic distribution of the population, which can change with time.

29. (MGM) Third, the licensee argues that "none of the SAMDAs in the LGS June 1989 Update would become cost beneficial if 2030 population numbers were assumed, the new information concerning population increase is not judged to be significant." (Exelon, 2011b). This statement is incorrect as it relies on an assumed linear relationship between total 50-mile population and estimated dose. But more importantly, the 1989 Limerick SAMDA analysis stated in conclusion that "…while the screening cost/benefit analysis performed above indicates that several candidate SAMDAs might be cost effective, based on a criterion of $1000 per person-rem averted, a more recent utility PRA presents lower risk estimates which indicate that SAMDAs are not justified." (NRC, 1989). Therefore contrary to the claim of the licensee in the License Renewal Application Environmental Report, the Limerick 1989 Supplement did find some of the eight initial SAMDA candidates to be potentially cost effective in that analysis. Those findings were subsequently questioned by the NRC staff due to uncertainties in averted dose and cost for the SAMDA candidates – uncertainties created by the 1989 owner's PRA analysis that NRC Staff had not yet evaluated.

30. (MGM) I also note that the 1984 FES, the 1989 FES Supplement, the 2011 License Renewal Application and its Environmental Report do not discuss or analyze uncertainty in offsite dose calculations for Limerick related to census undercount or to transient

populations. Beginning in the 1990s, demographers have commonly understood that the U.S. Census is subject to a systematic undercount of minority populations (Census Monitoring Board, 2001), a trend which has greater significance in urban areas like Philadelphia. In addition, the Census undercounts tourist and commuter populations. If an accident at Limerick occurred during a weekday, the population at risk may have a very different geographic distribution than if the accident occurred at night or on the weekend.

THE LIMERICK FES SUPPLEMENT AND LICENSE RENEWAL APPLICATION ENVIRONMENTAL REPORT FAIL TO CONSIDER OFF-SITE ECONOMIC COST RISKS

31. (MGM) Exelon confirms in the Limerick Environmental Report that the SAMDA analysis in the 1989 FES Supplement did not compute cost- benefit values for SAMDA candidates with respect to their reduction in land contamination subject to long-term interdiction, or the reduction in associated economic cost, from a severe accident (Exelon, 2011b). Economic cost risk calculations are now a codified component of SAMA cost- benefit assessments and have been performed as an integral part of other License Renewal Applications submitted to the NRC. New information pertaining to economic risk could plausibly cause materially different results in the assessment of impacts of an accident at Limerick, and materially different cost- benefit results in a new SAMA analysis for Limerick. The proximity of Limerick to the city of Philadelphia, with substantial economic activities and assets, reinforces this conclusion.
32. (MGM) The Limerick Environmental Report for its License Renewal Application does not remedy the lack of economic risk assessment in the 1989 SAMDA study. Principally this is because a new SAMA analysis for Limerick was not performed in support of

license renewal including economic cost risk. But in addition, the licensee commits errors in the 2011 Environmental Report in an effort to claim that economic risk is not significant new information.

33. (MGM) In its 2011 Environmental Report, the licensee claims that the economic cost of a severe accident at Limerick "can be estimated using information from other license renewal applications." The example of Three Mile Island Nuclear (TMI) Station Unit 1 Environmental Report for License Renewal is cited, and the licensee argues that the Three Mile Island finding that economic cost risk is 70% larger than the off-site exposure cost risk is representative (Exelon, 2011b). This argument is incorrect: an examination of 18 SAMA analyses performed in support of License Renewal Applications for BWR shows that the ratio of economic cost risk to exposure cost risk exhibits a wide variation, as shown by example in Table 3. Claiming that economic cost risk simply scales with the exposure cost risk assumes that economic productivity and assets scale with population density, which may not true when considering low-income communities, for example North Philadelphia. TMI is also an inappropriate example to use in estimating the economic risk for Limerick because TMI is a Pressurized Water Reactor (PWR) rather than a BWR, with correspondingly different accident scenario source terms, and Harrisburg near TMI is smaller and less urban economic center than Philadelphia near Limerick.

34. (MGM) Table 3: A comparison of dose risk cost and economic risk cost for selected SAMA performed for BWR License Renewal Applications (Exelon, 2003a; Entergy, 2011; PSEG Nuclear, 2009; Constellation Energy, 2004; Exelon, 2005; Entergy, 2006b; Exelon, 2003b; AmerGen, 2008).

Nuclear Plant	Weighted Population Dose Risk (person-rem/year)	Weighted Population Dose Risk Cost ($/year)	Offsite Economic Risk Cost ($/year)	Percentage Change in Off-Site Economic Cost over Off-Site Economic Exposure Cost
Dresden	10.23	$20,460.00	$18,408.00	-10.0%
Grand Gulf	0.486	$972.00	$1,240.00	+27.6%
Hope Creek	22.9	$45,800.00	$155,000.00	+238.4%
Nine Mile Point Unit 1	22.5	$45,000.00	$86,000.00	+91.1%
Nine Mile Point Unit 2	50.9	$101,800.00	$125,000.00	+22.8%
Oyster Creek	36	$72,000.00	$118,000.00	+63.9%
Pilgrim	13.6	$27,200.00	$45,900.00	+68.8%
Quad Cities	1.67	$3,340.00	$2,806.87	-16.0%
Three Mile Island Unit 1	32.61	$65,220.00	$112,259.00	+72.1%

35. (MGM) Economic risk to the east of Limerick is dominated by the economic productivity of the city of Philadelphia and its surrounding region. The 2010 gross domestic product for all industries in the Philadelphia-Camden-Wilmington Metropolitan Statistical Area which lies within the Limerick 50-mile zone was computed to be $347 billion, or more precisely $346,932,000,000.00 (Bureau of Economic Analysis, 2011). Personal income summaries for the 23 counties in Delaware, Maryland, New Jersey and Pennsylvania which substantially overlap the 50-mile zone around Limerick is given in Table 4 (Bureau of Economic Analysis, 2011). The sum of 2009 personal income in the three Pennsylvania counties that overlap the 10-mile EPZ is approximately $93 billion, and the sum of 2009 personal income in all of the counties that substantially overlap the 50-mile zone around Limerick is approximately $497 billion.

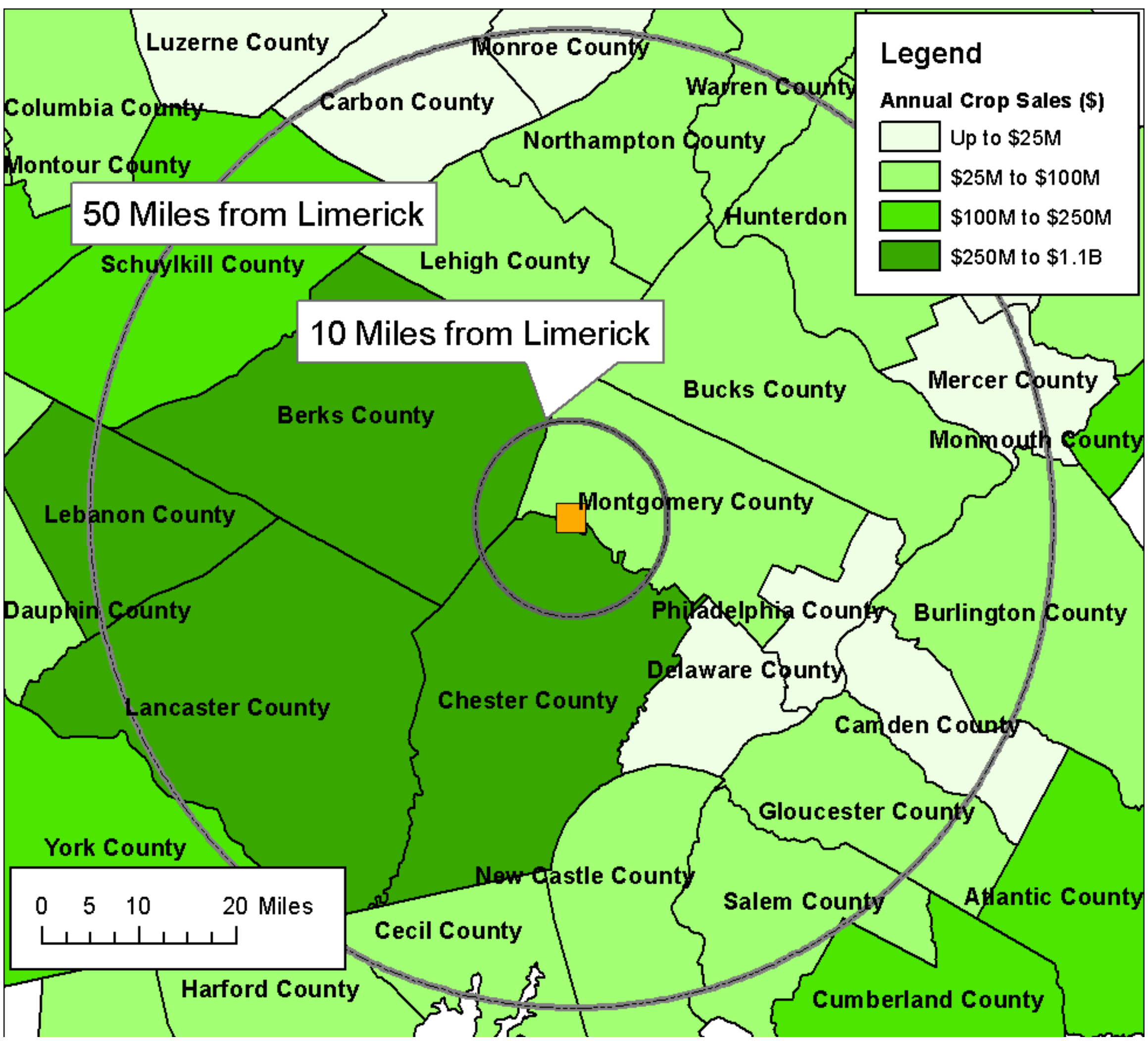
36. (MGM) Table 4: Personal income in dollars for the year 2009 summed for the indicated county (Bureau of Economic Analysis, 2011).

County Name, State	2009 Personal Income Summed by County
Counties Overlapping the Limerick 10-mile EPZ	
Berks County, PA	$14,793,423,000.00
Chester County, PA	$28,453,609,000.00
Montgomery County , PA	$49,654,050,000.00
Total in Counties Overlapping 10-mile EPZ	***$92,901,082,000.00***
Counties Outside the Limerick 10-mile EPZ and Overlapping the 50-mile zone	
Bucks County, PA	$31,862,647,000.00
Carbon County, PA	$2,007,062,000.00
Delaware County, PA	$27,524,171,000.00
Lancaster County, PA	$18,450,403,000.00
Lebanon County, PA	$4,809,208,000.00
Lehigh County, PA	$13,586,500,000.00
Monroe County, PA	$5,298,681,000.00
Northampton County, PA	$11,152,782,000.00
Philadelphia County, PA	$54,125,507,000.00
Schuylkill County, PA	$4,569,375,000.00
Total Pennsylvania	***$359,188,500,000.00***
New Castle County, DE	$23,500,800,000.00
Total Delaware	***$23,500,800,000.00***
Cecil County, MD	$3,715,479,000.00
Total Maryland	***$3,715,479,000.00***
Burlington County, NJ	$20,751,126,000.00
Camden County, NJ	$21,379,186,000.00
Gloucester County, NJ	$11,478,111,000.00
Hunterdon County, NJ	$8,497,001,000.00
Mercer County, NJ	$19,024,257,000.00
Salem County, NJ	$2,541,629,000.00
Somerset County, NJ	$22,679,780,000.00
Warren County, NJ	$4,673,941,000.00
Total New Jersey	***$111,025,031,000.00***
Total	***$497,429,810,000.00***

37. (MGM) Agriculture is an important component to the economic risk to the west of Limerick has. As an example of data pertinent to determining economic risk that is absent from the Limerick FES Supplement but found universally in SAMA analyses conducted

for other BWR License Renewal Applications, I have displayed U.S. Bureau of Agriculture statistics on crop sales by county within the 50-mile zone around Limerick in Figure 2 (USDA, 2011). As can be seen in this figure, Lancaster County to the southwest of Limerick had over $1 billion in crop sales in 2007, Chester Counties had about one-half billion dollars in crop sales in 2007, and Berks County had bout $400 million in crops sales in 2007 (USDA, 2011).

38. (MGM) Figure 2: US Bureau of Agriculture data on annual crop sales in the area surrounding Limerick in 2007 (USDA, 2011).



39. (CJW) As documented in a number of studies on considerations for decontamination costs (Chanin, 1996; Luna, 2008), the cost to cleanup fission products in a densely populated and developed region, such as the Philadelphia metropolitan area, could be significantly larger on a per capita basis than previously estimated. The reports state that input parameters used in analyses for less densely populated areas are inappropriate for highly populated urban areas. Without considerable modifications to the input values used by accident consequence codes such as MELCOR Accident Consequences Code System (MACCS2), the analysis could result in large underestimations of the decontamination costs associated with the off-site economic costs of a severe accident.

THE LIMERICK FES SUPPLEMENT AND LICENSE RENEWAL APPLICATION ENVIRONMENTAL REPORT USE FLAWED EVACUATION SPEED ASSUMPTIONS

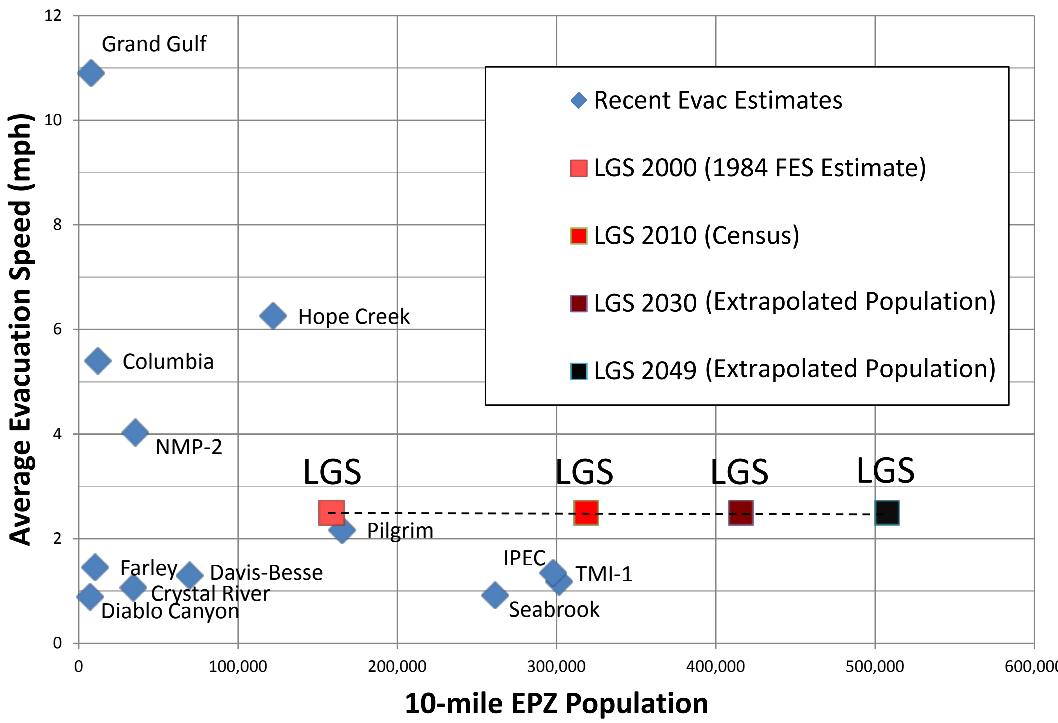
40. (CJW) An important step in calculating the offsite exposures for a SAMA analysis is to accurately model the evacuation within the 10-mile Emergency Planning Zone (EPZ). A typical nuclear accident evacuation assumption is a 95% response, i.e. 5% of the population does not evacuate during an accident. Other site-specific parameters needed for accurate evacuation modeling are the evacuation start time delay, and the radial evacuation speed. These input parameters can be obtained from the emergency action plans for the site in question, and studies on the evacuation dynamics which incorporates information such as the road network, traffic congestion, and other external effects (KLD, 2003).

41. (CJW) The 2005 Nuclear Energy Institute SAMA Guidance Document, which the NRC staff recommends using during license renewal, states: “Population dose may be significantly affected by radial evacuation speed, and uncertainties may be introduced

during derivation of a single evacuation speed from emergency plan information… Therefore, perform sensitivity analysis to show that variations in this parameter would not impact the results of the analysis." (NEI, 2005). The evacuation modeling performed in the 1984 FES appears to overestimate the evacuation speed based on comparisons with SAMA analyses in support of other reactor re-licensing, and does not include an uncertainty analysis.

42. (CJW) The only evacuation speed that was assumed in the 1984 Limerick evacuation modeling was 2.5 miles per hour (mph). The Indian Point Energy Center (IPEC) estimated that the evacuation of their entire EPZ, containing about 297,000 permanent residents, would take 9.25 hours, including a 2-hour delay, or mobilization time, for the start of evacuation (KLD, 2003). Factoring in this mobilization time would result in an actual evacuation duration for IPEC of 7.42 hours, resulting in an average evacuation speed of 1.35 mph. Both the year 2010 and projected year 2049 population within the Limerick EPZ are greater than that for IPEC, and suggest that an updated analysis of the evacuation scenarios needs to be performed for Limerick to account for the likely reduction in evacuation speeds. A reduced evacuation speed would likely increase the offsite exposure following a release because the complete dose is dependent on the exposure time. The evacuating population could remain in the plume pathway for extended periods in turn increasing their dose, which could plausibly cause materially different results in the assessment of impacts of an accident at Limerick, and materially different benefit/cost results in a new SAMA analysis for Limerick. Figure 3 plots evacuation speeds assumed in selected SAMA analyses against the total population within the 10-mile EPZ.

43. (CJW) Figure 3: A chart of base case evacuation speeds plotted against EPZ populations from License Renewal Application SAMA analyses for selected nuclear power plants (blue diamond symbols). The populations for the Limerick EPZ is given for the FES Supplement (light red square symbol), the 2010 Census (red square symbol), and population extrapolations to the year 2030 (dark red square symbol) and to the year 2049 (black square symbol).



44. (CJW) Finally, the FES Supplement for Limerick does not contain a sensitivity analysis with regard to evacuation speeds as described in the NRC SAMA guidance document. SAMA analyses for other nuclear power plants have provided the results of a sensitivity analysis, exploring the offsite exposure doses as a percentage change from the base speed result. I find that doses are characteristically determined for a 50% reduction in the evacuation speed, for which the resulting collective dose ranges anywhere from a few percent difference to as much as 15 percent higher. Therefore the sensitivity analysis

performed for SAMA analysis at other nuclear power plants reinforces that a reduction in evacuation speed from an updated SAMA analysis for Limerick could materially alter the assessment of impacts of a severe accident and the cost- benefit results of certain mitigation alternatives.

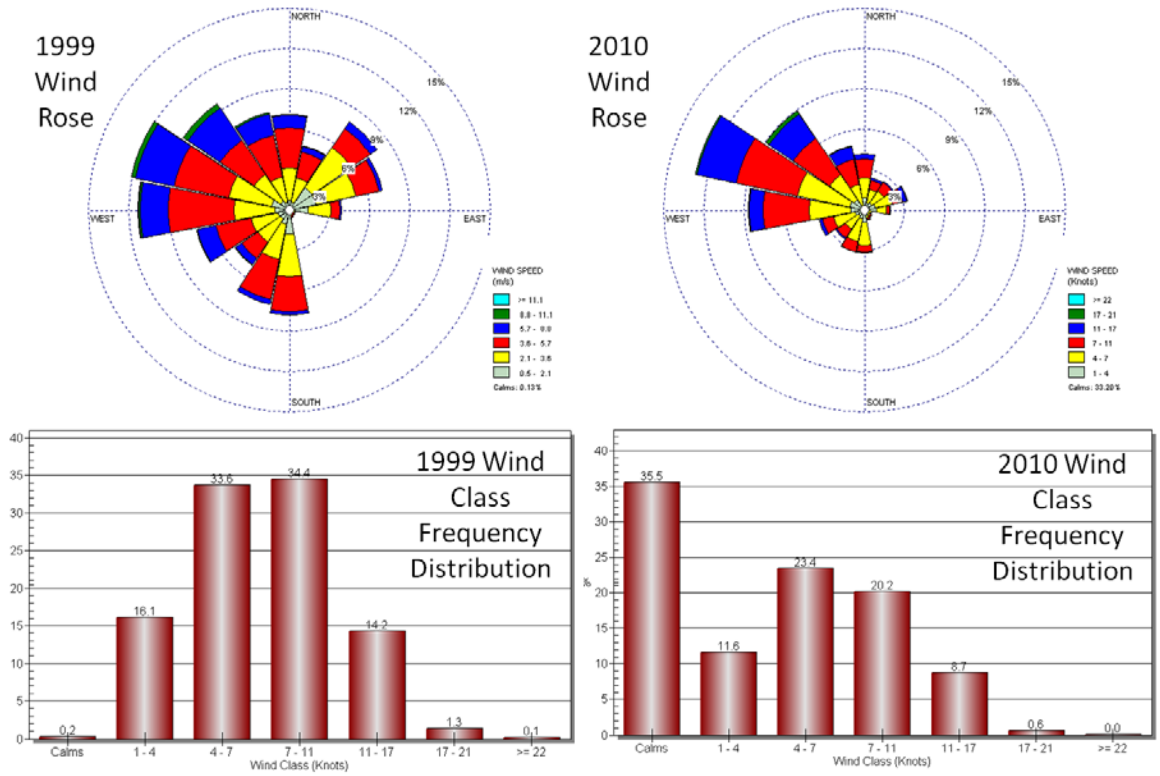
THE LIMERICK FES SUPPLEMENT AND LICENSE RENEWAL APPLICATION ENVIRONMENTAL REPORT RELY ON 1976 METEOROLOGY

45. (MGM) The Limerick FES Supplement relies on hourly wind data measurements for the single year 1976 (NRC, 1984). A review of other SAMA analyses submitted for License Renewal demonstrates that applicants used information current to the relicensing period, and screened wind data to determine whether this meteorology was characteristic of the site or represented atypical weather patterns. The SAMDA analysis in the Limerick FES Supplement is deficient in that the averaged wind speed along 16 compass directions used in the cost-benefit calculations would predate the end of the license renewal period by as much as 73 years. Nor has Exelon demonstrated that it determined the wind data for 1976 is characteristic of the site. Meteorological data, in particular prevailing wind directions and speeds, is a significant component in establishment of the baseline consequences of a severe accident, particularly when the population is clustered in an urban center along several compass directions downwind from the nuclear power plant.

46. (MGM) I have reviewed and analyzed hourly historical weather data from the Pottstown, Pennsylvania weather station, named KPTW, maintained by the Federal Aviation Administration. This weather station is located at latitude 40.240 North, longitude 75.550 West, which is approximately two miles northeast of Limerick. I downloaded hourly wind data at this station for the available years beginning in 1999 (Penn State, 2011), and

created wind rose and wind class frequency distribution charts using the software WRPLOT View by Lakes Environmental. Yearly-averaged wind roses and wind class frequency distributions at Pottstown are shown for the year 1990 and the year 2010 in Figure 4. I have found that the 1999 meteorology differs significantly from the 2010 meteorology for Pottstown. In 1999, northerly, northeasterly and southerly winds are a significant component to the wind rose, whereas in 2010 the winds are dominated by north-northwesterly, northwesterly and westerly winds, which is a pattern more like the 1976 data used for the Limerick SAMDA analysis (NRC, 1984). I have found that the wind class frequency distributions for 1999 and 2010 are also very different: 1999 was a much windier year in Pottstown, the most probable wind class for 2010 in Pottstown being calm. With respect to the Limerick SAMDA, wind data needs to be analyzed for representative patterns for direction and speed to properly estimate the off-site dose to surrounding populations.

(MGM) Figure 4: Yearly-averaged wind rose data from the Federal Aviation Administration's KPTW station located in Pottstown, Pennsylvania, approximately two miles northeast of Limerick. Shown at left are the 1999 wind rose and wind class frequency distribution, and shown at right are the 2010 wind rose and wind class frequency distribution.



47. (MGM) In addition, a 2008 study by Pennsylvania State University projects a warmer, wetter Pennsylvania, with a longer growing season and significantly less snow by the middle of the current century (Shortle, 2009). These predicted changes in the Pennsylvania climate could plausibly case a materially different result in analyzing the baseline consequences of a severe accident as winds and atmospheric stability depend strongly on ambient temperature.

SUMMARY: NEW AND SIGNIFICANT INFORMATION COULD MATERIALLY ALTER THE ASSESSMENT OF IMPACTS OF A SEVERE ACCIDENT AND THE COST-BENEFIT RESULTS OF MITIGATION ALTERNATIVES AT LIMERICK, INCLUDING NEW SAMA CANDIDATES

48. (TBC, MGM, CJW) A SAMA analysis entails five main steps: (1) the establishment of the baseline consequences of a severe accident, including off-site exposure costs and off-site economic costs; (2) the identification of SAMA candidates; (3) preliminary or Phase I screening of SAMA candidates; (4) final or Phase II Screening and cost-benefit evaluation of SAMA candidates; and (5) sensitivity analysis. We find that the Limerick FES Supplement is inadequate regarding all five steps of the SAMA analysis process. Building on industry lessons learned and NRC studies, hundreds of SAMA candidates have been identified for BWRs since the Limerick FES Supplement was published in 1989, and numerous SAMA candidates for BWRs have been analyzed to be cost-beneficial or potentially cost-beneficial in reducing risk. The Limerick FES Supplement relies on outdated and inappropriate population data, evacuation speeds and meteorology, neglects to calculate economic costs entirely, and uses $1000 per person-rem for dose risk costs, rather than $2000 per person-rem. A sensitivity analysis was not performed in the FES Supplement. These problems are not remedied in the 2011 Limerick Environmental Report.

49. (TBC, MGM, CJW) Our review of 18 SAMA analyses prepared by other BWR License Renewal applicants demonstrate that accurate site-specific data leads to results pertinent to individual cases. For example, the SAMA analysis for Hatch concluded that: "The area surrounding HNP is predominantly agricultural and forested land with sparse population. As a result, the baseline risk of the plant is low both for population doses and economic risk. This limits the potential averted risk from any severe accident modifications."

(Southern Nuclear Operating Company, 2000). Limerick represents an opposite extreme case from Hatch, as Limerick is located in an area of high population density and high economic productivity. We have found that new information in seven areas – 1) additional SAMA candidates analyzed for BWRs; 2) additional accident scenarios analyzed for BWRs; 3) real world information regarding reactor core damage frequency; 4) population within 50 miles Limerick; 5) economic consequences from accident scenarios at Limerick; 6) evacuation speed assumed during accident scenarios at Limerick; and 7) meteorology at Limerick – are plausibly significant. Taken individually and in combination, this new information would plausibly cause a materially different result in the SAMA analysis for Limerick. Given that applicants are required by law to perform a SAMA analysis for License Renewal as a component of assessing environmental impacts under NEPA, Exelon's License Renewal Application would therefore be incomplete.

Pursuant to 28 U.S.C. § 1746, we declare that the foregoing is true and correct to the best of our knowledge, information and belief, and that this declaration was executed in Washington, DC on November 22, 2011.

/s/ Dr. Thomas B Cochran (electronic signature approved)

/s/ Dr. Matthew G. McKinzie (electronic signature approved)

/s/ Dr. Christopher J. Weaver (electronic signature approved)

LBP-12-08

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD

Before Administrative Judges:

William J. Froehlich, Chairman
Dr. Michael F. Kennedy
Dr. William E. Kastenberg

In the Matter of	Docket Nos. 50-352-LR, 50-353-LR
EXELON GENERATION COMPANY, LLC	ASLBP No. 12-916-04-LR-BD01
(Limerick Generating Station, Units 1 and 2)	April 4, 2012

TABLE OF CONTENTS

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MEMORANDUM AND ORDER

(Ruling on Petition to Intervene and Request for Hearing)

Before this Atomic Safety and Licensing Board (Board) is a petition to intervene and request for a hearing (Petition) filed by the Natural Resources Defense Council (NRDC or Petitioner).[1] NRDC challenges the application filed by Exelon Generation Company, LLC (Exelon or Applicant) to renew its nuclear power reactor operating licenses for the Limerick Generating Station, Units 1 and 2 (Limerick) for an additional twenty years (i.e., until October 26, 2044 for Unit 1, and June 22, 2049 for Unit 2).[2] Limerick is a dual-unit nuclear power facility that is located on the east bank of the Schuylkill River in Limerick Township, Montgomery County, Pennsylvania, approximately four river miles downriver from Pottstown, 35 river miles

[1] Natural Resources Defense Council Petition to Intervene and Notice of Intention to Participate (Nov. 22, 2011) [hereinafter Petition].

[2] See Notice of Acceptance for Docketing of the Application and Notice of Opportunity for Hearing Regarding Renewal of Facility Operating License Nos. NPF-39 and NPF-85 for an Additional 20-Year Period; Exelon Generation Co., LLC, Limerick Generating Station, 76 Fed. Reg. 52,992, 52,992 (Aug. 24, 2011) [hereinafter Application Notice].

upriver from Philadelphia, and 49 river miles above the confluence of the Schuylkill with the Delaware River.[3]

NRDC has proffered four contentions. While Exelon and the NRC Staff concede that NRDC has established standing, they both assert that all of NRDC's four proposed contentions are inadmissible.

The Board finds that NRDC has established standing and has proffered at least one contention that is admissible pursuant to 10 C.F.R. § 2.309(f)(1). In accordance with 10 C.F.R. § 2.309(a), we therefore grant the request for public hearing and admit NRDC as a party to this proceeding. As limited by the Board, the adjudicatory proceeding for the admitted contention will be conducted under the procedures set forth in 10 C.F.R. Part 2, Subpart L.

I. Procedural Background

Exelon filed its license renewal application (LRA), which included an environmental report (ER) on June 22, 2011.[4] A notice was published in the Federal Register on August 24, 2011 stating that any person whose interests may be affected by this proceeding, and who wishes to participate as a party, must file a petition for leave to intervene within 60 days of the notice (i.e., by October 24, 2011) in accordance with 10 C.F.R. § 2.309.[5] On September 22, 2011, NRDC requested an extension of time for filing a Petition to Intervene until November 22,

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[3] Applicant's Environmental Report – Operating License Renewal Stage, Limerick Generating Station, Units 1 and 2, at 2-3 (June 2011) (ADAMS Accession No. ML11179A104) [hereinafter ER].

[4] See Application Notice.

[5] Id. at 52,993.

2011.[6] On October 17, 2011, the Secretary of the Commission granted this request.[7]

On November 22, 2011, NRDC timely filed its Petition, proffering four contentions.[8] The Petition was supported by two Declarations – one jointly submitted by Thomas B. Cochran, Ph.D., Matthew G. McKinzie, Ph.D., and Christopher J. Weaver, Ph.D. (Joint Declaration),[9] and the second submitted by Christopher Paine (Paine Declaration).[10] Contention 1-E alleges that the Environmental Report (ER) supporting license renewal has not adequately considered new and significant information relating to severe accident mitigation alternatives (SAMAs).[11] Contention 2-E alleges that in relying on a Severe Accident Mitigation Design Alternatives (SAMDA) analysis from 1989, Exelon has failed to provide an adequate analysis of

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[6] NRDC Request for Extension of Time for Opportunity to Request a Hearing and Petition for Leave to Intervene in the NRC's Notice of Opportunity for Hearing Regarding Renewal of Facility Operating License Nos. NPF-39 and NPF-85 for an Additional 20-Year Period (Sept. 22, 2011).

[7] Commission Order (Granting Extension of Time) (Oct. 17, 2011) (unpublished).

[8] See Petition at 16-24.

[9] See Declaration of Thomas B. Cochran, Ph.D., Matthew G. McKinzie, Ph.D. and Christopher J. Weaver, Ph.D., on Behalf of the Natural Resources Defense Council (Nov. 22, 2011) [hereinafter Joint Declaration].

[10] See Declaration of Christopher E. Paine of the Natural Resources Defense Council (Nov. 22, 2011) [hereinafter Paine Declaration].

[11] Petition at 16. We use the term SAMA to refer to an additional feature or action that could prevent or mitigate the consequences of serious accidents. SAMA analysis includes consideration of (i) hardware modifications, procedure changes, and training program improvements; (ii) SAMAs that could prevent core damage as well as SAMAs that could mitigate severe accident consequences; and (iii) the full scope of potential accidents (meaning both internal and external events). In 1989, the NRC Staff performed a severe accident mitigation alternatives analysis in a Supplement to the Final Environmental Statement which it referred to as a SAMDA analysis. See Final Environmental Statement Related to the Operation of Limerick Generating Station, Units 1 and 2, NUREG-0974 Supplement (Aug. 1989) (ADAMS Accession No. ML11221A204) [hereinafter 1989 SAMDA Analysis].

alternatives.[12] Contention 3-E alleges that Exelon is not legally entitled to claim an exemption under 10 C.F.R. § 51.53(c)(3)(ii)(L) from the requirement to conduct a SAMA analysis, and that the ER is therefore inadequate for failure to include such an analysis.[13] Contention 4-E claims that the ER is deficient for its failure to provide an adequate analysis of a "no-action" alternative.[14]

On December 20, 2011, Exelon filed an answer opposing NRDC's Petition.[15] On December 21, 2011, the NRC Staff filed an answer opposing the Petition.[16] Although Exelon and the NRC Staff concede that NRDC has standing, both claim that none of NRDC's four proffered contentions is admissible.[17] NRDC filed a combined reply to the Exelon and the NRC Staff answers on January 6, 2012.[18] On January 17, 2012, Exelon and NRC Staff each filed motions to strike portions of NRDC's combined reply.[19] NRDC filed a brief in opposition of these motions on January 27, 2012.[20]

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[12] Petition at 19.

[13] Id. at 21.

[14] Id. at 23.

[15] Exelon Answer Opposing NRDC's Petition to Intervene (Dec. 20, 2011) [hereinafter Exelon Answer].

[16] NRC Staff's Answer to Natural Resources Defense Council's Petition to Intervene and Notice of Intention to Participate (Dec. 21, 2011) [hereinafter NRC Answer].

[17] Exelon Answer at 1; NRC Answer at 1.

[18] Natural Resources Defense Council ("NRDC") Combined Reply to Exelon and NRC Staff Answers to Petition to Intervene (Jan. 6, 2012) [hereinafter NRDC Reply].

[19] Exelon's Motion to Strike Portions of NRDC's Reply (Jan. 17, 2012) [hereinafter Exelon Motion to Strike]; NRC Staff's Motion to Strike Impermissible New Claims in Natural Resources Defense Council's Reply Brief (Jan. 17, 2012) [hereinafter NRC Motion to Strike].

[20] [NRDC] Combined Opposition to Motions to Strike (Jan. 27, 2012).

This Board heard oral argument on the petition to intervene and the motions to strike in Norristown, Pennsylvania, on February 21, 2012.[21]

II. Standing

A. Standards Governing Standing

As noted above, neither Exelon nor NRC Staff has challenged NRDC's assertion that it has standing to intervene in this proceeding.[22] However, NRC regulations state that "the Atomic Safety and Licensing Board designated to rule on the request for hearing and/or petition for leave to intervene, will grant the request/petition if it determines that the requestor/petitioner has standing . . . and has proposed at least one admissible contention."[23] As such, we proceed with an independent analysis of standing despite the lack of disagreement on the subject.

It is well established that the NRC applies "contemporaneous judicial concepts of standing."[24] In other words, "a petitioner must demonstrate that (1) it has suffered a distinct and palpable harm that constitutes injury-in-fact within the zone of interests arguably protected by the governing statute; (2) that the injury can fairly be traced to the challenged action; and (3) that the injury is likely to be redressed by a favorable decision."[25] The Commission has found that geographic proximity to a facility (i.e., living or working within 50 miles) is presumptively sufficient to meet these traditional standing requirements in certain types of proceedings,

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[21] See Tr. at 1-269.

[22] Exelon Answer at 1; NRC Answer at 1.

[23] 10 C.F.R. § 2.309(a).

[24] See, e.g., Calvert Cliffs 3 Nuclear Project, LLC, and Unistar Nuclear Operating Servs., LLC (Combined License Application for Calvert Cliffs, Unit 3), CLI-09-20, 70 NRC 911, 915 (2009) (quotation omitted).

[25] Yankee Atomic Elec. Co. (Yankee Nuclear Power Station), CLI-96-1, 43 NRC 1, 6 (1996).

including operating license renewal proceedings.[26] This is because a license renewal allows operation of a reactor over an additional period of time during which the reactor could be subject to the same equipment failures and personnel errors as during operations over the original period of the license.[27]

When the petitioner is an organization rather than an individual (as is the case here), it must demonstrate organizational or representational standing.

> An organization may base its standing on either immediate or threatened injury to its organizational interests, or to the interests of identified members. To derive standing from a member, the organization must demonstrate that the individual member has standing to participate, and has authorized the organization to represent his or her interests.[28]

B. Ruling on Standing

In its Petition, NRDC claims that it has the right to intervene "on behalf of [its] members;"[29] in other words, NRDC asserts representational standing. NRDC states it represents the interests of three of its members in this proceeding – Suzanne Day, Charles W. Elliott, and William P. White.[30] For NRDC to be granted representational standing, one or more

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[26] See Calvert Cliffs 3, CLI-09-20, 70 NRC at 915 n.15 (citing with approval Fla. Power & Light Co. (Turkey Point Nuclear Generating Plant, Units 3 and 4), LBP-01-06, 53 NRC 138, 150 (2001), aff'd on other grounds, CLI-01-17, 54 NRC 3 (2001) (applying proximity presumption in reactor operating license renewal proceeding)).

[27] Duke Energy Corp. (Oconee Nuclear Station, Units 1, 2, and 3), LBP-98-33, 48 NRC 381, 385 n.1 (1998).

[28] Ga. Inst. of Tech. (Ga. Tech Research Reactor, Atlanta, Ga.), CLI-95-12, 42 NRC 111, 115 (1995) (citations omitted).

[29] Petition at 5.

[30] Petition at 6; see also Declaration of Suzanne Day (Nov. 18, 2011) [hereinafter Day Declaration]; Declaration of Charles W. Elliott (Nov. 17, 2011) [hereinafter Elliott Declaration]; Declaration of William P. White (Nov. 16, 2011) [hereinafter White Declaration].

of its members must individually have standing, and must have authorized NRDC to represent them.[31]

Ms. Day, Mr. Elliott, and Mr. White have each submitted declarations indicating that they are members of NRDC, and that they live within 50 miles of Limerick.[32] As such, each would be able to claim individual standing to intervene in this proceeding based on the proximity presumption. In addition, each authorized NRDC to act on their behalf in this proceeding.[33] We, therefore, find that NRDC has met the elements required for representational standing.

III. Contention Admissibility

A. Standards Governing Contention Admissibility

To intervene in a proceeding, a petitioner must not only demonstrate that it has standing, but it must also put forward at least one admissible contention. 10 C.F.R. § 2.309(f)(1) requires that each proffered contention must meet all of the following requirements: (i) provide a specific statement of the issue of law or fact to be raised; (ii) provide a brief explanation of the basis for the contention; (iii) demonstrate that the issue raised is within the scope of the proceeding; (iv) demonstrate that the issue raised is material to the findings the NRC must make to support the action that is involved in the proceeding; (v) provide a concise statement of the alleged facts or expert opinions that support the petitioner's position and upon which the petitioner intends to rely at hearing; and (vi) show that a genuine dispute exists on a material issue of law or fact.[34]

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[31] Ga. Tech Research Reactor, CLI-95-12, 42 NRC at 115.

[32] Day Declaration at 1, 2 (stating she lives 35 miles from Limerick); Elliott Declaration at 1 (stating he lives 30 miles from Limerick); White Declaration at 1 (stating he lives 38 miles from Limerick).

[33] Day Declaration at 4; Elliott Declaration at 5; White Declaration at 4.

[34] 10 C.F.R. § 2.309(f)(1)(i)-(vi).

Although "[m]ere 'notice pleading' is insufficient" in NRC proceedings,[35] a petitioner need not prove its contentions at the admissibility stage,[36] and we do not adjudicate disputed facts at this juncture.[37] The Commission has recently reiterated that "contentions shall not be admitted if at the outset they are not described with reasonable specificity or are not supported by some alleged fact or facts demonstrating a genuine material dispute" with the applicant.[38] The factual support required to render a proposed contention admissible is "a minimal showing that material facts are in dispute."[39]

B. Relevant Regulatory Standards

The National Environmental Policy Act (NEPA) requires all Federal agencies, including the NRC, to prepare an Environmental Impact Statement (EIS) for every major federal action that may significantly affect the quality of the human environment.[40] The issuance of a renewed operating license for a nuclear power reactor is a major federal action under NEPA.[41] NEPA

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[35] Fansteel, Inc. (Muskogee, Okla., Site), CLI-03-13, 58 NRC 195, 203 (2003).

[36] Private Fuel Storage L.L.C. (Independent Spent Fuel Storage Installation), CLI-04-22, 60 NRC 125, 139 (2004).

[37] Miss. Power & Light Co. (Grand Gulf Nuclear Station, Units 1 & 2), ALAB-130, 6 AEC 423, 426 (1973).

[38] FirstEnergy Nuclear Operating Co. (Davis-Besse Nuclear Power Station, Unit 1), CLI-12-08, 75 NRC __, __ (slip op. at 4) (Mar. 27, 2012) (citing Duke Energy Corp. (Oconee Nuclear Station, Units 1, 2, and 3), CLI-99-11, 49 NRC 328, 335 (1995))

[39] Gulf States Utils. Co. (River Bend Station, Unit 1), CLI-94-10, 40 NRC 43, 51 (1994) (quotations omitted).

[40] See 42 U.S.C. § 4332(2)(C).

[41] See New York v. NRC, 589 F.3d 551, 553 (2d Cir. 2009).

requires the NRC to take a "hard look" at alternatives, including SAMAs, and to provide a rational basis for rejecting alternatives that are cost-effective.[42]

NRC regulations at 10 C.F.R. § 51.53 require a license renewal application to include an Environmental Report (ER) to assist the NRC Staff in preparing its EIS.[43] The ER must address both the impacts of the proposed renewal and alternatives to those impacts.[44] Applicants are further subject to the requirements of 10 C.F.R. § 51.53(c)(3), which lists the issues that an applicant must address in the ER, as well as those that it need not address.

In 1996, the NRC issued NUREG-1437, Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS).[45] The NRC also amended its environmental regulations at 10 C.F.R. Part 51 to reflect certain findings in the GEIS.[46] Part 51 divides the environmental requirements for license renewal into Category 1 and Category 2 issues.[47] Category 1 issues are those resolved generically by the GEIS and need not be addressed as part of license renewal. Category 2 issues require plant-specific review.[48] For each license renewal application, Part 51 requires that the NRC Staff prepare a plant-specific supplement to

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[42] Robertson v. Methow Valley Citizens Council, 490 U.S. 332, 350 (1989) accord Limerick Ecology Action v. NRC, 869 F.2d 719, 737 (3d Cir. 1989).

[43] See 10 C.F.R. § 51.53(c)(1).

[44] See id. § 51.53(c)(2).

[45] Generic Environmental Impact Statement for License Renewal of Nuclear Plants, NUREG-1437, Vol. 1, (May 1996) (ADAMS Accession No. ML040690705) [hereinafter GEIS].

[46] See Environmental Review for Renewal of Nuclear Power Plant Operating Licenses, 61 Fed. Reg. 28,467 (June 5, 1996).

[47] See 10 C.F.R. Part 51, Subpt. A, App. B, Tbl. B-1.

[48] See 61 Fed. Reg. at 28,467; see also 10 C.F.R. Part 51, Subpt. A, App. B, Tbl. B-1 n.2.

the GEIS that adopts applicable generic impact findings from the GEIS and analyzes site-specific impacts.[49]

A license renewal applicant's ER is further required to consider any "new and significant" information that might alter previous environmental conclusions.[50] NEPA requires the agency to reevaluate any prior analysis if it is presented any new and significant information which would cast doubt on a previous environmental analysis.[51] With this background in mind, we consider the admissibility of each of NRDC's four contentions.

C. Contention 1-E

NRDC's proposed Contention 1-E reads as follows:

> Applicant's Environmental Report (§ 5.3) erroneously concludes that new information related to its severe accident mitigation design alternatives ("SAMDA") analysis is not significant, in violation of 10 C.F.R. § 51.53(c)(3)(iv), and thus the ER fails to present a legally sufficient analysis of severe accident mitigation alternatives.[52]

NRDC presents two distinct but related claims in this contention. First, NRDC asserts that Exelon has considered certain new information for its significance, but that it has done so inadequately. Second, NRDC contends that Exelon has omitted other new information that NRDC believes is significant.[53] NRDC's argument is predicated on 10 C.F.R. § 51.53(c)(3)(iv), which requires Exelon to consider any "new and significant" information that might alter a previously conducted SAMA analysis.[54] While Exelon and the NRC Staff seem to concede that

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[49] See 10 C.F.R. §§ 51.95(c), 51.71(d).

[50] Id. § 51.53(c)(3)(iv).

[51] Marsh v. Or. Natural Res. Council, 490 U.S. 360, 374 (1989).

[52] Petition at 16.

[53] See id. at 16-17.

[54] Id. at 3; 10 C.F.R. § 51.53(c)(3)(iv).

Exelon is required to consider new information for its significance,[55] both argue that NRDC may not challenge that consideration.[56] We consider, and ultimately reject, this argument below.

1. Litigability of New and Significant Information

Exelon makes the blanket assertion that its consideration of new and significant information is "not challengeable in [this] license renewal proceeding."[57] The NRC Staff agrees with this position, with the caveat that NRDC could challenge Exelon's analysis if NRDC sought a waiver from the Commission.[58] We first analyze this argument challenging the "litigability" of new and significant information before turning to the contention admissibility requirements of 10 C.F.R. § 2.309(f)(1).

Exelon and the NRC Staff contend that SAMAs are a "Category 1 issue," or should be treated as such, for Limerick, and as such they may not be challenged absent a waiver from the Commission.[59] Exelon and the NRC Staff base their position on the Commission's holding that "[a]djudicating Category 1 issues site by site based merely on a claim of 'new and significant information,' would defeat the purpose of resolving generic issues in a GEIS."[60] In other words, a petitioner may not challenge in an adjudicatory proceeding an applicant's alleged failure to consider new and significant information relevant to a Category 1 issue, without seeking a

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[55] See Exelon Answer at 26; NRC Staff Answer at 16.

[56] See Exelon Answer at 26-27; NRC Staff Answer at 16-17.

[57] Tr. at 43-44.

[58] Id. at 52.

[59] See Exelon Answer at 27; NRC Staff Answer at 16-17.

[60] Entergy Nuclear Vt. LLC and Entergy Nuclear Operations, Inc. (Vt. Yankee Nuclear Power Station) et al., CLI-07-03, 65 NRC 13, 21 (2007).

waiver. The question before the Board is whether, as Exelon and the NRC Staff claim, SAMAs are a Category 1 issue for Limerick.

As an initial matter, the regulations clearly specify that the SAMA analysis is a Category 2 issue. Table B-1 of 10 C.F.R. Part 51 "summarizes the Commission's findings on the scope and magnitude of environmental impacts of renewing the operating license for a nuclear power plant."[61] Acknowledging that the risks posed by severe accidents are small for all plants, Table B-1 declares that "severe accidents" are a Category 2 issue, and provides that SAMAs "must be considered for all plants that have not considered such alternatives."[62] Exelon and NRC Staff would have it that these last six words ("that have not considered such alternatives"), which repeat the admonition in 10 C.F.R. § 51.53(c)(3)(ii)(L), transform SAMAs into a Category 1 issue for Limerick.[63]

In support of this argument, Exelon cites to rulings by two Licensing Boards in the Vermont Yankee and Pilgrim license renewal proceedings (and the affirmance of those decisions by the Commission).[64] In both of these proceedings, the Attorney General of Massachusetts challenged the applicant's failure to consider new and significant information

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[61] 10 C.F.R. Part 51, Subpt. A, App. B.

[62] Id. Part 51, Subpt. A, App. B, Tbl. B-1 (Postulated Accidents).

[63] Exelon Answer at 28, NRC Answer at 16.

[64] Entergy Nuclear Generation Co. (Pilgrim Nuclear Power Station), LBP-06-23, 64 NRC 257 (2006); Entergy Nuclear Vt. Yankee, LLC (Vt. Yankee Nuclear Power Station), LBP-06-20, 64 NRC 131 (2006); Vt. Yankee, CLI-07-03, 65 NRC 13. We note also that Exelon relies on a decision of the United States Court of Appeals for the First Circuit upholding the Commission's decision in these proceedings. See Massachusetts v. United States, 522 F.3d 115 (1st Cir. 2008). While we ultimately find this line of decisions inapplicable to the proceedings now before the Board for reasons explained below, it is also worth noting that Limerick is located within the Third Circuit, and as such, decisions of the First Circuit Court of Appeals have no binding authority in this proceeding.

about a possible severe spent fuel pool fire.[65] Exelon also relies on the Commission's decision in the Turkey Point license renewal proceeding.[66] There, the Commission ruled on an appeal of a Licensing Board order denying a petition to intervene that presented contentions concerning release of radiological, chemical, and herbicidal materials and storage of spent fuel.[67]

It is readily apparent that the Pilgrim, Vermont Yankee, and Turkey Point decisions are inapplicable to the instant proceeding. All three of these cases involved petitioners submitting contentions regarding issues – spent fuel storage and the release of radiological, chemical and herbicidal materials – that Part 51 explicitly declares Category 1.[68] In contrast, the contention in this proceeding, challenging an analysis of new and significant information regarding SAMAs, raises a Category 2 issue. For this Board to be bound by these decisions, Exelon or the NRC Staff would need to establish that SAMAs are, indeed, Category 1 issues for Limerick. In an attempt to do just that, Exelon analogizes SAMAs for Limerick to the treatment afforded groundwater quality in license renewal proceeding environmental analyses:

> [C]onsider Section 51.53(c)(3)(ii)(D), which provides that a license renewal ER must include, "[i]f the applicant's plant is located at an inland site and utilizes cooling ponds, an assessment of the impact of the proposed action on groundwater quality." Because the South Texas and Turkey Point plants have cooling ponds in salt marshes, they are not subject to the requirements of Section 51.53(c)(3)(ii)(D). The GEIS is explicit that for these plants, "this is a Category 1 issue."[69]

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[65] Pilgrim, LBP-06-23, 64 NRC at 280; Vt. Yankee, LBP-06-20, 64 NRC at 152.

[66] Fla. Power & Light Co. (Turkey Point Nuclear Generating Plant, Units 3 and 4), CLI-01-17, 54 NRC 3 (2001).

[67] Id. at 5-6.

[68] See 10 C.F.R. Part 51, Subpt. A, App. B, Tbl. B-1.

[69] Exelon Answer at 28 (citations omitted).

And indeed, Table B-1 bears this out – groundwater quality degradation for cooling ponds in salt marshes is a Category 1 issue.[70] But Exelon's argument merely serves to highlight the failure of its reasoning. The Commission was explicit in both the GEIS and Table B-1 that groundwater quality degradation for plants with cooling ponds in salt marshes was to be considered a Category 1 issue. In this case, however, Exelon requests that we find that the Commission implicitly intended SAMAs to be a Category 1 issue for those sites that had already performed an analysis.[71] We reject the proposition that 10 C.F.R. § 51.53(c)(3)(ii)(L) converts this Category 2 (site-specific) issue into a Category 1 issue. If the Commission intended SAMAs to be a Category 1 issue for Limerick and other plants that had previously considered SAMAs or SAMDAs, it would have said so explicitly, as it did when it found groundwater degradation to be a Category 1 issue for the South Texas and Turkey Point facilities. In addition, in Turkey Point, the Commission recognized that site-specific environmental issues are Category 2 issues, and made no suggestion that this was not the case for any specific plants.[72]

It is, of course, within the Commission's authority to declare an issue to be Category 1 for all plants or a sub-set of plants. However, this Board is unaware of any provision in our governing regulations that would transform an issue listed as a Category 2 issue into a Category 1 issue absent an explicit statement from the Commission.

Exelon has expressed concern that allowing a petitioner to challenge the analysis of new and significant information relevant to the 1989 SAMDA would "eviscerate" 10 C.F.R.

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[70] 10 C.F.R. Part 51, Subpt. A, App. B, Tbl. B-1 (Ground-water Use and Quality); see GEIS at 4-122.

[71] See Exelon Answer at 33.

[72] Turkey Point, CLI-01-17, 54 NRC at 11.

§ 51.53(c)(3)(ii)(L).[73] However, Exelon and NRC Staff concede that Exelon is required by regulation to consider new information relevant to the 1989 SAMDA for its significance.[74] This analysis of new and significant information is intended to help the NRC Staff in its preparation of an EIS.[75] Yet, at this stage of a proceeding, a petitioner must challenge the ER, which "acts as a surrogate for the EIS during the early stages of a relicensing proceeding."[76] Challenging the ER preserves the petitioner's right to challenge the EIS at a later stage of the proceedings.[77]

The Board's ruling recognizes the premise that when a petitioner identifies an omission in or a portion of an applicant's application with which it disagrees and meets the requirements of 10 C.F.R. § 2.309(f)(1), that petitioner shall be allowed to litigate its disagreement. Accordingly, we reject that claim of Exelon and the NRC Staff that SAMAs are a Category 1 issue and hence that NRDC's challenge to Exelon's consideration of new and significant information is not litigable. There is nothing in the NRC regulations or case precedent that leads us to any other conclusion. Indeed, beyond the Commission regulations is the obligation imposed by NEPA. Regulations cannot trump statutory mandates.[78] "NEPA requires that [the Commission] conduct [its] environmental review with the best information available today."[79]

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[73] Exelon Answer at 26; Tr. at 48, 106.

[74] See Tr. at 46, 50-51; ER at 5-4; NRC Staff Answer at 16.

[75] See ER at 5-2; Tr. at 51.

[76] Northern States Power Co. (Prairie Island Nuclear Generating Plant, Units 1 and 2), LBP-08-26, 68 NRC 905, 931 (2008).

[77] See Progress Energy Fla., Inc. (Levy County Nuclear Power Plant, Units 1 and 2), LBP-09-10, 70 NRC 51, 88 (2009), aff'd in part and rev'd in part on other grounds, CLI-10-02, 71 NRC 27 (2010).

[78] See Ramadan v. Chase Manhattan Corp., 229 F.3d 194, 201 (3d Cir. 2000).

[79] Luminant Energy Co. LLC (Comanche Peak Nuclear Power Plant, Units 3 and 4) et al., CLI-12-07, 75 NRC __, __ (slip op. at 14) (Mar. 16, 2012).

Therefore, relying upon Part 51, Subpart A, Appendix B, we find that SAMAs are a Category 2 issue and are not transformed into a Category 1 issue for sites such as Limerick for which a SAMA analysis has been previously performed. Exelon has argued, though, that even if we conclude SAMAs are not a Category 1 issue for Limerick, we should still find that its analysis of new and significant information relevant to SAMAs is not litigable in this proceeding.[80] Exelon argues that 10 C.F.R. § 51.53(c)(2)(iii)(L) exempts Limerick from performing a SAMA, and that this regulatory exception requires that SAMAs be treated as a Category 1 issue, even if they are categorized as a Category 2 issue.[81] We find no regulatory basis for such a wide-ranging argument. SAMAs are listed as Category 2 issues,[82] and we must treat them as such.

2. Admissibility Under 10 C.F.R. § 2.309(f)(1)

Our ruling that SAMAs are not a Category 1 issue for Limerick does not settle the admissibility of Contention 1-E. In order to be admitted, contentions must meet the requirements of 10 C.F.R. § 2.309(f)(1)(i)-(vi). NRDC has alleged facts and provided declarations to support the admissibility of Contention 1-E. We find that most of Contention 1-E fails to satisfy one or more of the requirements of Section 2.309(f)(1), for the reasons stated below.

a. New Population Data

NRDC argues that Exelon's ER "misinterprets and/or misuses new information regarding increased population in the area within 10 miles of the plant and thus fails to account for the significant increase in total person-rems of exposure that could occur in the event of a severe

[80] See Exelon Answer at 33; Tr. at 48.

[81] See Tr. at 48.

[82] 10 C.F.R. Part 51, Subpt. A, App. B, Tbl. B-1 (Postulated Accidents).

accident."[83] NRDC continues, "This population was substantially underestimated in the 1989 SAMDA analysis upon which the Applicant continues to rely."[84] Moreover, NRDC makes essentially the same claims regarding Exelon's treatment of population within 50 miles of the plant.[85]

Exelon contends first that the 1989 SAMDA is "simply not at issue in this proceeding," and therefore Contention 1-E is inadmissible as outside the scope of the proceeding insofar as it challenges that analysis.[86] We agree. While Exelon has pointed to the existence of the 1989 SAMDA to show that it meets a regulation exempting it from filing a new SAMA in its license renewal ER, the 1989 SAMDA is not part of the ER, nor is it incorporated by reference.[87] Therefore, any challenge to the 1989 SAMDA necessarily does not frame an appropriate challenge to Exelon's license renewal application because any challenge to the particulars of the 1989 SAMDA is outside the scope of this proceeding, thereby contravening 10 C.F.R. § 2.309(f)(1)(iii).[88]

NRDC also challenges Exelon's consideration of new post-1989 information regarding population data. NRDC argues that Exelon should have considered population estimates up to the year 2049 – when the license for Unit 2 would expire if Exelon succeeds in renewing its operating licenses – rather than 2030, as Exelon did in its ER.[89] While NRDC demonstrates

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[83] Petition at 16.

[84] Id.

[85] See id. at 17.

[86] Exelon Answer at 36.

[87] Id.

[88] 10 C.F.R. § 2.309(f)(1)(iii).

[89] Joint Declaration at par. 27.

that other plants have included population estimates in SAMAs up to the license expiration date,[90] Exelon notes that NRDC has not provided "any legal or technical support for its suggestion that population projections to the end of the license term are required."[91]

In this, Exelon is correct, as we find no legal requirement that an applicant consider such data. However, a petitioner could succeed in raising such a contention if it demonstrated that considering such data would be material to the proceeding.[92] NRDC has not demonstrated how consideration of population data through 2049 would change Exelon's analysis of new and significant information. As such, this aspect of Contention 1-E lacks the support required by 10 C.F.R. § 2.309(f)(1)(v)[93] and seeks to raise questions that have not been shown to be material to the findings the NRC must make.[94] It is therefore inadmissible.

b. Other Mitigation Alternatives

Next, NRDC argues that Exelon "ignores new and significant information regarding potential mitigation alternatives that have been considered for other BWR Mark II containment reactors that were not considered in the original SAMDA analysis and ignores new and significant information regarding additional plausible severe accident scenarios."[95]

Exelon responds that it need not consider "new" severe accident mitigation alternatives because 10 C.F.R. § 51.53(c)(3)(ii)(L) grants it an exemption from submitting a SAMA analysis

[90] Id.

[91] Exelon Answer at 37.

[92] See 10 C.F.R. § 2.309(f)(1)(iv).

[93] Id. § 2.309(f)(1)(v).

[94] Id. § 2.309(f)(1)(iv).

[95] Petition at 17.

in its ER.[96] Essentially, Exelon argues that considering new mitigation alternatives in the context of a new and significant information analysis is fundamentally the same as performing an entirely new SAMA analysis, which it argues it is not required by law to perform.[97]

We do not agree. Determining whether information regarding SAMAs is "new" and "significant" does not involve the same analysis as performing an entirely new SAMA analysis, as Exelon suggests. Using a screening technique similar to the one performed in the 1989 Supplement to the Final Environmental Statement,[98] Exelon can determine the "significance" of new mitigation alternatives without performing a "new SAMA analysis." The NRC Staff performed such a screening in the preparation of the 1989 Supplement to the Final Environmental Statement,[99] and Exelon did so with regard to other new information in Section 5.3 of the ER (Significance of New Information).[100] To the extent that this aspect of Contention 1-E is a direct challenge to the 1989 SAMDA,[101] it is inadmissible. But, insofar as this contention challenges the ER's lack of consideration of new and significant information regarding potentially new, previously unanalyzed SAMAs, it is admissible.

NRDC states that the Limerick ER "fails to consider more than a very narrow group of mitigation measures identified in the 1989 SAMDA analysis."[102] NRDC continues that the ER

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[96] We consider Exelon's arguments regarding sub-section (L) in-depth in our analysis of Contention 3-E below. See infra at 30-33.

[97] See Tr. at 106.

[98] See 1989 SAMDA Analysis at v.

[99] Id.

[100] See ER at 5-7 to 5-9.

[101] See, e.g., Joint Declaration at par. 7, 8.

[102] Petition at 17.

"ignores new and significant information regarding potential mitigation alternatives that have been considered for other BWR Mark II containment reactors that were not considered in the original SAMDA analysis."[103]

NRDC has provided a specific statement, as well as an adequate basis, for the proffered contention.[104] Given that NRDC is challenging an omission in Exelon's ER of material that NRDC alleges is required to be there under 10 C.F.R. § 51.53(c)(3)(iv), this issue is within the scope of the proceeding.[105] Further, NRDC's Joint Declaration adequately demonstrates that this issue is material to the NRC's licensing decision, supported by alleged facts and expert opinion, and has raised a genuine dispute with Exelon.[106] NRDC's Declarant, Dr. Matthew G. McKinzie,[107] points out that the 1989 SAMDA considered a cost-benefit analysis for only seven mitigation alternatives.[108] In comparison, "the cohort of 27 U.S. BWR units at 18 sites that are undergoing license renewal reviews, or that have recently been granted license renewal, have on average considered 175 Phase I SAMA candidates and 35 Phase II SAMA candidates."[109] Given this information, we find that NRDC has provided adequate support under 10 C.F.R. § 2.309(f)(1)(v) for its claim that there exists new information that Exelon has not considered.

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[103] Id.

[104] 10 C.F.R § 2.309(f)(1)(i)-(ii).

[105] Id. § 2.309(f)(1)(iii).

[106] Id. § 2.309(f)(1)(iv)-(vi).

[107] Exelon and the NRC Staff have not challenged the bona fides of Dr. McKinzie, who received a Ph.D. in Physics from the University of Pennsylvania and a B.A. in Physics from Bard College. Joint Declaration, Attachment B, Curriculum Vitae for Matthew G. McKinzie.

[108] Joint Declaration at par. 7.

[109] Id. at par. 9.

NRDC has shown there are numerous new SAMA candidates which should be evaluated for their significance.

In advancing this contention, NRDC has alleged facts and provided expert testimony that other plants seeking license renewal have considered these "new" SAMA candidates and have found certain candidates to be cost-beneficial.[110] NRDC has demonstrated that among recent BWR applications for license renewal, applicants have found between two and eleven SAMA candidates to be cost-beneficial or potentially cost-beneficial.[111] NRDC has meticulously listed which SAMA candidates these plants found to be cost-beneficial.[112] This suggests to us that this contention is material, as consideration of new information regarding SAMA candidates could very well lead to a conclusion that this information is significant.[113] Further, we find that NRDC's analysis of recently-performed SAMAs at other plants provides support for its argument that the information that Exelon has failed to consider is not only new, but also significant.[114]

NRDC argues also that Exelon must consider "additional plausible severe accident scenarios."[115] Looking to NRDC's Joint Declaration, however, it is clear that NRDC is alleging that Exelon must consider information related to the March, 11, 2011 events at Fukushima, Japan.[116] The Commission has stated, "we do not know today the full implications of the Japan events for U.S. facilities. Therefore, any generic NEPA duty – if one were appropriate at all –

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[110] See id. at par. 13.

[111] Id.

[112] Id.

[113] 10 C.F.R. § 2.309(f)(1)(iv).

[114] Id. § 2.309(f)(1)(v).

[115] Petition at 17.

[116] See Joint Declaration at par. 16-17.

does not accrue now."[117] The Commission has also affirmed a Licensing Board's rejection of a contention in a license renewal proceeding based on an applicant's failure to consider alleged "new and significant information" arising from NRC's Fukushima Task Force Report.[118] Therefore, in the context of this proceeding, the events at Fukushima, and the ensuing NRC response, are not, at this point, to be considered "new and significant information" under NEPA.[119] Accordingly, we conclude that this aspect of Contention 1-E is inadmissible as beyond the scope of this proceeding.[120]

c. Core Damage Frequency

NRDC alleges that Exelon's analysis of new and significant information is based on a flawed core damage frequency (CDF).[121] NRDC argues that using "historical data" to calculate CDF leads to a higher value than the "theoretical value calculated by the applicant."[122] Essentially, NRDC calculates core damage frequency by looking at actual core damage events that have occurred at Three Mile Island Unit 2, Greifswald Unit 5, and Fukushima Units 1, 2, and 3.[123] However, NRDC goes on to note that "we do not argue that any of [these] CDF estimates

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[117] Union Elec. Co. d/b/a Ameren Mo. (Callaway Plant, Unit 2) et al., CLI-11-05, 74 NRC __, __ (slip op. at 30) (Sept. 9, 2011).

[118] Comanche Peak et al., CLI-12-07, 75 NRC at __ (slip op. at 15).

[119] Id.

[120] 10 C.F.R. § 2.309(f)(1)(iii).

[121] Petition at 18.

[122] Joint Declaration at par. 19-20.

[123] Id. at par. 19.

based on the historical evidence represent the most accurate CDFs for Limerick Units 1 and 2."[124]

This aspect of Contention 1-E is inadmissible. NRDC has not provided any alleged facts or expert opinion to support its position that the use of historical data is more appropriate than the plant-specific CDF calculated for Limerick.[125] Therefore, this aspect of Contention 1-E does not meet 10 C.F.R. § 2.309(f)(1)(v).

d. Economic Consequences

NRDC argues that in its analysis of new and significant SAMA-related information the ER "fails to evaluate the impact of a properly conducted economic analysis on the assessment of the environmental consequences of a severe accident at Limerick" by relying on data from an analysis conducted at Three Mile Island (TMI), "a site that involves a markedly different and less economically developed area than the area within 50 miles of Limerick."[126] NRDC also argues that Exelon's economic analysis is inadequate because it "ignores new and significant information regarding the likely cost of cleanup from a severe accident in a metropolitan area like Philadelphia."[127]

Exelon responds that what NRDC has put forth is a contention of omission that is inadmissible because in its ER, Exelon "did evaluate whether off-site economic cost risks qualified as new and significant information," by looking at data from TMI.[128] While NRDC

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[124] Id. at par. 21.

[125] Indeed, NRDC has admitted that a CDF calculated with this historical data is likely inaccurate. Joint Declaration at par. 21.

[126] Petition at 18.

[127] Id.

[128] Exelon Answer at 48; see ER at 5-8.

argues in part that Exelon's ER "does not remedy the lack of economic risk assessment in the 1989 SAMDA,"[129] this aspect of Contention 1-E challenges the adequacy of Exelon's consideration of new and significant information. NRDC states, "[Exelon] commits errors in the 2011 [ER] in an effort to claim that economic risk is not significant new information."[130] NRDC alleges further that Exelon's use of data from TMI is inappropriate because "the ratio of economic cost risk to exposure cost risk exhibits a wide variation," and because "TMI is a Pressurized Water Reactor (PWR) rather than a BWR, with correspondingly different accident scenario source terms, and Harrisburg near TMI is [a] smaller and less urban economic center than Philadelphia near Limerick."[131] NRDC has also provided a table showing the ratio of economic cost risk to exposure cost for nine recently renewed BWRs.[132]

These arguments and the alleged facts discussed above support NRDC's claim that Exelon's reliance on data from TMI was inappropriate in an analysis of economic cost risk for Limerick. NRC regulations require a petitioner to provide "a concise statement of the alleged facts or expert opinions which support" its position.[133] NRDC has done this, as its Joint Declaration provides a set of alleged facts regarding the ratio of economic cost risk to exposure cost risk at other BWR facilities. Dr. McKinzie submitted a declaration in which he challenges the appropriateness of using TMI data to analyze economic consequences for Limerick.[134] NRC regulations also require a petitioner to make reference to "specific sources and documents" on

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[129] Joint Declaration at par. 32.

[130] Id.

[131] Id. at par. 33.

[132] Id. at par. 34.

[133] 10 C.F.R. § 2.309(f)(1)(v).

[134] Joint Declaration at par. 32-34.

which it intends to rely.[135] NRDC has done this, as well, as it has drawn its analysis from and cited to SAMAs performed for other BWRs seeking license renewal.[136] NRDC has met its burden and provided the alleged facts and expert opinion required by 10 C.F.R. § 2.309(f)(1)(v).

We find also that the other requirements of Section 2.309(f)(1) are satisfied. NRDC raises a specific challenge to Exelon's use of TMI data. It provides a brief description of its basis by explaining the reasons why use of that data was inappropriate.[137] This constitutes a genuine dispute on a material issue because Exelon claims that its use of TMI data is appropriate[138] and NRDC has provided arguments to the contrary.[139] Lastly, we find that this aspect of Contention 1-E is within the scope of this proceeding because it challenges the adequacy of the ER. Thus, it satisfies Section 2.309(f)(1)(iii).

To the extent that Contention 1-E challenges Exelon's reliance on data from TMI to evaluate the significance of economic cost risks, it is admissible. In other words, we admit the following issue for hearing: whether Exelon's use of data from TMI in its analysis provides an adequate consideration of new and significant information regarding economic cost risk. However, to the extent the contention directly challenges the contents of the 1989 SAMDA, this portion of Contention 1-E is inadmissible.

Further, in the context of this contention we find that NRDC's assertion that Exelon must consider new information regarding cleanup costs does not meet the standards in 10 C.F.R. § 2.309(f)(1). NRDC simply notes that cleanup costs in Philadelphia "could be significantly

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[135] 10 C.F.R. § 2.309(f)(1)(v).

[136] Joint Declaration at par. 34.

[137] 10 C.F.R. § 2.309(f)(1)(i)-(ii); Joint Declaration at par. 33.

[138] Exelon Answer at 48.

[139] 10 C.F.R. § 2.309(f)(1)(iv), (vi); Joint Declaration at par. 33.

larger on a per capita basis than previously estimated."[140] This claim is not adequately supported, as required by 10 C.F.R. § 2.309(f)(1)(v), to warrant admission.[141] It contains no alleged facts or expert opinion that support the petitioner's position. As such, Contention 1-E is denied insofar as it challenges Exelon's consideration of new and significant information regarding cleanup costs.

e. Human Environment

NRDC asserts that "[t]he ER fails to include an analysis of the impacts to the quality of the human environment."[142] NRDC provides as examples of such impacts, "loss of family homestead, possessions, abandonment of livestock and domestic animals, pain and suffering, including that associated with loss of one's job or possessions, and uncertainties associated with the safety of the food supply."[143]

As Exelon points out, "[t]he Declarations attached to the Petition are silent on these issues."[144] As the Commission has directed in Duke Energy, "contentions shall not be admitted if at the outset they . . . are not supported by 'some alleged fact or facts' demonstrating a genuine material dispute."[145] Because NRDC and its Declarations do not include any legal or

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[140] Joint Declaration at par. 39.

[141] See 10 C.F.R. § 2.309(f)(1)(v).

[142] Petition at 19.

[143] Id.

[144] Exelon Answer at 50.

[145] Duke Energy Corp. (Oconee Nuclear Station, Units 1, 2, and 3), CLI-99-11, 49 NRC 328, 334 (1999); see also NextEra Energy Seabrook, LLC (Seabrook Station Unit 1), CLI-12-05, 75 NRC __, __ (slip op. at 7) (Mar. 8, 2012).

technical support for this statement, we find that this aspect of Contention 1-E is inadmissible for failure to satisfy 10 C.F.R. § 2.309(f)(1)(v).[146]

3. Conclusion Regarding Contention 1-E

For the foregoing reasons, we admit that portion of Contention 1-E that challenges Exelon's failure to consider as part of its new and significant information analysis new severe accident mitigation alternatives not previously analyzed in the 1989 SAMDA for the facility. We also admit that portion of Contention 1-E that challenges Exelon's use of data from TMI in evaluating the significance of information regarding economic cost impacts. Contention 1-E thus is admitted, but is limited as follows:

> Applicant's Environmental Report (§ 5.3) erroneously concludes that new information related to its severe accident mitigation design alternatives ("SAMDA") analysis is not significant, in violation of 10 C.F.R. § 51.53(c)(3)(iv), and thus the ER fails to present a legally sufficient analysis in that:
>
> > 1. Exelon has omitted from its ER a required analysis of new and significant information regarding potential new severe accident mitigation alternatives previously considered for other BWR Mark II Containment reactors.
> >
> > 2. Exelon's reliance on data from TMI in its analysis of the significance of new information regarding economic cost risk constitutes an inadequate analysis of new and significant information.

In all other respects, we find that Contention 1-E is inadmissible.

D. Contention 2-E

NRDC's proposed Contention 2-E reads as follows:

> Applicant's Environmental Report (§5.3) in relying on a SAMDA analysis from 1989 fails to comply with 10 C.F.R. §§ 51.45, 51.53(c)(2) and 51.53(c)(3)(iii) because it does not include an accurate or complete analysis of "alternatives available for reducing or avoiding adverse environmental effects," does not "contain sufficient data to aid the commission in its development of an independent analysis" of alternatives and does not contain an adequate

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[146] 10 C.F.R. § 2.309(f)(1)(v).

"consideration of alternatives for reducing adverse impacts . . . for all Category 2 license renewal issues.[147]

This contention alleges that the 1989 SAMDA analysis relies on inadequate and outdated data and methodologies, and as a result, the Limerick ER "fails to provide a reliable basis for the conclusion that there are no cost-beneficial SAMAs."[148] NRDC alleges that the Limerick ER does not comply with 10 C.F.R. §§ 51.45, 51.53(c)(2), and 51.53(c)(3)(iii).[149] These sections require an applicant to provide in its ER an analysis of "alternatives to the proposed action" that is "sufficiently complete to aid the Commission in developing and exploring" its own set of alternatives[150] and "an analysis that considers and balances the environmental effects of the proposed action, the environmental impacts of alternatives to the proposed action, and alternatives available for reducing or avoiding adverse environmental effects."[151] NRDC maintains that this contention is within the scope of this proceeding because Exelon has "incorporate[d] and adopt[ed the 1989 SAMDA] as [its] analysis of alternatives to mitigate impacts of severe accidents at Limerick."[152]

Exelon and NRC Staff argue that this contention is not admissible.[153] NRC Staff asserts that "the 1989 Limerick SAMDA Analysis, and any claimed deficiencies in that analysis, is outside the scope of this proceeding . . . [because] the Applicant's ER does not incorporate and

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[147] Petition at 19.

[148] Id. at 21.

[149] Id. at 19-21.

[150] 10 C.F.R. § 51.45(b)(3).

[151] Id. § 51.45(c).

[152] Petition at 19 n.6.

[153] See Exelon Answer at 50-56; NRC Staff Answer at 19-20.

adopt the 1989 Limerick SAMDA Analyses as its analysis of severe accident mitigation alternatives."[154] Exelon concurs that Contention 2-E is outside the scope of this proceeding,[155] and argues further that 10 C.F.R. § 51.53(c)(3)(ii)(L) trumps the regulations cited by NRDC in this contention.[156]

NRDC responds by arguing that Exelon has adopted and incorporated the 1989 SAMDA as part of its license renewal ER,[157] and that Section 51.53(c)(3)(ii)(L) does not trump the regulations cited by NRDC.[158] NRDC claims that Exelon effectively adopted the 1989 SAMDA in its consideration of new information for significance in Section 5.3 of its ER.[159]

It is not necessary to interpret Section 51.53(c)(3)(ii)(L) in order to determine the admissibility of this contention.[160] Indeed, we find that this contention can be disposed of by looking solely to the ER.

Section 4.20 of the ER, entitled "Severe Accident Mitigation Alternatives (SAMA)," states that "no analysis of SAMAs for [Limerick] is provided in this License Renewal Environmental Report as none is required as a matter of law."[161] Exelon relies upon the exemption provided by

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[154] NRC Staff Answer at 19.

[155] Exelon Answer at 52.

[156] Id. at 51.

[157] Petition at 19 n.6.

[158] See Tr. at 139.

[159] Petition at 19 n.6; see also ER at 5-4 to 5-9.

[160] Contention 3-E presents this issue more clearly, so we withhold judgment at this juncture on the proper interpretation of sub-section (L).

[161] ER at 4-49.

10 C.F.R. § 51.53(c)(3)(ii)(L).[162] Section 5.3 of the ER addresses new and significant information relating to severe accident mitigation.[163] Throughout Section 5.3 of the ER, Exelon makes reference to the 1989 SAMDA.[164] Because of these references, NRDC argues that Exelon has incorporated the 1989 SAMDA by reference.[165] This Board does not find this argument persuasive. As Exelon states in Section 5.1 of the ER, it has identified new information relating to severe accident mitigation because it is required to do so by 10 C.F.R. § 51.53(c)(3)(iv), and because doing so "alert[s] NRC staff to such information, so the staff can determine whether to seek the Commission's approval to waive or suspend application of the rule with respect to the affected generic analysis."[166] By complying with 10 C.F.R. § 51.53(c)(3)(iv), Exelon has not submitted or resubmitted the 1989 SAMDA to the NRC Staff nor has it sought a determination by the NRC Staff that it satisfies the sub-section (L) exemption. Exelon has stated that it has operated under the assumption that it need not provide a SAMA analysis with its ER – either a new SAMA or the 1989 SAMDA.

Unlike most portions of Contention 1-E, which challenges Exelon's analysis of new and significant information, this contention is a direct attack on the 1989 SAMDA. The 1989 SAMDA is not a part of the Limerick license renewal ER. Therefore, Contention 2-E is inadmissible because NRDC has not raised a dispute with Exelon's application, contravening 10 C.F.R. § 2.309(f)(1)(vi), and because it is outside the scope of this proceeding.[167]

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[162] Id.

[163] Id. at 5-4 to 5-9.

[164] Id.

[165] Petition at 19, n.6.

[166] ER at 5-2.

[167] 10 C.F.R. § 2.309(f)(1)(iii), (vi).

E. Contention 3-E

NRDC's proposed Contention 3-E reads as follows:

> Applicant's Environmental Report erroneously concludes that the SAMDA analysis conducted in 1989 is a SAMA analysis within the meaning of 10 C.F.R. § 51.53(c)(3)(ii)(L) and thus the ER is deficient for its failure to include a SAMA analysis.[168]

10 C.F.R. § 51.53(c) sets forth requirements for environmental reports as part of license renewal. Applicants must submit "a consideration of alternatives to mitigate severe accidents."[169] However, this regulation provides that such consideration need only be provided "[i]f the staff has not previously considered severe accident mitigation alternatives for the applicant's plant in an environmental impact statement or related supplement or in an environmental assessment."[170] In other words, a license renewal applicant need not provide an analysis of SAMAs in its ER if the staff has already considered a SAMA analysis for that applicant's plant. NRDC argues that, while NRC Staff considered a 1989 document that it called a "SAMDA," this document was not a SAMA within the meaning of 10 C.F.R. § 51.53(c)(3)(ii)(L), and thus this exception would not apply to Exelon.[171]

Exelon and the NRC Staff oppose admission of this contention. Exelon maintains that the Commission clearly had Limerick in mind during the 10 C.F.R. § 51.53(c)(3)(ii)(L) rulemaking,[172] and that NRDC's contention amounts to a direct challenge to this regulation.[173]

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[168] Petition at 21.

[169] 10 C.F.R. § 51.53(c)(3)(ii)(L).

[170] Id.

[171] See Petition at 21-22; see also Tr. at 19, 126.

[172] Exelon Answer at 18-19.

[173] Id. at 19-20.

The NRC Staff concurs in these arguments.[174]

A brief history of 10 C.F.R. § 51.53(c)(3)(ii)(L) would be useful at this juncture. In 1974, Philadelphia Electric Company (PECO) was granted a license to construct Limerick Units 1 and 2.[175] In 1981, PECO applied to the NRC for a license under 10 C.F.R. Part 50 to begin operating Unit 1. A group called Limerick Ecology Action, Inc. (LEA) intervened in that proceeding and put forward a number of contentions regarding, among other topics not relevant here, severe accident risks.[176] Ultimately, PECO received its operating license, and LEA appealed the licensing decision to the United States Court of Appeals for the Third Circuit.[177] Part of LEA's appeal was a challenge to NRC's failure to consider SAMDAs in the Limerick operating license proceeding. Among other findings, the court ruled that careful consideration of SAMDAs is required under NEPA, and that the NRC's failure to consider SAMDAs was a violation of that Act.[178] Thus, in August 1989, the NRC Staff issued a Supplement to the Final Environmental Statement for Limerick containing a SAMDA analysis.[179]

In 1996, the Commission issued a final rule amending its regulations regarding license renewal.[180] These amendments were intended to streamline the license renewal process by

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[174] NRC Staff Answer at 32, 34.

[175] PECO became a part of Exelon Corporation in 2000.

[176] Philadelphia Elec. Co. (Limerick Generating Station, Units 1 and 2), LBP-84-31, 20 NRC 446, 550-572 (1984).

[177] See Limerick Ecology Action 869 F.2d 719.

[178] Id. at 741.

[179] See 1989 SAMDA Analysis.

[180] See Environmental Review for Renewal of Nuclear Power Plant Operating Licenses, 61 Fed. Reg. 28,467 (June 5, 1996).

setting forth a number of generic findings that would apply to all plants.[181] Among these was a finding that the risk of severe accidents is small for all plants.[182] The amendments also included the requirement that applicants perform a SAMA analysis, unless the NRC Staff had already considered one for that plant.[183]

In the Statement of Consideration accompanying this rulemaking, the Commission provided further explanation of this requirement. It noted:

> [i]n response to the [Third Circuit's] decision, an NRC staff consideration of SAMDAs was specifically included in the Final Environmental Impact Statement for the Limerick 1 and 2 and Comanche Peak 1 and 2 operating license reviews, and in the Watts Bar Supplemental Final Environmental Statement for an operating license.[184]

The Commission continued:

> a site-specific consideration of severe accident mitigation alternatives is required at license renewal for those plants for which this consideration has not been performed . . . . NRC staff considerations of severe accident mitigation alternatives have already been completed and included in an EIS or supplemental EIS for Limerick, Comanche Peak, and Watts Bar. Therefore, severe accident mitigation alternatives need not be reconsidered for these plants for license renewal.[185]

Despite this language, NRDC argues that the 1989 SAMDA does not qualify for the exception referenced in the quotation above and codified in 10 C.F.R. § 51.53(c)(3)(ii)(L).[186] This Board finds, however, that the intent of the Commission in promulgating 10 C.F.R. § 51.53(c)(3)(ii)(L) is clear – to exempt applicants from being required to submit SAMA analyses

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[181] Id. at 28,467-68.

[182] See 10 C.F.R. Part 51, Subpt. A, App. B, Tbl. B-1 (Postulated Accidents).

[183] Id.

[184] 61 Fed. Reg. at 28,481.

[185] Id.

[186] Petition at 21-22.

in the license renewal proceedings for Limerick, Watts Bar, and Comanche Peak. Because sub-section (L) cannot reasonably be construed any other way, Contention 3-E is not admissible for two reasons.

First, insofar as it asserts that Exelon must provide a SAMA analysis as part of its ER, Contention 3-E amounts to a direct challenge to sub-section (L), and is thus outside the scope of this proceeding. 10 C.F.R. § 2.335(a) states that "no rule or regulation of the Commission . . . is subject to attack . . . in any adjudicatory proceeding subject to this part."[187] Second, while a disagreement over the proper interpretation of NRC regulations may give rise to an admissible contention, NRDC's proposed interpretation of 10 C.F.R. § 51.53(c)(3)(ii)(L) is in direct conflict with the plain meaning of the regulation and its Statement of Consideration. We therefore find that NRDC has failed to present a genuine dispute of fact or law with Exelon, as required by NRC regulations.[188]

For these reasons, we find that Contention 3-E is not admissible.

F. Contention 4-E

NRDC's proposed Contention 4-E reads as follows:

> Applicant's Environmental Report (§7.2) fails to adequately consider the no action alternative in violation of 10 C.F.R. §§ 51.45(c), 51.53(c)(2) and 51.53(c)(iii).[189]

NRDC alleges that "[t]he ER violates 10 C.F.R. § 51.45(c) because it omits an analysis that 'considers and balances the environmental effects of the proposed action' and the alternative of No Action."[190] While this sounds like it is raising a contention of omission, NRDC

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[187] 10 C.F.R. § 2.335(a).

[188] See id. § 2.309(f)(1)(vi).

[189] Petition at 23.

[190] Id.

goes on to argue that Exelon's discussion of the no-action alternative is inadequate because it "unreasonably and arbitrarily limits its analysis of the No Action alternative in a manner that fails, 'to the fullest extent practicable, [to] quantify the various factors considered' and neglects discussion of 'important qualitative considerations or factors that cannot be quantified.'"[191] NRDC further argues that Exelon's ER is inadequate because it limits its discussion of the no-action alternative to "decommissioning impacts" and single-source power generation alternatives, and because it fails to consider "growth in demand side management and renewable energy sources."[192]

Exelon and the NRC Staff argue that this contention is inadmissible.[193] Exelon contends first that Contention 4-E is too vague and unsupported to pass muster under the NRC's contention admissibility rules.[194] Moreover, Exelon states that its ER does contain the exact information that NRDC claims is missing.[195] The NRC Staff agrees that Contention 4-E is fatally unsupported[196] and that Exelon's ER sufficiently addresses the no-action alternative.[197]

Before proceeding, we think it appropriate to outline exactly what the no-action alternative is. As a general matter, NRC regulations require that a license renewal applicant in its ER "shall discuss . . . the environmental impacts of alternatives."[198] An ER's "discussion of

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[191] Id.

[192] Id. at 23-24.

[193] Exelon Answer at 57-70; NRC Staff Answer at 40-53.

[194] Exelon Answer at 61.

[195] Id. at 62.

[196] NRC Staff Answer at 45-51.

[197] Id. at 46.

[198] 10 C.F.R. § 51.53(c)(2).

alternatives shall be sufficiently complete to aid the Commission in developing and exploring" its own set of alternatives in its EIS,[199] and NRC regulations require an EIS to consider the "alternative of no action."[200] Therefore, to satisfy the requirements of 10 C.F.R. § 51.45(b)(3), an applicant must provide a discussion of the no-action alternative in its ER.

But, the question remains, what is the no-action alternative? The agency's regulations appear to be silent on this matter, but NRC's GEIS discusses the issue. The GEIS states that the purpose of the no-action alternative is to enable the agency to consider "the environmental consequences of taking no action at all."[201] It goes on to state:

> The no-action alternative is the denial of a renewed license. In general, if a renewed license were denied, a plant would be decommissioned and other electric generating sources would be pursued if power were still needed. It is important to note that NRC's consideration of the no-action alternative does not involve the determination of whether any power is needed or should be generated. The decision to generate power and the determination of how much power is needed are at the discretion of state and utility officials.[202]

In essence, the no-action alternative is an analysis of what would be reasonably likely to happen were the Commission to deny the requested license renewal.

We note that Exelon's ER contains a section entitled "No-Action Alternative."[203] NRDC contends that this analysis is inadequate because it does not adequately consider "expected growth in demand side management and renewable energy sources,"[204] fails to "quantify the

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[199] Id. § 51.45(b)(3).

[200] Id. Part 51, Subpt. A, App. A.

[201] GEIS at 8-1.

[202] Id.

[203] ER at 7-3.

[204] Petition at 24.

various factors considered,"[205] and omits a discussion of "important qualitative considerations or factors that cannot be quantified."[206] NRDC further argues that Exelon:

> improperly and illogically narrow[ed its] discussion of the No Action alternative to consideration of (1) decommissioning impacts and (2) power generation alternatives that would 'equivalently satisfy the purpose and need for the proposed action' by 'replacing the generating capacity of [Limerick]' with 'single discrete generation sources.'[207]

NRDC's support for this contention is the Paine Declaration.[208] It cites no regulations or case law that require Exelon to explore the no-action alternative in the way Contention 4-E would require.[209] Exelon, citing the Commission's decisions in Hydro Resources and Louisiana Energy Services, has shown that the Commission requires only a brief discussion of the no-action alternative.[210] The Commission has stated, "[f]or the 'no action' alternative, there need not be much discussion. It is most simply viewed as maintaining the status quo."[211] The Commission has also held that "[t]he extent of the 'no-action' discussion is governed by a 'rule of reason.' It is clear that the discussion 'need not be exhaustive or inordinately detailed.'"[212]

As noted above, Exelon discusses the no-action alternative in Section 7.1 of its ER.[213]

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[205] Id. at 23.

[206] Id.

[207] Id. at 23-24, quoting Paine Declaration at par. 5-7.

[208] See generally Paine Declaration.

[209] See Exelon Answer at 60; NRC Staff Answer at 46.

[210] See Exelon Answer at 59 n.298.

[211] Hydro Res., Inc. (P.O. Box 15910, Rio Rancho, NM 87174), CLI-01-04, 53 NRC 31, 54 (2001) (citations omitted).

[212] La. Energy Servs., L.P. (Claiborne Enrichment Center), CLI-98-3, 47 NRC 77, 97 (1998) (citations omitted).

[213] See ER at 7-3.

In this Section, Exelon discusses the impacts of decommissioning and cross-references a discussion of alternative means of providing energy along with their environmental impacts.[214] Exelon then discusses the environmental impacts of energy sources that could replace Limerick in the event that license renewal is denied, including gas-fired generation,[215] coal-fired generation,[216] purchased power,[217] new nuclear generation,[218] wind energy,[219] solar energy,[220] a combination of wind energy, solar energy, and gas-fired combined-cycle generation,[221] and a combination of wind energy and compressed air energy storage.[222] While NRDC would like to have seen a discussion of "Demand Side Management (DSM),[223] waste heat co-generation, combined heat and power, and distributed renewable energy resources,"[224] given the Commission's holdings that the no-action alternative discussion "need not be exhaustive,"[225]

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[214] Id.; see also ER at Section 7.2.2.

[215] Id. at Section 7.2.2.1.

[216] Id. at Section 7.2.2.2.

[217] Id. at Section 7.2.2.3.

[218] Id. at Section 7.2.2.4.

[219] Id. at Section 7.2.2.5.

[220] Id. at Section 7.2.2.6.

[221] Id. at Section 7.2.2.7.

[222] Id. at Section 7.2.2.8.

[223] We note that the ER does discuss DSM and determines that it is not a reasonable alternative. See ER at 7-16. Exelon noted at oral argument that it cross-referenced the impacts of DSM into its analysis of the no-action alternative. See Tr. at 180.

[224] Paine Declaration at par. 7.

[225] Claiborne, CLI-98-3, 47 NRC at 97.

and need only include "feasible, non-speculative alternatives,"[226] we conclude that NRDC has provided us with no support for the notion that Exelon's analysis of the no-action alternative is unreasonable under NEPA. Contention 4-E is inadmissible because it fails to provide "a concise statement of the alleged facts or expert opinions which support the … petitioner's position on the issue."[227]

IV. Motions to Strike

Exelon and the NRC Staff filed motions to strike portions of NRDC's reply brief for allegedly proffering arguments beyond the scope of NRDC's initial petition and the answers. The Commission has stated, "[w]e have long held that a reply may not contain new information that was not raised in either the petition or answers, but we have not precluded arguments that respond to the petition or answers, whether they are offered in rebuttal or in support."[228] Exelon and the NRC Staff assert that NRDC has raised new arguments or provided new factual support for its contentions in its reply,[229] while NRDC claims that it has merely responded to arguments made by either Exelon or the NRC Staff.[230]

Our review of the Table attached to Exelon's motion to strike and NRC Staff's "List of Statements to Be Stricken or Not Considered" reveals no "entirely new arguments, references or factual claims." It appears that NRDC's reply responds to arguments raised by the NRC Staff

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[226] Long Island Lighting Co. (Shoreham Nuclear Power Station, Unit 1), CLI-91-02, 33 NRC 61, 65 (1991) (quoting Piedmont Heights Social Club, Inc. v. Moreland, 637 F.2d 430, 436 (5th Cir. 1981)).

[227] 10 C.F.R. § 2.309(f)(1)(v).

[228] Entergy Nuclear Operations, Inc. (Indian Point Nuclear Generating Units 2 and 3), CLI-11-14, 74 NRC __, __ (slip op. at 10) (Dec. 22, 2011).

[229] Exelon Motion to Strike at 2; NRC Motion to Strike at 1-2.

[230] [NRDC] Combined Opposition to Motions to Strike at 2.

and Exelon in their answers. This approach is permissible and consistent with the Commission's decision in Indian Point.[231]

Because we have based our decision primarily on information presented in NRDC's petition to intervene, Exelon's answer, and the NRC Staff's answer, and because we find little over-reaching in NRDC's reply brief, we deny the motions to strike.

V. Conclusion

For the foregoing reasons, it is determined:

A. NRDC has demonstrated standing and submitted at least one admissible contention. NRDC is admitted as a party to this proceeding.

B. NRDC's Contention 1-E is admitted in part, as limited and reworded by the Board as follows:

> Applicant's Environmental Report (§ 5.3) erroneously concludes that new information related to its severe accident mitigation design alternatives ("SAMDA") analysis is not significant, in violation of 10 C.F.R. § 51.53(c)(3)(iv), and thus the ER fails to present a legally sufficient analysis in that:
>
> > 1. Exelon has omitted from its ER a required analysis of new and significant information regarding potential new severe accident mitigation alternatives previously considered for other BWR Mark II Containment reactors.
> >
> > 2. Exelon's reliance on data from TMI in its analysis of the significance of new information regarding economic cost risk constitutes an inadequate analysis of new and significant information.

C. In all other respects, we find Contention 1-E is inadmissible.

D. Contentions 2-E, 3-E and 4-E are not admitted.

E. Exelon's and the NRC Staff's motions to strike are denied.

F. A Subpart L hearing is granted with respect to the above-admitted Contention 1-E.

G. The Licensing Board will hold a telephone conference with the parties in which we

[231] Indian Point, CLI-11-14, 74 NRC at __ (slip op. at 10).

will discuss a schedule of further proceedings in this matter.

H. This Order is subject to appeal to the Commission in accordance with the provisions of 10 C.F.R. § 2.311. Any petitions for review meeting applicable requirements set forth in that section must be filed within ten (10) days of service of this Memorandum and Order.

It is so ORDERED.

THE ATOMIC SAFETY AND
LICENSING BOARD

/RA/

William J. Froehlich, Chairman
ADMINISTRATIVE JUDGE

/RA/

Dr. Michael F. Kennedy
ADMINISTRATIVE JUDGE

/RA/

Dr. William E. Kastenberg
ADMINISTRATIVE JUDGE

Rockville, Maryland
April 4, 2012

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE COMMISSION

In the Matter of:	)	Docket Nos. 50-352-LR
	)	50-353-LR
EXELON GENERATION COMPANY, LLC	)	
	)	
(Limerick Generating Station, Units 1 and 2)	)	April 16, 2012

EXELON'S NOTICE OF APPEAL OF LBP-12-08

This appeal presents a threshold legal question of potentially wide-ranging impact; namely, whether the adequacy of an applicant's consideration of "new and significant information" under 10 C.F.R. § 51.53(c)(3)(iv), in this case related to an issue resolved by rule in Section 51.53(c)(3)(ii), may nonetheless be challenged in a proceeding before an Atomic Safety and Licensing Board ("Board" or "ASLB") absent a waiver from the Commission. The Commission addressed this issue with respect to Section 51.53(c)(3)(i) in CLI-07-03,[1] and held that a waiver is necessary. Pursuant to 10 C.F.R. § 2.311(d)(1), Exelon Generation Company, LLC ("Exelon") hereby appeals LBP-12-08 so that the Commission can address the issue with respect to Section 51.53(c)(3)(ii), as well as other clear errors made by the Board in this proceeding.

In LBP-12-08, the Board presiding over the license renewal proceeding for the Limerick Generating Station, Units 1 and 2 ("Limerick") granted the petition to intervene filed by the

[1] *See Entergy Nuclear Generation Co. & Entergy Nuclear Operations, Inc.* (Pilgrim Nuclear Power Station) *and Entergy Nuclear Vermont Yankee, LLC. & Entergy Nuclear Operations, Inc.* (Vermont Yankee Nuclear Power Station), CLI-07-03, 65 NRC 13, 16 (2007).

Natural Resources Defense Council ("NRDC"),[2] and admitted for litigation one National Environmental Policy Act-related contention.[3] Specifically, the Board admitted two parts of Contention 1-E that challenge the evaluation of new and significant information under 10 C.F.R. § 51.53(c)(3)(iv), related to severe accident mitigation alternatives ("SAMAs") in Exelon's Environmental Report ("ER").

Contention 1-E is *not* a conventional SAMA contention. Exelon is not required to prepare a SAMA analysis in support of the Limerick license renewal application, because the NRC Staff has already performed an analysis of severe accident mitigation design alternatives ("SAMDAs") as part of original plant licensing.[4] This specific exception is set forth clearly and unambiguously in 10 C.F.R. § 51.53(c)(3)(ii)(L). Although Exelon need not perform a new SAMA analysis to support license renewal, it is required to determine if there is any "new and significant information regarding the environmental impacts of license renewal of which the applicant is aware" under 10 C.F.R. § 51.53(c)(3)(iv).

Thus, the threshold legal question on appeal is whether the adequacy of the applicant's consideration of new and significant information related to the NRC Staff's prior SAMDA analysis may be challenged in a license renewal proceeding *absent a waiver from the Commission*. Exelon argues that it cannot. This position is fully consistent with Commission decisions in *Pilgrim* and *Vermont Yankee*, which stand for the proposition that an intervenor may

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2 [NRDC] Petition to Intervene and Notice of Intention to Participate (Nov. 22, 2011) ("Petition"), *available at* ADAMS Accession No. ML11326A320.

3 *Exelon Generation Co., LLC* (Limerick Generating Station, Units 1 and 2, LBP-12-08, 75 NRC __, slip op. (Apr. 4, 2012).

4 *See* 10 C.F.R. § 51.53(c)(3)(ii)(L); *Environmental Review for Renewal of Nuclear Power Plant Operating Licenses*, 61 Fed. Reg. 28,467, 28,481 (June 5, 1996) ("NRC staff considerations of [SAMAs] have already been completed and included in an EIS or supplemental EIS for Limerick, Comanche Peak, and Watts Bar. Therefore, [SAMAs] need not be reconsidered for these plants for license renewal.").

not challenge an applicant's analysis of new and significant information for matters otherwise resolved by rule.[5] To allow otherwise would obviate the exceptions in Section 51.53(c)(3), and permit unfettered challenges to analyses that the Commission has expressly determined, by rule, need not be conducted *again* for license renewal, absent a waiver. Such a result is not confined to this proceeding, or even license renewal proceedings, but is germane to NRC adjudicatory proceedings in general.

In addition, to the extent that Contention 1-E, as admitted by the Board, challenges Exelon's economic cost analysis, it fails to include sufficient support to show that Exelon's analysis was unreasonable, and thus fails to demonstrate a genuine dispute on a material issue, as required by 10 C.F.R. § 2.309(f)(1). Exelon explained in its Answer why NRDC's support for the Contention actually illustrates the reasonableness of Exelon's analysis[6], but the Board failed to address this argument in LBP-12-08. Therefore, it was clear error for the Board to admit this part of Contention 1-E.

Exelon's Brief in Support of the Appeal of LBP-12-08 is attached. Exelon respectfully requests that the Commission expedite its review of this appeal, to minimize the expenditure by all parties of resources towards litigation of Contention 1-E.

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5 *See Entergy Nuclear Generation Co. & Entergy Nuclear Operations, Inc.* (Pilgrim Nuclear Power Station) *and Entergy Nuclear Vermont Yankee, LLC. & Entergy Nuclear Operations, Inc.* (Vermont Yankee Nuclear Power Station), CLI-07-03, 65 NRC 13, 17-18 (2007); *see also Entergy Nuclear Generation Co.* (Vt. Yankee Nuclear Power Station), LBP-06-20, 64 NRC 131, 149 (2006); *Entergy Nuclear Generation Co* (Pilgrim Nuclear Power Station), LBP-06-23, 64 NRC 257, 288 (2006).

6 Exelon's Answer Opposing NRDC's Petition to Intervene at 47-49 (Dec. 20, 2011), *available at* ADAMS Accession No. ML11354A541.

Respectfully submitted,

Signed (electronically) by Alex S. Polonsky

Alex S. Polonsky
Kathryn M. Sutton
Anna V. Jones
Morgan, Lewis & Bockius LLP
1111 Pennsylvania Avenue, NW
Washington, DC 20004
Phone: 202-739-5830
Fax: 202-739-3001
E-mail: apolonsky@morganlewis.com

J. Bradley Fewell
Vice President and Deputy General Counsel
Exelon Generation Company, LLC
200 Exelon Way
Kennett Square, PA 19348
Phone: 630-657-3769
Fax: 630-657-4335
E-mail: Bradley.Fewell@exeloncorp.com

COUNSEL FOR EXELON

Dated in Washington, D.C.
this 16th day of April 2012

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE COMMISSION

In the Matter of:	)	Docket Nos. 50-352-LR 50-353-LR
EXELON GENERATION COMPANY, LLC	)	
(Limerick Generating Station, Units 1 and 2)	)	April 16, 2012

EXELON'S BRIEF IN SUPPORT OF THE APPEAL OF LBP-12-08

TABLE OF CONTENTS

TABLE OF AUTHORITIES

DECISIONS	**Page**
Entergy Nuclear Generation Co. (Vt. Yankee Nuclear Power Station), LBP-06-20, 64 NRC 131 (2006).	1, 7, 12, 14, 15, 16, 17, 18, 20
Exelon Generation Co. (Limerick Generating Station, Units 1 and 2), Sec'y Order (Oct. 17, 2011), *available at* ADAMS Accession No. ML11290A233.	2
Exelon Generation Co. (Limerick Generating Station, Units 1 and 2), Notice and Order (Scheduling Oral Argument) at 3-4 (Jan. 31, 2012).	3
Exelon Generation Co. (Limerick Generating Station, Units 1 and 2), LBP-12-08, 75 NRC __ (Apr. 4, 2012).	1, 3, 6, 7, 8, 11, 12, 14, 20, 21, 22, 23, 24, 25
FirstEnergy Nuclear Operating Co. (Davis-Besse Nuclear Power Station, Unit 1), CLI-12-08, 75 NRC __ (Mar. 27, 2012).	4, 6, 24, 26, 27
Fla. Power & Light Co. (Turkey Point Nuclear Generating Plant, Units 3 & 4), CLI-01-17, 54 NRC at 3 (2001).	20
Hart v. McLucas, 535 F.2d 516 (9th Cir. 1976).	14
Hydro Resources, Inc. (2929 Coors Road, Suite 101, Albuquerque, NM 87120), CLI-99-22, 50 NRC 3 (1999).	23
Jay v. Boyd, 351 U.S. 345 (1956).	14
La. Energy Servs. L.P. (Nat'l Enrichment Facility), LBP-06-8, 63 NRC 241 (2006).	8
Limerick Ecology Action, Inc. v. U.S. NRC, 869 F.2d 719 (3rd Cir. 1989).	10
Marsh v. Oregon Natural Resources Council, 490 U.S. 360 (1989).	23
Massachusetts v. U.S. NRC, 522 F.3d 115 (1st Cir. 2008).	12,14, 20
NextEra Energy Seabrook (Seabrook Station, Unit 1), CLI-12-05, 75 NRC __ (Mar. 8, 2012).	4, 5, 6, 26
Pa'ina Haw., LLC (Material License Application), CLI-06-13, 63 NRC 508 (2006).	4, 10

I. INTRODUCTION

In accordance with 10 C.F.R. § 2.311(d)(1), Exelon Generation Company, LLC ("Exelon" or the "Applicant") hereby timely appeals the Atomic Safety and Licensing Board's ("Board") April 4, 2012 Order (LBP-12-08)[1] granting a Petition to Intervene[2] in the license renewal proceeding for the Limerick Generating Station, Units 1 and 2 ("Limerick"). Specifically, the Board's Order admitted for litigation one contention (*i.e.*, Contention 1-E), which challenges the analysis of new and significant information contained in Exelon's Environmental Report ("ER") related to severe accident mitigation alternatives ("SAMAs"), even though Exelon is excepted *by rule* from considering SAMAs for Limerick in a license renewal proceeding.

In summary and as demonstrated below, the Board made a clear error in admitting this contention. Commission precedent and regulatory history recognize that an applicant's consideration of new and significant information, related to a matter resolved by rule, is not litigable in a license renewal proceeding absent a waiver.[3] In addition, the contention fails to demonstrate a genuine dispute of a material issue, contrary to the requirements of 10 C.F.R. § 2.309(f)(1).

For these reasons, Contention 1-E does not satisfy the contention admissibility requirements of 10 C.F.R. § 2.309(f)(1). As a result, the Petition should have been wholly

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1 *Exelon Generation Co.* (Limerick Generating Station, Units 1 and 2), LBP-12-08, 75 NRC __, slip op. (Apr. 4, 2012).

2 Natural Resources Defense Council Petition to Intervene and Notice of Intention to Participate (Nov. 22, 2011) ("Petition"), *available at* ADAMS Accession No. ML11326A320.

3 *See Entergy Nuclear Generation Co. & Entergy Nuclear Operations, Inc.* (Pilgrim Nuclear Power Station) *and Entergy Nuclear Vermont Yankee, LLC. & Entergy Nuclear Operations, Inc.* (Vermont Yankee Nuclear Power Station), CLI-07-03, 65 NRC 13, 16 (2007); *see also Entergy Nuclear Generation Co*. (Vt. Yankee Nuclear Power Station), LBP-06-20, 64 NRC 131, 149 (2006); *Entergy Nuclear Generation Co* (Pilgrim Nuclear Power Station), LBP-06-23, 64 NRC 257, 288 (2006).

denied. Exelon hereby files this Appeal of the Board's Order, pursuant to 10 C.F.R. § 2.311(d)(1).

II. BACKGROUND

Limerick, located in Limerick Township, Pennsylvania, has safely generated 2,340 MWe of baseload electrical power for the Mid-Atlantic region for more than 20 years, with only temporary breaks for refueling and outages.[4] On June 22, 2011, Exelon submitted an application to the NRC requesting the renewal of the Limerick operating licenses for an additional 20 years (*i.e.*, until midnight on October 26, 2044, for Unit 1, and midnight on June 22, 2049, for Unit 2).[5]

The NRC Staff accepted Exelon's application for docketing and published a Hearing Notice in the *Federal Register* on August 24, 2011.[6] The Hearing Notice states that any person whose interest may be affected by this proceeding, and who wishes to participate as a party, must file a petition for leave to intervene in accordance with 10 C.F.R. § 2.309.[7] On November 22, 2011, Natural Resources Defense Council ("NRDC") timely filed its Petition, which contained four proposed contentions challenging portions of Exelon's ER.[8] None of the proposed

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4 Applicant's Environmental Report – Operating License Renewal Stage, Limerick Generating Station, Units 1 and 2, at 2-3, 7-4 to 7-5, 7-10, 7-17 (Jun. 2011) ("ER"), *available at* http://www.nrc.gov/reactors/operating/licensing/renewal/applications/limerick/lgs-er-web.pdf; *see also* Tr. 22 (Polonsky).

5 *See* Letter from M. Gallagher, Exelon, to NRC, "Application for Renewed Operating Licenses" (June 22, 2011), *available at* ADAMS Accession No. ML11179A096.

6 *See* Notice of Acceptance for Docketing of the Application and Notice of Opportunity for Hearing Regarding Renewal of Facility Operating License Nos. NPF-39 and NPF-85 for an Additional 20-Year Period; Exelon Generation Co., LLC, Limerick Generating Station, 76 Fed. Reg. 52,992, 52,992-94 (Aug. 24, 2011) ("Hearing Notice").

7 Hearing Notice, 73 Fed. Reg. at 52,993.

8 *See generally* Petition. Although the Hearing Notice indicated that a Petition to Intervene would be timely if filed by October 24, 2011, NRDC requested an extension of time for filing its Petition until November 22, 2011. *See* Letter from G. Fetus, NRDC, to NRC Sec'y, "Extension of Time for Opportunity to Request a Hearing and Petition for Leave to Intervene in the NRC Notice of Opportunity for Hearing Regarding Renewal of [Limerick Station] for Additional 20-Year Period (Sept. 22, 2011), *available at* ADAMS Accession No. ML11266A083. By Order dated October 17, 2011, the Secretary for the Commission granted this request. Sec'y Order (Oct. 17, 2011), *available at* ADAMS Accession No. ML11290A233 (granting NRDC an extension of 30 days to file a petition to intervene).

contentions raised a safety concern.

Exelon and the NRC Staff filed timely answers to the Petition on December 20 and 21, 2011, respectively.[9] Exelon and the NRC Staff did not challenge NRDC's standing, but they did challenge the admissibility of all of the contentions.[10] On January 6, 2012, NRDC filed its Combined Reply to Exelon's and the NRC Staff's Answers.[11]

Shortly thereafter, the Board scheduled oral argument on the admissibility of the four contentions.[12] The Board's Order scheduling oral argument included a preliminary list of questions the hearing participants should be prepared to answer at oral argument, which was held on February 21, 2012.[13] Thereafter, on April 4, 2012, the Board issued LBP-12-08, ruling that NRDC has standing and admitting a limited and re-worded Contention 1-E. In accordance with the Board's Order[14] and 10 C.F.R. § 2.311(d)(1), Exelon hereby appeals that decision.

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9 Exelon's Answer Opposing NRDC's Petition to Intervene (Dec. 20, 2011) ("Exelon Answer"), *available at* ADAMS Accession No. ML11354A541; NRC Staff's Answer to [NRDC] Petition to Intervene and Notice of Intention to Participate (Dec. 21, 2011) ("Staff Answer"), *available at* ADAMS Accession No. ML11355A174.

10 *See generally* Exelon Answer; Staff Answer.

11 [NRDC] Combined Reply to Exelon and NRC Staff Answers to Petition to Intervene (Jan. 6, 2012) ("Reply"), *available at* ADAMS Accession No. ML12006A224. Because the Reply provided new bases and supporting material for the contentions, the NRC Staff and Exelon separately moved to strike portions of the Reply on January 17, 2012. Exelon's Motion to Strike Portions of NRDC's Reply (Jan. 17, 2012), *available at* ADAMS Accession No. ML12017A258; NRC Staff's Motion to Strike Impermissible New Claims in [NRDC's] Reply Brief (Jan. 17, 2012), *available at* ADAMS Accession No. ML12017A202. NRDC responded to those motions on January 27, 2012. [NRDC] Combined Opposition to Motions to Strike (Jan. 27, 2012), *available at* ML12027A234. The Board denied the Motions to Strike, but because the Motions related to contentions that the Board rejected in LBP-12-08, the Motions to Strike are moot, and Exelon is not appealing their denial.

12 *See* Notice and Order (Scheduling Oral Argument) at 3-4 (Jan. 31, 2012).

13 *Id.* at 4 n.17; *id.* App. A.

14 *Limerick*, LBP-12-08, slip op. at 41.

III. LEGAL STANDARDS

A. Standard of Review

To intervene in an NRC licensing proceeding, a petitioner must demonstrate standing and propose at least one contention that satisfies the admissibility criteria set forth in 10 C.F.R. § 2.309(f)(1).[15] Under 10 C.F.R. § 2.311(d)(1), an applicant may appeal an order granting a petition to intervene, if "the request for hearing or petition to intervene should have been wholly denied." In other words, the applicant must dispute the admissibility of *all* of the contentions admitted by the Board.[16]

Although the Commission generally defers to board decisions on contention admissibility, it will reverse a decision if there is clear "error of law or abuse of discretion."[17] The Commission has explained that allowing boards "to entertain contentions grounded on little more than guesswork would waste the scarce adjudicatory resources of all involved."[18]

B. Contention Admissibility Standards

NRC regulations at 10 C.F.R. § 2.309(f)(1) specify that a hearing request "must set forth *with particularity* the contentions sought to be raised."[19] In addition, each contention must:

(1) provide a specific statement of the legal or factual issue sought to be raised;
(2) provide a brief explanation of the basis for the contention;
(3) demonstrate that the issue raised is within the scope of the proceeding;
(4) demonstrate that the issue raised is material to the findings the NRC must make to support the action that is involved in the proceeding;

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15 *See* 10 C.F.R. § 2.309(a).

16 *See AmerGen Energy Co.* (Oyster Creek Nuclear Generating Station), CLI-06-24, 64 NRC 111, 119 (2006); *Pa'ina Haw., LLC* (Material License Application), CLI-06-13, 63 NRC 508, 509 (2006).

17 *See, e.g.*, *FirstEnergy Nuclear Operating Co.* (Davis-Besse Nuclear Power Station, Unit 1), CLI-12-08, 75 NRC __, slip op. at 5 (Mar. 27, 2012)*; NextEra Energy Seabrook* (Seabrook Station, Unit 1), CLI-12-05, 75 NRC __, slip op. at 8 (Mar. 8, 2012).

18 *Crow Butte Res. Inc.* (N. Trend Expansion Project), CLI-09-12, 69 NRC 535, 552 (2009); *see also Crow Butte Res., Inc.* (License Renewal for In Situ Leach Facility, Crawford, Neb.), CLI-09-9, 69 NRC 331, 363-364 (2009).

19 10 C.F.R. § 2.309(f)(1) (emphasis added).

(5) provide a concise statement of the alleged facts or expert opinions, including references to specific sources and documents that support the petitioner's position and upon which the petitioner intends to rely; and
(6) provide sufficient information to show that a genuine dispute exists with regard to a material issue of law or fact.[20]

Licensing boards *must* reject a proposed contention that fails to comply with any one of these six admissibility criteria.[21]

The Commission's rules on contention admissibility are "strict by design."[22] The Commission "toughened [the rules] in 1989 because in prior years 'licensing boards had admitted and litigated numerous contentions that appeared to be based on little more than speculation.'"[23] The Commission designed its current contention pleading requirements to avoid the admission of "frivolous contentions" where the petitioner "may not fully understand a contention" or does not "adequately identify the issues that [it] seeks to litigate."[24] Quite recently, the Commission instructed that "'contentions shall not be admitted if at the *outset* they are not described with reasonable specificity or are not supported by some alleged fact or facts *demonstrating* a genuine material dispute' with the applicant. We properly 'reserve our hearing process for genuine, material controversies between knowledgeable litigants.'"[25]

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[20] 10 C.F.R. § 2.309(f)(1)(i)-(vi). The seventh contention admissibility requirement—10 C.F.R. § 2.309(f)(1)(vii)—is only applicable in proceedings arising under 10 C.F.R. § 52.103(b) and, therefore, has no bearing on the admissibility of NRDC's proposed contentions in this proceeding. Exelon provided a more thorough description of the legal principles governing the application of each of the six criterion in its December 20, 2011 Answer. *See* Exelon's Answer at 5-10.

[21] *Private Fuel Storage, L.L.C.* (Indep. Spent Fuel Storage Installation), CLI-99-10, 49 NRC 318, 325 (1999).

[22] *Dominion Nuclear Conn., Inc.* (Millstone Nuclear Power Station, Units 2 & 3), CLI-01-24, 54 NRC 349, 358 (2001) (citing *Duke Energy Corp.* (Oconee Nuclear Station, Units 1, 2, & 3), CLI-99-11, 49 NRC 328, 334 (1999)).

[23] *Millstone*, CLI-01-24, 54 NRC at 358 (citing *Oconee*, CLI-99-11, 49 NRC at 334).

[24] Proposed Rule, Rules of Practice for Domestic Licensing Proceedings—Procedural Changes in the Hearing Process, 51 Fed. Reg. 24,365, 24,366 (July 3, 1986). The Commission also has emphasized that the "contention pleading rules are designed to ensure both that only well-defined issues are admitted for hearing and that parties admitted to litigate sophisticated technical issues are qualified to do so." *North Trend*, CLI-09-12, 69 NRC at 552.

[25] *Seabrook,* CLI-12-05, slip op. at 7 (citation omitted).

IV. <u>ARGUMENT</u>

The Board erred when it admitted Contention 1-E, which was reframed by the Board as follows:

> Applicant's [ER] § 5.3 erroneously concludes that new information related to its severe accident mitigation design alternatives [("SAMDAs")] analysis is not significant, in violation of 10 C.F.R. § 51.53(c)(3)(iv), and thus the ER fails to present a legally sufficient analysis in that:
>
> 1. Exelon has omitted from its ER a required analysis of new and significant information regarding potential new [SAMAs] previously considered for other [boiling water reactor ("BWR")] Mark II Containment reactors.
>
> 2. Exelon's reliance on data from [Three Mile Island ("TMI")] in its analysis of the significance of new information regarding economic cost risk constitutes an inadequate analysis of new and significant information.[26]

As a threshold matter, Contention 1-E is *not* a conventional SAMA contention like those that other licensing boards and the Commission have seen in recent license renewal proceedings for *Seabrook*,[27] *Pilgrim*,[28] and *Davis Besse*,[29] for example. As explained in the sections that follow, unlike the applicants in those proceedings, Exelon is *not* required to conduct a SAMA analysis to support Limerick's license renewal, because the NRC Staff performed an analysis of SAMDAs as part of Limerick's original plant licensing. This specific exception is set forth clearly and unambiguously in 10 C.F.R. § 51.53(c)(3)(ii)(L).

Although Exelon need not perform a new SAMA analysis to support Limerick's license renewal, Section 51.53(c)(3)(iv) does require Exelon to evaluate whether there is any "new and

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26 *Limerick*, LBP-12-08, slip op. at 40.

27 *See Seabrook*, CLI-12-05, slip op. at 47 (reversing the licensing board's admission of a SAMA contention).

28 *See Entergy Nuclear Generation Co.* (Pilgrim Nuclear Power Station), CLI-12-01, 75 NRC __, slip op. at 2, 31 (Feb. 9, 2012) (denying intervenor's appeal of the board's rejection of a SAMA contention).

29 *See Davis-Besse*, CLI-12-08, slip op. at 5 (reversing the licensing board's admission of two aspects of a SAMA contention).

significant information regarding the environmental impacts of license renewal of which the applicant is aware." It is Exelon's position that the adequacy of its consideration of new and significant information related to the prior Limerick SAMA analysis, however, may not be challenged in the instant license renewal proceeding absent a waiver. This position is consistent with the Commission's rulings in *Pilgrim* and *Vermont Yankee*, in which it upheld licensing board determinations that an intervenor may not challenge an applicant's analysis of new and significant information for matters otherwise resolved by rule.[30] To allow otherwise would obviate the exceptions in Section 51.53(c)(3), and permit unfettered challenges to analyses that the Commission has expressly determined, by rule, need not be conducted *again* for purposes of license renewal.

In addition, as admitted by the Board, Contention 1-E challenges Exelon's consideration of off-site economic costs related to a severe accident, as those costs pertain to SAMA cost-benefit analyses. But this part of Contention 1-E fails to include sufficient support to show that Exelon's analysis was unreasonable, and thus fails to demonstrate a genuine dispute on a material issue, as required by 10 C.F.R. § 2.309(f)(1). Exelon's Answer fully explains why NRDC's purported support for the Contention actually illustrates the reasonableness of Exelon's analysis of new and significant information.[31] The Board, however, fails to address the Exelon Answer's argument in LBP-12-08, which was a clear error.

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30 *See Entergy Nuclear Generation Co.* (Pilgrim Nuclear Power Station), CLI-07-3, 65 NRC 13, 17-18 (2007); *see also Entergy Nuclear Generation Co.* (Vt. Yankee Nuclear Power Station), LBP-06-20, 64 NRC 131, 149 (2006); *Entergy Nuclear Generation Co* (Pilgrim Nuclear Power Station), LBP-06-23, 64 NRC 257, 288 (2006).

31 *See* Exelon's Answer at 47-49 (explaining that the economic cost ratios proffered by NRDC actually demonstrate that the value used by Exelon was reasonable).

A. <u>Relevant Background</u>

NRC regulations expressly provide that Exelon need not evaluate SAMAs for purposes of Limerick's license renewal.[32] The regulatory and procedural context underlying this regulatory provision—with which the Board correctly agrees[33]—is summarized below.

As a threshold matter, NRC regulations at 10 C.F.R. § 51.53, implementing the requirements of the National Environmental Policy Act, as amended ("NEPA"),[34] require that a license renewal application include an ER that analyzes the environmental impacts of the proposed action, as well as certain mitigation alternatives.[35] Among the mitigation alternatives that license renewal applicants may be required to address under 10 C.F.R. § 51.53(c)(3)(ii)(L), are SAMAs. The genesis of that requirement lies in the litigation over issuance of the *original* Limerick operating licenses, which ultimately reached the Third Circuit Court of Appeals.[36] As a result of that litigation, the NRC Staff prepared an analysis of SAMDAs as part of initial Limerick licensing.[37] In August 1989, the NRC Staff published its findings in the NUREG-0974 Supplement, "Final Environmental Statement related to the operation of Limerick Generating

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32 *See* Exelon's Answer at 10-16.

33 *See* LBP-12-08, slip op. at 33-34.

34 *See* 42 U.S.C. § 4321, *et seq*.

35 *See id*. § 4332(2)(C). Issuance by NRC of a renewed operating license is a major federal action under NEPA. *See La. Energy Servs. L.P.* (Nat'l Enrichment Facility), LBP-06-8, 63 NRC 241, 258 (2006).

36 *See Limerick Ecology Action, Inc. v. U.S. NRC*, 869 F.2d 719, 726 (3rd Cir. 1989). In the licensing proceeding for the original operating license at Limerick, several intervenors challenged the applicant's failure to consider SAMAs in its ER. *See id*. at 722-23. The licensing board did not admit that contention. *See id*. at 732. An Appeal Board affirmed the licensing board's decision, *see Phil. Elec. Co.* (Limerick Generating Station, Units 1 and 2), ALAB-819, 22 NRC 681, 696-97 (1985), and the Commission declined review. *See Phil. Elec. Co.* (Limerick Generating Station, Units 1 and 2), CLI-86-5, 23 NRC 125 (1986). Prior to the ruling by the U.S. Court of Appeals for the Third Circuit in that matter, the NRC reasoned that the probability of severe accidents was so low that consideration of the consequences *under NEPA* was unnecessary. *See Limerick Ecology Action,* 869 F.2d at 726; Answer at 11-12. The Third Circuit disagreed, however, and found that the NRC's failure to consider SAMAs in individual licensing proceedings violated NEPA. *Limerick Ecology Action*, 869 F.2d at 741 (remanding the matter for consideration of the SAMA contention).

37 *See* NUREG-0974, Supp., Final Environmental Statement Related to the Operation of Limerick Generating Station, Units 1 and 2 (Aug. 1989), *available at* ADAMS Accession No. ML11221A204 ("Limerick FES").

Station, Units 1 and 2" ("Limerick FES"), concluding that, based on its analysis of the cost of SAMDAs and the resulting cost per person-rem averted, no modifications to the plant were justified for mitigating severe accident risk.[38]

In the years that followed, the NRC Staff evaluated the environmental impacts of licensing that it could address generically, consistent with NEPA.[39] The Commission reasoned that many environmental issues that apply to license renewal applicants, in particular, could be resolved generically.[40] Thus, in 1996, the NRC published its generic findings in NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" ("GEIS").[41]

The NRC also amended its environmental regulations at 10 C.F.R. Part 51 to codify certain findings from the GEIS.[42] In this regard, Part 51 divides the environmental impacts from license renewal into Category 1 and Category 2 issues.[43] Category 1 issues are those resolved for *all* plants by the GEIS and as such, Category 1 issues need not be addressed in plant-specific license renewal ERs.[44] In comparison, Category 2 issues require plant-specific review.[45] For each license renewal applicant, Part 51 requires that the NRC Staff prepare a plant-specific

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38 *See* Limerick FES at vi.

39 *See Balt. Gas & Elec. Co. v.* [*NRDC*], 462 U.S. 87, 97-98 (1983).

40 *See Environmental Review for Renewal of Nuclear Power Plant Operating Licenses*, 61 Fed. Reg. 28,467, 28,467-68 (June 5, 1996).

41 NUREG-1437, Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Vol. 1 (May 1996), *available at* ADAMS Accession No. ML040690705.

42 *See* Environmental Review for Renewal of Nuclear Power Plant Operating Licenses, 61 Fed. Reg. at 28,467.

43 *See* generally, 10 C.F.R. pt. 51, subpt. A, app. B, tbl. B-1.

44 *See* Environmental Review for Renewal of Nuclear Power Plant Operating Licenses, 61 Fed. Reg. at 28,474.

45 *See id*.

supplement to the GEIS that adopts applicable generic impact findings from the GEIS, evaluates any new and significant information, and discusses site-specific impacts.[46]

As for mitigation of severe accidents, the Commission determined that SAMAs must be considered on a plant-specific basis, pursuant to the NRC's NEPA regulations and the Third Circuit's 1989 *Limerick* decision.[47] But the Commission expressly noted that the Staff had already conducted a plant-specific SAMDA analysis at the operating license stage for three plants—Limerick Units 1 and 2, Comanche Peak Units 1 and 2, and Watts Bar.[48] As a result, the Commission does not require *another* SAMA analysis to be conducted for purposes of license renewal for any of these plants.[49] Section 51.53(c)(3)(ii)(L) codifies this determination, requiring:

> If the staff has not previously considered severe accident mitigation alternatives for the applicant's plant in an environmental impact statement or in an environmental assessment, a consideration of alternatives to mitigate severe accidents must be provided.[50]

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46 *See* 10 C.F.R. § 51.95(c).

47 *See* Environmental Review for Renewal of Nuclear Power Plant Operating Licenses, 61 Fed. Reg. at 28,480; *see also Limerick Ecology Action*, 869 F.2d at 736-39.

48 *See* Environmental Review for Renewal of Nuclear Power Plant Operating Licenses, 61 Fed. Reg. at 28,481 ("an NRC staff consideration of SAMDAs was specifically included in the [FES] for the Limerick 1 and 2 and Comanche Peak 1 and 2 operating license reviews, and in the Watts Bar Supplemental Final Environmental Statement for an operating license").

49 *Id.* ("NRC staff considerations of [SAMAs] have already been completed and included in an EIS or supplemental EIS for Limerick, Comanche Peak, and Watts Bar. Therefore, [SAMAs] need not be reconsidered for these plants for license renewal."). Statements of Consideration illustrate or explain rules that are legally binding. *See* Exelon Answer at 19 n.107; Oral Arguments Tr. 134-136 (Polonsky), Feb. 21, 2012 (citing *Pa'ina*, CLI-08-03, for the premise that the Commission uses Statements of Consideration as an aid in interpreting NRC regulations, in response to questions posed by the Board in its January 31, 2012 Notice and Order (Scheduling Oral Argument)).

50 10 C.F.R. § 51.53(c)(3)(ii)(L); *see also* 10 C.F.R. pt. 51, subpt. A, app. B, tbl. B-1; *see also* Tr. 166 ("the Commission recognized back in 1996 that future SAMA analyses could identify other cost beneficial mitigation measures, but that they still made the determination. They drew the line and made the determination that if a SAMA had been done for a plant, another one need not be for license renewal given the other generic and site specific studies that had been done and would continue to be done for that plant.") (Kanatas).

Because the Commission could not resolve the matter of SAMAs generically for *all* plants, it determined in the Part 51 rulemaking that "the issue of severe accidents must be reclassified as a Category 2 issue that requires a consideration of severe accident mitigation alternatives, *provided this consideration has not already been completed*."[51] In other words, consideration of severe accident mitigation alternatives is functionally a Category 1 issue for Limerick; that is, an issue that need not be addressed at license renewal, and one that the Commission has resolved generically by rule for Limerick and other similarly situated plants.[52]

In this procedural context, and within this regulatory framework, Exelon prepared its ER for license renewal. For purposes of compliance with Section 51.53(c)(3)(ii)(L), Exelon did not conduct another SAMA analysis.[53] But, as required by Section 51.53(c)(3)(iv), Exelon did evaluate the significance of new information that post-dated the 1989 FES, relating to matters such as offsite economic cost risk.[54] Exelon concluded "that there is no new and significant information relevant to the conclusions codified in 10 C.F.R. § 51.53(c)(3)(ii)(L)."[55]

B. <u>The Board Clearly Erred in Admitting a Contention Challenging New and Significant Information Related to An Issue Resolved by Rule, Absent a Waiver</u>

The threshold legal issue on appeal is whether the adequacy of Exelon's analysis of new and significant information related to SAMAs is litigable in a license renewal proceeding, absent

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51 Environmental Review for Renewal of Nuclear Power Plant Operating Licenses, 61 Fed. Reg. at 28,480 (emphasis added); *see also* 10 C.F.R. pt. 51, subpt. A, app. B, tbl. B-1 (identifying severe accident mitigation as a Category 2 issue).

52 *See* Exelon's Answer at 14-16 (providing a more fulsome explanation of the relevant regulatory history).

53 *See* ER at 4-49. Nor did Exelon incorporate the Limerick 1989 SAMDA analysis in the Limerick license renewal ER, as NRDC erroneously suggests. *See* Petition at 16; ER at 5-4; *see also Limerick*, LBP-12-08, slip op. at 30.

54 *See* ER at 5-6 to 5-9; *see also* Tr. 72-73, 75, 98-99 (Polonsky).

55 ER at 4-49.

a waiver from the Commission under Section 2.335.[56] In LBP-12-08, the Board held that it is, and that a waiver is not necessary.[57] As explained below, that holding is inconsistent with NRC precedent in the license renewal proceedings for *Pilgrim* and *Vermont Yankee*[58] and misinterprets a dispositive legal argument posed by Exelon and the NRC Staff.

To fully appreciate the question presented by Contention 1-E, it is helpful to review the regulatory construction of 10 C.F.R. § 51.53(c)(3). Section 51.53(c) contains the NRC's requirements for a license renewal applicant's environmental review. Section 51.53(c)(1) requires that a license renewal applicant submit an ER, and Section 51.53(c)(2) describes the required components of that ER. Section 51.53(c)(3) provides that the ER "shall include the information required in paragraph (c)(2) of this section *subject to the following conditions and considerations*." Emphasis added. Section 51.53(c)(3) then lists four subsections defining the applicable "conditions and considerations": (i), (ii), (iii), and (iv).

Subsections (i), (ii), and (iv) are relevant to the instant analysis. Subsection (i) provides that "Category 1" issues need not be addressed in an ER. This is the subsection that the Commission explicitly addressed in *Pilgrim* and *Vermont Yankee*.[59] Subsection (ii) contains

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56 The Board's description of Exelon's position as a "blanket assertion" that these issues are not litigable at license renewal is not accurate. *See Limerick*, LBP-12-08, slip op. at 11. Both in its Answer and at oral argument, Exelon repeatedly made clear—as did the Staff—that such issues are not litigable *absent a waiver*. *See, e.g.*, Exelon's Answer at 25 ("Commission precedent clearly requires that—absent a waiver—an [ASLB] must reject any contention"); *id*. at 26 ("NRDC's argument must fail given its failure to seek and obtain waiver"); *id*. at 27 ("because NRDC has not sought the requisite waiver . . ."); *id*. at 28 ("it is well-settled that, absent a waiver . . ."); *id*. at 33 ("contentions that challenge an applicant's consideration of new and significant information related to a Category 1 issue are inadmissible, absent a waiver."); Tr. at 24 (Polonsky) ("an existing NRC regulation cannot be challenged in a license renewal proceeding, absent a waiver"); Tr. at 54 (Polonsky) ("I tend to simplify and say it's not litigable. It's not litigable. But clearly, [10 C.F.R. §] 2.335 exists to everything I am saying, and if there is a waiver that it submitted and granted by the Commission then of course, it could be litigable, but we don't have those circumstances here.").

57 *See Limerick*, LBP-12-08, slip op. at 11, 16.

58 *See Vt. Yankee*, LBP-06-20, 64 NRC at 155-61; *Pilgrim*, LBP-06-23, 64 NRC at 294-300; *Pilgrim & Vt. Yankee*, CLI-07-3, 65 NRC at 16; *see also Massachusetts v. U.S. NRC*, 522 F.3d 115 (1st Cir. 2008).

59 *See Pilgrim & Vt. Yankee*, CLI-07-3, 65 NRC at 16.

specific analyses that must be included in an ER, and other analyses that—like Category 1 issues—need not be included in an ER. This is the subsection that contains the exception for Exelon from the requirement to prepare a SAMA analysis for Limerick as part of license renewal. Finally, subsection (iv) requires the ER generally to include "any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware."

The threshold legal question before the Commission, then, is: how should the requirement at Subsection (iv) to consider new and significant information be understood in light of the other subsections of 51.53(c)(3) (*i.e.*, Subsections (i) and (ii)) that exempt certain analyses from consideration in license renewal? In other words, what is a licensing board to do with a contention that challenges the adequacy of an applicant's analysis of new and significant information for an issue otherwise precluded by rule?

The answer to this question reaches far beyond the *Limerick* license renewal proceeding. Indeed, if the Board's ruling is allowed to stand, then license renewal applicants excluded from the requirements to consider any of the analyses listed under 10 C.F.R. §§ 51.53(c)(3)(ii)(A)-(D), (F)-(H), or (L), may nevertheless find those analyses at issue in license renewal litigation. Moreover, the Board's ruling could undermine the waiver requirement of 10 C.F.R. § 2.335, as it applies to NRC adjudicatory proceedings generally.

Even at the most superficial level, admission of Contention 1-E obviates the plain language exception in Section 51.53(c)(3)(ii)(L). It would be illogical for the rule to except Limerick from the requirement to include a SAMA analysis in its license renewal ER, but nonetheless subject the adequacy of such an analysis to litigation in a license renewal proceeding.[60] And reading Section 51.53(c)(3)(iv) to eviscerate Section 51.53(c)(3)(ii) violates Supreme Court instruction to "read the body of regulations . . . so as to give effect, if possible, to all of its provisions."[61]

But the Commission need not decide this question on a superficial level, or even decide it anew. A series of NRC and federal court holdings pertaining to license renewal for *Pilgrim* and *Vermont Yankee* previously examined the fundamental legal question that is at issue here.[62] In those cases, and after a thorough examination of the regulatory history of Section 51.53(c)(3), Licensing Boards, the Commission, and the Court of Appeals for the First Circuit all concluded that a petitioner in a license renewal proceeding may not use Subsection (iv) to litigate matters excluded under Subsection (i), absent a waiver from the Commission.[63] The crux of those decisions was not the "Category 1" nomenclature covered by Subsection (i). Rather, it was because the analyses at issue were expressly precluded by rule from consideration in a license renewal proceeding.

In LBP-12-08, the Board erroneously interpreted this precedent as being limited to whether Exelon could "establish that SAMAs are, indeed, Category 1 issues for Limerick."[64]

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60 *See* Tr. 106 (Polonsky) ("one of the concerns from a legal perspective is that the Commission created the exception, and that there not be some back door to eviscerate the exception . . . .).

61 *Jay v. Boyd,* 351 U.S. 345, 360 (1956); *see also Hart v. McLucas,* 535 F.2d 516, 519 (9th Cir. 1976) ("constructions which render regulatory provisions superfluous are to be avoided"); *see also* Exelon's Answer at 26, 33.

62 *See, e.g., Vt. Yankee*, LBP-06-20, 64 NRC. at 156 ("assuming *arguendo* that an ER fails to include new and significant information (known to the applicant) relating to a Category 1 environmental issue and thus fails to comply with 10 C.F.R. § 51.53(c)(3)(iv), does this give rise to an admissible contention? Normally, the answer would be yes. Indeed, the essence of virtually all admissible contentions is an allegation that the applicant has failed to address, or has inadequately addressed, some legally required matter. In this case, however, the Commission has answered the question in the negative. The AG's contention is therefore inadmissible.").

63 *See id.*, LBP-06-20, 64 NRC. at 155-61; *Pilgrim*, LBP-06-23, 64 NRC at 294-300; 65 NRC at 16; *Pilgrim & Vt. Yankee*, CLI-07-3, 65 NRC at 16; *Massachusetts*, 522 F.3d 115.

64 *Limerick*, LBP-12-08, slip op. at 13. Likewise, Counsel for NRDC depends on the conclusion that SAMA analyses are Category 2, but misses the larger point that for Limerick, this analysis is precluded by rule. *See* Tr. 59-61, 84 (Roisman). And beyond arguing that SAMA analyses are Category 2, NRDC's counsel

But that is not what Exelon asserted. Although it is Exelon's position that SAMA analysis is a Category 1 issue for Limerick and certain other plants[65]—by virtue of previous completion of NRC-approved SAMDA analyses for those plants—Exelon also made clear that a SAMA analysis for Limerick need not be a Category 1 issue for the legal principle in *Pilgrim* and *Vermont Yankee* to apply.[66] As the NRC Staff noted at oral argument, whether or not SAMA analyses are a Category 1 issue for Limerick is "a distinction without a difference."[67] Either way, the analysis at issue is one that the Commission has expressly precluded by rule, which itself precludes litigation absent a waiver from the Commission under Section 2.335.

The following paragraphs explain the legal precedent at issue and its applicability to this proceeding. In the license renewal proceedings for both *Pilgrim* and *Vermont Yankee*, the Massachusetts Attorney General ("AG") proffered one contention challenging Entergy's ERs on the basis that they failed to address new and significant information regarding a Category 1 issue; specifically, a severe spent fuel pool fire.[68] The AG asserted that a "plain reading" of Section 51.53(c)(3)(iv) leads to the conclusion that the new and significant information an

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has no other basis or legal support for his assertion that *Pilgrim* and *Vermont Yankee* do not apply to the instant proceeding. *See* Tr. 89 (Roisman).

65 *See* Exelon Answer at 27-28; Tr. at 47-49, 63-66, 83-84, 122-123 (Polonsky); *see also* Environmental Review for Renewal of Nuclear Power Plant Operating Licenses, 61 Fed. Reg. 28,480 ("the issue of severe accidents must be reclassified as a Category 2 issue that requires a consideration of severe accident mitigation alternatives, *provided this consideration has not already been completed*.") (emphasis added); GEIS at xliv, 5-114 ("Staff evaluations of alternatives to mitigate severe accidents have already been completed and included in an EIS or supplement for Limerick, Comanche Peak, and Watts Bar; therefore, *severe accident mitigation need not be reassessed for these plants for license renewal*. . . . [S]evere accidents are a Category 2 issue *for plants that have not performed a site-specific consideration of severe accident mitigation and submitted that analysis for Commission review*.") (emphasis added).

66 *See* Exelon's Answer at 33 ("And the same result must ensue, even setting aside the 'Category' nomenclature. Given the construction of Section 51.53(c)(3), there is no basis to distinguish the Commission's holdings with respect to contentions based on Section 51.53(c)(3)(i), from contentions based on Section 51.53(c)(3)(ii)."); Tr. at 47-48 (Polonsky) ("the Board does not need to find that the SAMDA or SAMA issue is a Category 1 issue for Limerick.").

67 Tr. at 65-66 (Smith).

68 *See Pilgrim*, LBP-06-23, 64 NRC at 280; *Vt. Yankee*, LBP-06-20, 64 NRC at 152.

applicant provides must include Category 1 issues, and a petitioner is entitled to challenge the adequacy of the ER in this regard.[69]

Both the *Pilgrim* and *Vermont Yankee* Boards disagreed with the AG, ruling that a petitioner may not challenge the applicant's consideration of new and significant information related to Category 1 issues.[70] The *Pilgrim* Board explained:

> Section 51.53(c)(3)(iv) may well be viewed as being ambiguous, in that it clearly conflicts with Section 51.53(c)(3)(i) and there is no 'plain language' explicitly stating that § 51.53(c)(3)(iv) creates an exception to Section 51.53(c)(3)(i) – in *any* context. From this perspective, the Commission . . . may be viewed as having the discretion to state its interpretation of these regulatory provisions as it did in *Turkey Point*. And thus this Licensing Board would appear to be bound by the Commission's interpretation of § 51.53(c)(3)(iv) in *Turkey Point*, to the effect that § 51.53(c)(3)(iv) creates an exception to Section 51.53(c)(3)(i) in the context of the requirements for ERs and EISs but *not* with regard to the scope of issues permitted to be raised in contentions in a license renewal adjudication context, absent a waiver. . . .[71]

In other words, reading Subsections (i) and (iv) together, an applicant's ER must address new and significant information about even those matters otherwise precluded from consideration by rule. But the sufficiency of the applicant's evaluation of that new and significant information may not be litigated, absent a waiver.[72]

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69 *See Pilgrim*, LBP-06-23, 64 NRC at 298 n.170.

70 *See Vt. Yankee*, LBP-06-20, 64 NRC at 155-61; *Pilgrim*, LBP-06-23, slip op. at 294-300. Moreover, the *Pilgrim* Board reached this result despite finding the AG's interpretation to be "a reasonable reading of the rule." *See Pilgrim*, LBP-06-23, 64 NRC at 298 n.170.

71 *Pilgrim*, LBP-06-23 at 299 n.170.

72 Although Exelon and the NRC Staff have repeatedly asserted that Contention 1-E is inadmissible absent a waiver, *see supra* note 56, NRDC has not sought a waiver in this proceeding. In its Petition to Intervene, NRDC claims that it cannot seek a waiver until it has been admitted to the proceeding as a "party." *See* Petition at 25 n.7. In response to Exelon's position that NRDC is "incorrect as a matter of law," Exelon's Answer at 20, NRDC asserts that a waiver petition would not be ripe unless the Board held that SAMAs are a Category 1 issue for Limerick. *See* NRDC Reply at 11 n.6.

At the oral argument, counsel for Exelon or the NRC Staff raised NRDC's option of seeking a waiver well over a dozen times. *See* Tr. at 24 (Polonsky); *id*. at 51 (Smith); *id*. at 52 (Smith); *id*. at 54 (Polonsky); *id*. at 81 (Polonsky); *id*. at 84 (Polonsky); *id*. at 108 (Smith); *id*. at 117 (Smith); *id*. at 121 (Polonsky); *id*. at 154

Given the construction of Section 51.53(c)(3), and as Exelon made clear in its Answer, there is no basis to distinguish the above holding for a contention based on Section 51.53(c)(3)(i) from contentions based on Section 51.53(c)(3)(ii).[73] Both subsections include limits to the "conditions and considerations" that a license renewal applicant must consider.[74] And both are equally positioned with respect to Section 51.53(c)(3)(iv).[75] Thus, although it is Subsection (ii), rather than Subsection (i), that is at issue for Limerick, the *Pilgrim* and *Vermont Yankee* logic applies: Section 51.53(c)(3)(iv) creates an exception to Section 51.53(c)(3)(ii) in the context of the requirements for ERs and EISs, but *not* with regard to the scope of issues permitted to be raised in contentions in a license renewal adjudication context, absent a waiver.

The *Pilgrim* and *Vermont Yankee* Boards concluded that this outcome was "consistent with the regulatory history of 10 C.F.R. § 51.53(c)(3)(iv)."[76] They explained that Section 51.53(c)(3)(iv) was not originally part of the proposed rule.[77] When the NRC Staff discussed the addition of Section 51.53(c)(3)(iv) in a memorandum to the Commission (SECY-93-032), it specifically proposed that litigation of Category 1 environmental issues in license renewal hearings *would not be permitted, absent a waiver*.[78] This proposal was vetted openly during the

(Polonsky); *id*. at 163 (Kanatas); *id*. at 168 (Kanatas); *id*. at 172 (Polonsky); *id*. at 173 (Polonsky); *id*. at 176 (Kanatas); *id*. at 257 (Polonsky). But the Board did not once ask counsel for NRDC why it had not sought a waiver, and counsel for NRDC did not offer that information. *See generally*, Tr.

73 *See* Exelon's Answer at 33-34.

74 *See* 10 C.F.R. § 51.53(c)(3).

75 *Russello v. United States*, 464 U.S. 16, 22-23 (1983) (considering statutory structure an element of statutory interpretation); *Black & Decker Corp. v. Comm'r of Internal Revenue,* 986 F.2d 60, 65 (4th Cir. 1993) ("Regulations, like statutes, are interpreted according to the canons of construction.").

76 *Pilgrim*, LBP-06-23, 64 NRC at 295; *Vt. Yankee*, LBP-06-20, 64 NRC at 157.

77 *Pilgrim*, LBP-06-23, 64 NRC at 295-96; *Vt. Yankee*, LBP-06-20, 64 NRC at 157.

78 *See Pilgrim*, LBP-06-23, 64 NRC at 296; *Vt. Yankee*, LBP-06-20 64 NRC at 157-58. Specifically, as documented in SECY-93-032, the Staff assured the Commission that "[l]itigation of environmental issues in a hearing will be limited to [Category 2] issues unless the rule is suspended or waived." SECY-93-032, 10 CFR Part 51 Rulemaking on Environmental Review for Renewal of Nuclear Power Plant Operating Licenses at 4 (Feb. 9, 1993), available at ADAMS Accession No. ML072260444.

deliberations of the modifications to Part 51 that were supported by the 1996 GEIS and the recommendations of SECY-93-032. Notably, one Commissioner twice asked whether a petitioner could litigate a Category 1 issue, under Section 51.53(c)(3)(iv) or any other regulation, on the claim that there was new and significant information on the issue.[79] And on both occasions, the NRC Deputy General Counsel responded that the claim could not be litigated *unless the petitioner first obtained a waiver from the Commission*.[80]

It was with this understanding of the regulations that the Commission approved and finalized the addition of Section 51.53(c)(3)(iv).[81] The regulatory history of Part 51 thus unequivocally demonstrates that the Commission did not intend Section 51.53(c)(3)(iv) to allow petitioners to challenge issues precluded by rule from consideration in an ER, absent a waiver from the Commission.

That regulatory history requires the same conclusion in the instant proceeding. As Exelon explained in its Answer, the NRC Deputy General Counsel's specific assurance to the Commission was that "[l]itigation of environmental issues in a hearing will be limited to unbounded category 2 and category 3 issues unless the rule is suspended or waived."[82] At the time of those deliberations, the NRC divided environmental issues into *three* categories for the Part 51 rulemaking.[83] Under the three-category scheme, "Category 2" issues were those for which "[a] generic conclusion on the impact has been reached for affected nuclear power plants

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79 *See Pilgrim*, LBP-06-23, 64 NRC at 297; *Vt. Yankee*, LBP-06-20, 64 NRC at 158-59.

80 *Pilgrim*, LBP-06-23, 64 NRC at 297; *Vt. Yankee*, LBP-06-2064 NRC at 158.

81 *Pilgrim*, LBP-06-23, 64 NRC at 297; *Vt. Yankee*, LBP-06-20, 64 NRC at 158.

82 SECY-93-032, at 4;. *see also* Exelon's Answer at 31 n.157.

83 *See* Environmental Review for Renewal of Nuclear Power Plant Operating Licenses, 61 Fed. Reg. at 28,474; Exelon's Answer at 31 n.157. Ultimately, the Commission employed the two category scheme described at page 9, above. *See also* Environmental Review for Renewal of Nuclear Power Plant Operating Licenses, 61 Fed. Reg. at 28,473-74 (explaining the transition from three categories to two).

that fall within defined bounds."[84] "[A]pplicants would have . . . not provided additional analyses if their plant falls within the bounds defined in the rule for a Category 2 issue."[85] In other words, "bounded Category 2" issues, like Category 1 issues, need not be considered at license renewal.

Under that three-category construct, SAMA analyses would be a "bounded Category 2" issue for Limerick; that is, Limerick need not provide additional SAMA analysis, because it falls within the bounds defined in the rule.[86] And according to the NRC Deputy General Counsel's assurance, upon which the Commission relied in approving the addition of Section 51.53(c)(3)(iv), SAMA analyses—a "bounded Category 2" issue for Limerick—could not be litigated in a hearing.[87]

The Commission and the U.S. Court of Appeals for the First Circuit affirmed the boards' rulings in *Pilgrim* and *Vermont Yankee* that Section 51.53(c)(3)(iv) does not permit petitioners to challenge issues precluded under Section 51.53(c)(3)(i). After the Massachusetts AG appealed both licensing board determinations, the Commission denied the appeals and affirmed the

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84 *Id*. at 28,473.

85 *Id*.

86 *See* 10 C.F.R. § 51.53(c)(3)(ii)(L) ("If the staff has not previously considered [SAMAs] for the applicant's plant . . . .").

Although the determination is not legally significant, the Statements of Consideration for Part 51 contain further evidence that SAMA analyses are a Category 1 issue for Limerick. In the final rule, the NRC merged the three categories into two categories. *See* Environmental Review for Renewal of Nuclear Power Plant Operating Licenses, 61 Fed. Reg. at 28,473-74. Category 1 issues become those that could be resolved for *all* plants, and Category 2 was reserved for everything else. *See id*. at 28,474. The NRC explained, "[i]f the [] Category 1 criteria apply to a subset of plants that are readily defined by a common plant characteristic, [*i.e.*, prior completion of a SAMA analysis], the population of plants is partitioned into the set of plants with the characteristic and the set of plants without the characteristic. For the set of plants with the characteristic, the issue is Category 1 . . . ." *Id*. at 28,474.

87 *See supra* note 82.

licensing boards' decisions and underlying reasoning.[88] On further appeal by the Massachusetts AG, the First Circuit upheld the decisions of both licensing boards and the Commission.[89]

The First Circuit noted that NEPA permits the NRC to streamline the license renewal process via rulemakings.[90] The court further reasoned that prohibiting petitioners from challenging new and significant information pertaining to issues decided by rulemaking was permissible under NEPA, because the NRC has established "other means" to challenge those findings.[91] Specifically, individuals may petition for rulemaking, comment on the NRC Staff's draft FES, or seek a waiver from the Commission.[92] The court concluded that denial of the Massachusetts AG's contention was "reasonable in context, and consistent with [NRC] rules."[93]

Clearly then, reaching the same result in the instant proceeding would be a consistent application of the law. As the Boards in *Pilgrim* and *Vermont Yankee* noted, while NRC rules "provide a number of opportunities for individuals to alert the Commission to new and significant information that might render a generic finding invalid, either with respect to all nuclear power plants or for one plant in particular," individual licensing proceedings are not one such opportunity.[94] Likewise, NRDC has had multiple opportunities to challenge the SAMDA

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88 *Pilgrim & Vt. Yankee*, CLI-07-3, 65 NRC at 16.

89 *See generally Massachusetts*, 522 F.3d 115. The *Limerick* Board correctly noted that a First Circuit decision is not binding on the Third Circuit, the jurisdiction in which Limerick is located. *Limerick*, LBP-12-08, slip op. at 12 n.64. But this First Circuit decision does give weight to the underlying Commission decision. And that Commission decision was, of course, binding on the *Limerick* Board.

90 *See Massachusetts*, 522 F.3d at 119.

91 *Id.* at 120.

92 *See id.* at 120-21; *see also Fla. Power & Light Co.* (Turkey Point Nuclear Generating Plant, Units 3 & 4), CLI-01-17, 54 NRC at 3, 12 (2001).

93 *Massachusetts*, 522 F.3d at 127.

94 *Pilgrim*, LBP-06-23, 64 NRC at 295 (citing *Turkey Point*, CLI-01-17, 54 NRC at 12); *see also id.* ("In [statements of the Commission in *Turkey Point*], the Commission has indicated that any new and significant information on matters designated as Category 1 issues in Part 51 may be initiated by petitioners only through means other than the submission of contentions."); *see also Vt. Yankee*, LBP-06-20, 64 NRC at 156-57; *Entergy Nuclear Generation Co.* (Pilgrim Nuclear Power Station), CLI-10-14, 71 NRC 449, 475 (2010).

analysis for Limerick, as well as the NRC's rule that Limerick need not conduct an additional SAMA analysis at license renewal.[95] This licensing proceeding, however, is not another such opportunity.

Accordingly, the same reasoning that dictated the outcome in *Pilgrim* and *Vermont Yankee* must apply in the instant proceeding: petitioners in license renewal proceedings may not litigate new and significant information related to an issue precluded *by rule* absent a waiver. The Board incorrectly dismissed this precedent based on its conclusion that the Commission has not *explicitly* stated that SAMA analyses are Category 1 issues for Limerick.[96] But this was not the only argument that Exelon presented on this issue. The Board clearly erred in not fully considering Exelon's alternative position that SAMAs for Limerick cannot be challenged in a license renewal proceeding because they are excepted by rule, even absent a finding that SAMAs are Category 1 issues for Limerick.[97] In particular, despite Exelon's lengthy explanation of the applicability of this precedent in its Answer and at oral argument, as summarized above, the Board dismissed this position in only three sentences (and in so doing, demonstrated that it misunderstood Exelon's basis for citing this precedent):

> Exelon argues that 10 C.F.R. § 51.53(c)(2)(iii)(L) [(sic)] exempts Limerick from performing a SAMA, and that this regulatory exception requires that SAMAs be treated as a Category 1 issue, even if they are categorized as a Category 2 issue. We find no regulatory basis for such a wide ranging argument.[98]

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95 *See* Tr. 24-25, 119-121, 171-172 (Polonsky) (identifying multiple ways in which NRDC may challenge the SAMA analysis for Limerick).

There are also multiple ways in which the NRC ensures that Exelon's consideration of new and significant information related to SAMAs is adequate. As the NRC Staff explains in its Answer, the NRC has ongoing regulatory programs to identify plant vulnerabilities to severe accidents and consider cost beneficial improvements. *See* NRC Staff Answer at 8-13. In addition, the NRC Staff takes "a hard look at new and significant information" related to SAMAs, as part of its NEPA review. *Id*. at 13.

96 *See Limerick*, LBP-12-08, slip op. at 14.

97 *See* Exelon's Answer at 33.

98 *Limerick*, LBP-12-08, slip op. at 16 (citations omitted).

The Board said nothing further in this regard. It did not explain why Section 51.53(c)(3)(i) should be construed any differently than Section 51.53(c)(3)(ii), in relation to Section 51.53(c)(3)(iv). Nor did it explain why the regulatory history that formed the basis of the decisions in *Pilgrim* and *Vermont Yankee* did not apply equally to other issues precluded from consideration by rule, such as bounded Category 2 issues.

The Board's decision is thus clear error. Section 51.53(c)(3)(iv) is not a "loophole" through which NRDC may litigate matters that the NRC has resolved through rulemaking. Contentions challenging Section 51.53(c)(3)(ii) under the guise of Section 51.53(c)(3)(iv) are inadmissible absent a waiver from the Commission, which NRDC has not sought.

C. The Board Also Clearly Erred When It Admitted a Contention That Does Not Demonstrate a Genuine Dispute of a Material Issue

In addition, to the extent that Contention 1-E, as admitted by the Board, challenges Exelon's economic cost analysis, the Contention altogether fails to demonstrate a genuine dispute of a material issue, as required by 10 C.F.R. § 2.309(f)(1)(iv). Specifically, the second part admitted by the Board in support of Contention 1-E asks "whether Exelon's use of data from [Three Mile Island] in its analysis provides an adequate consideration of new and significant information regarding economic cost risk."[99] Yet this part of Contention 1-E fails to raise a "significant deficiency" in Exelon's ER, or demonstrate that the evaluation in the Limerick ER

[99] *Limerick*, LBP-12-08, slip op. at 25. The Board clarified that "[t]o the extent that Contention 1-E challenges Exelon's reliance on data from TMI to evaluate the significance of economic cost risks, it is admissible." *Id*. The Board also explained, consistent with Exelon's position, "to the extent the contention directly challenges the contents of the 1989 SAMDA, this portion of Contention 1-E is inadmissible." *Id*. The Board further agreed with Exelon that under 10 C.F.R. § 51.53(c)(3)(ii)(L), Exelon need not conduct another SAMA analysis for license renewal. *See id*. at 33-34; *see also* Exelon's Answer at 48 (maintaining that Exelon "is not legally obligated to conduct another SAMA analysis"). Accordingly, Exelon has not reiterated those positions in this Appeal.

was "unreasonable."[100] In fact, the support upon which the Petitioners and the Board rely shows that Exelon's analysis *is* reasonable. As a result, the Board clearly erred in admitting this basis for Contention 1-E.

In admitting this part of the contention, the Board relied on NRDC's assertion that Exelon's use of economic cost data from TMI is inappropriate because: (1) TMI is a pressurized water reactor ("PWR"), rather than a BWR, and has "correspondingly different accident scenario source terms"[101]; and (2) the economic center near TMI is "smaller and less urban" than Philadelphia, near Limerick.[102] In particular, the Board relied upon a table presented in Dr. McKinzie's Declaration, listing the ratios of economic cost risk to exposure cost risk calculated for other BWR facilities.[103] The Board found that the table provided the necessary support to render this part of the contention admissible.[104] NRDC provided, and the Board relied on, no further support for this basis, despite the Commission's instruction that "the burden is on Petitioners to come forward with the support—the 'reason to believe'—that reliance on the [data

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100 *Pilgrim*, CLI-12-01, slip op. at 24-25; *see also Union Elec. Co.* (Callaway Plant, Unit 2), CLI-11-05, slip op. at 31 (Sept. 9, 2011) (requiring that an admissible contention present "a seriously different picture of the environmental impact of the proposed project from what was previously envisioned") (citing *Hydro Resources, Inc*. (2929 Coors Road, Suite 101, Albuquerque, NM 87120), CLI-99-22, 50 NRC 3, 14 (1999); *Marsh v. Oregon Natural Resources Council*, 490 U.S. 360, 373 (1989); *Sierra Club v. Froehlke*, 816 F.2d 205, 210 (5th Cir. 1987). In the SAMA context, the Commission focuses on whether a license renewal applicant has provided a "reasonable consideration" of SAMAs. Environmental Review for Renewal of Nuclear Power Plant Operating Licenses, 61 Fed. Reg. at 28,481-82.

101 *See Limerick*, LBP-12-08, slip op. at 24.

102 *See id.* (*citing* Declaration of Thomas B. Cochran, Ph.D., Matthew G. McKinzie, Ph.D. and Christopher J. Weaver, Ph.D., on Behalf of the Natural Resources Defense Council ¶ 33 (Nov. 22, 2011) ("Declaration"), *available at* ADAMS Accession No. ML11326A322.

103 *See id.* at 24-25 (*citing* Declaration ¶ 34).

104 *See id*. at 24 ("NRDC has also provided a table showing the ratio of economic cost risk to exposure cost for nine recently renewed BWRs.") (citing Declaration ¶ 34); *id*. ("NRC regulations require a petitioner to provide 'a concise statement of the alleged facts or expert opinions which support" its position. NRDC has done this, as its Joint Declaration provides a set of alleged facts regarding the ratio of economic cost risk to exposure cost risk at other BWR facilities.") (citing Declaration ¶¶ 32-34); *id*. at 24-25 ("NRC regulations also require a petitioner to make reference to 'specific sources and documents' on which it intends to rely. NRDC has done this, as well, as it has drawn its analysis from and cited to SAMAs performed by other BWRs") (citing Declaration ¶ 34).

in question] posed a 'significant defect.'"[105]

Under NEPA, Exelon's economic cost risk analysis is adequate if it is reasonable.[106] But in admitting this part of the contention, the Board failed to address Exelon's response to the data proffered by Dr. McKinzie, in which Exelon maintained that its reliance on economic cost data from TMI is reasonable.[107] As Exelon explained in its Answer, NRDC not only failed to show that Exelon's economic cost analysis is *not* reasonable, but it actually demonstrates the reasonableness of the analysis.[108] Exelon's argument is not an attack on the merits. Rather, it is appropriate probing of an intervenor's affidavit, which the Commission itself has performed at the admissibility stage.[109] Therefore, the Board clearly erred in finding that this basis demonstrated a "genuine dispute on a material issue."[110]

By way of background, Exelon stated in its Answer that, in evaluating whether off-site economic cost risks qualified as new and significant information, economic cost risk could be represented as a percentage of offsite exposure cost risk.[111] Exelon looked to TMI Unit 1, a plant

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105 *Davis-Besse*, CLI-12-08, slip op. at 29.

106 Consideration of mitigation alternatives, including SAMAs, is governed by the NEPA "rule of reason." *Duke Energy Corp.* (McGuire Nuclear Station, Units 1 & 2; Catawba Nuclear Station, Units 1 & 2), CLI-02-17, 56 NRC 1, 12 (2002) (*citing Vt. Yankee Nuclear Power Corp. v.* [*NRDC*] , 435 U.S.519, 551 (1978); *Citizens Against Burlington v. Busey*, 938 F.2d 190, 195 (D.C. Cir. 1991)). In the SAMA context, the Commission focuses on whether a license renewal applicant has provided a "reasonable consideration" of SAMAs. Environmental Review for Renewal of Nuclear Power Plant Operating Licenses, 61 Fed. Reg. at 28,481-82.

107 *See Limerick*, LBP-12-08, slip op. at 23-25; Exelon's Answer at 47-49.

108 *See* Exelon's Answer at 48-49.

109 *See Davis-Besse*, CLI-12-08, slip op. at 26-27 (examining documents that the Board relied on in concluding the admitted contention was adequately supported); *id*. at 28 ("At the contention admissibility stage, it is *Petitioners'* burden to come forward with factual or expert support for their argument that use of [different or additional data] could have altered the SAMA analysis to show . . . significantly different cost-benefit results").

110 *Limerick*, LBP-12-08, slip op. at 25.

111 *See* Exelon's Answer at 48 (citing ER at 5-4 to 5-7, 5-8).

also located in Pennsylvania, to obtain a value for that ratio of about 70%.[112] Using that value, Exelon calculated the effect of off-site economic cost risk and determined that, even for the most cost beneficial alternatives, it "would result in an adjusted cost per person-rem averted of $5,000, which remains well above . . . the currently used $2,000 per person-rem averted threshold."[113] In other words, new information about economic cost risks did not qualify as new *and significant* information.[114]

To support NRDC's claim that the ratio of economic cost risk to exposure cost risk "exhibits a wide variation," Dr. McKinzie's Declaration provides cost ratios for eight BWR units, as well as TMI.[115] Those nine cost ratios range from -16.0% to 238.4%.[116] But the median ratio of these nine units is 63.9%, the average ratio is 62.1%, and only two reactor units have a greater ratio than TMI (72.1%): Nine Mile Point Unit 1 (91.1%) and Hope Creek (238.4%).[117] Even considering only the data in Dr. McKinzie's table from BWRs, as NRDC would have Exelon do,[118] the median economic cost ratio is 48.2%, and the average ratio is 60.8%.[119] In

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[112] Exelon's Answer at 48 (citing ER at 5-8). The actual cost risk is 72.1%, but was rounded to 70%. *See, e.g.*, Declaration ¶ 34.

[113] ER at 5-8; *see* Exelon's Answer at 48. The ER explains, "the off-site economic cost risk is approximately 70% larger than the off-site exposure cost risk. Therefore, . . . a factor of 3 increase in the person-rem averted value for each SAMDA would provide an approximation for the impact due to economic cost." ER at 5-8. In other words, because off-site economic cost for TMI is 72% higher than off-site dose cost, off-site economic cost can be viewed as 1.72 times larger than off-site dose cost. Dose cost (a factor of 1) plus economic cost (a factor of 1.72) results in a factor of 2.72, which Exelon conservatively rounded to 3.

[114] *See* Exelon's Answer at 48 (citing ER at 5-8).

[115] Declaration ¶¶ 33-34.

[116] Declaration ¶ 34.

[117] Declaration ¶ 34.

[118] Declaration ¶ 33 ("TMI is also an inappropriate example to use in estimating economic cost for Limerick because TMI is a [PWR] rather than a BWR"). In admitting Contention 1-E, the Board relied on NRDC's position that economic cost data from TMI are inappropriate for use at Limerick because TMI is a PWR. *See Limerick*, LBP-12-08, slip op. at 24. But the Board ignores Exelon's argument that NRDC's own data demonstrate that the TMI value is reasonable, in light of values for the BWRs in Dr. McKenzie's table.

The Board also relied upon NRDC's position that Exelon's use of TMI data was unreasonable because the economic center near TMI is smaller and less urban than that near Limerick. *See Limerick*, LBP-12-08, slip op. at 24. Yet NRDC's own data fail to illustrate the materiality of proximate urban areas. For other words, and as Exelon's Answer makes clear, for all but two of the eight BWRs referenced by NRDC, economic cost risks represented a *lower* (*i.e.*, less conservative) ratio of exposure cost risks than Exelon assumed in the Limerick ER.[120] It is clear error for the Board to ignore this argument.

NRDC would have Exelon "fine tune" its economic cost analysis by conducting site-specific economic risk calculations for Limerick.[121] But NRDC has not shown that the economic cost risk value used by Exelon is not reasonable, or that it produced a "significant deficiency" in the NEPA analysis.[122] This basis is not admissible on the mere premise that another economic cost analysis might be superior. As the Commission recently explained,

> To challenge an application, a petitioner must point with support to an asserted deficiency that renders the SAMA analysis unreasonable under NEPA. In other words, '[a] contention proposing alternative inputs or methodologies must present some factual or expert basis for why the proposed changes in the analysis are warranted (*e.g.*, why the inputs or methodology used is unreasonable, and the proposed changes or methodology would be more appropriate).' Unless a petitioner sets forth a supported contention pointing to an apparent error or deficiency that may have significantly skewed the environmental conclusions, there is no genuine material dispute for hearing.[123]

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example, the ratios for the Nine Mile Point units shown on Dr. McKinzie's table vary (22.8% and 91.1%), although the units are co-located. *See* Declaration ¶ 34.

119 Declaration ¶ 34.

120 *See* Exelon's Answer at 47-49.

121 *See Pilgrim*, CLI-12-01, slip op. at 24-25 ("There is questionable benefit to spending considerable agency resources in an attempt to fine-tune a NEPA mitigation analysis.").

122 *See Pilgrim*, CLI-12-01, slip op. at 24-25 ("With respect to a SAMA analysis in particular, unless a contention, submitted with adequate factual, documentary, or expert support, raises a potentially *significant deficiency* in the SAMA analysis—that is, a deficiency that could credibly render the SAMA analysis altogether unreasonable under NEPA standards—a SAMA-related dispute will not be material to the licensing decision, and is not appropriate for litigation in an NRC proceeding.").

123 *Davis-Besse*, CLI-12-08, slip op. at 18 (citing *Seabrook*, CLI-12-05, slip op. at 29); *see also Pilgrim*, CLI-12-01, slip op. at 24-25.

Exelon does not dispute that the ratio of economic cost risk to exposure cost risk may vary between plants.[124] But NEPA requires only "reasonable" analyses.[125] Plainly, Dr. McKinzie's data support a conclusion that the use of the TMI value for the ratio of economic cost risk to exposure cost risk is "reasonable," and thus consistent with NEPA requirements. But the Board altogether failed to address this result. And neither NRDC nor the Board relied on any other support for the premise that Exelon's analysis is unreasonable. Accordingly, the Board's admission of this aspect of Contention 1-E represents clear error, as it fails to raise a genuine dispute of a material issue, and thus fails to satisfy the contention admissibility requirement under Section 2.309(f)(1)(iv).

[124] *See* Exelon's Answer at 49.

[125] *Davis-Besse*, CLI-12-08, slip op. at 5 (NEPA requires consideration of 'reasonable' alternatives."); *Private Fuel Storage*, CLI-02-25, 56 NRC 340, 348-49 (2002) ("It is well established that NEPA requires only a discussion of 'reasonably foreseeable' impacts. Grappling with this concept, various courts have described it as a 'rule of reason,' or 'rule of reasonableness,' which excludes 'remote and speculative' impacts or 'worst-case' scenarios.") (citations omitted).

V. CONCLUSION

For the foregoing reasons, the Commission should reverse the Board's admission of Contention 1-E. Because this is the only contention admitted by the Board, the Commission also should terminate the proceeding.

Respectfully submitted,

Signed (electronically) by Alex S. Polonsky

Alex S. Polonsky
Kathryn M. Sutton
Anna V. Jones
Morgan, Lewis & Bockius LLP
1111 Pennsylvania Avenue, NW
Washington, DC 20004
Phone: 202-739-5830
Fax: 202-739-3001
E-mail: apolonsky@morganlewis.com

J. Bradley Fewell
Vice President and Deputy General Counsel
Exelon Generation Company, LLC
200 Exelon Way
Kennett Square, PA 19348
Phone: 630-657-3769
Fax: 630-657-4335
E-mail: Bradley.Fewell@exeloncorp.com

COUNSEL FOR EXELON

Dated in Washington, D.C.
this 16th day of April 2012

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD

Before Administrative Judges:

William J. Froehlich, Chairman
Dr. Michael F. Kennedy
Dr. William E. Kastenberg

In the Matter of:	Docket No. 50-352-LR, 50-353-LR
EXELON GENERATION COMPANY LLC	ASLBP No. 12-916-04-LR-BD01
(Limerick Generating Station, Units 1 & 2)	August 8, 2012

ORDER
(Suspending Procedural Date Related to Proposed Waste Confidence Contention)

This proceeding concerns the application filed by Exelon Generation Company LLC (Exelon) to extend its operating licenses for the Limerick Generating Station, Units 1 and 2 (Limerick) for an additional twenty years (i.e., until October 26, 2044 for Unit 1, and June 22, 2049 for Unit 2) pursuant to Part 54 of Title 10 of the Code of Federal Regulations.[1] In response to an August 24, 2011 notice of opportunity for hearing published in the Federal Register,[2] the Natural

[1] License Renewal Application; Limerick Generating Station (June 2011) (ADAMS Accession No. ML11179A101) [hereinafter Application]. The application also seeks renewal of the associated source material, special nuclear material, and by-product material licenses under 10 C.F.R. Parts 30, 40, and 70.

[2] Notice of Acceptance for Docketing of the Application and Notice of Opportunity for Hearing Regarding Renewal of Facility Operating License Nos. NPF-39 and NPF-85 for an Additional 20-Year Period; Exelon Generation Co., LLC, Limerick Generating Station, 76 Fed. Reg. 52,992, 52,992 (Aug. 24, 2011).

Resources Defense Council (NRDC) filed a petition to intervene and request for hearing on the Limerick application, setting forth four contentions.[3]

In an April 4, 2012 memorandum and order, the Board ruled that NRDC had standing to intervene in this proceeding.[4] The Board admitted a narrowed version of Contention 1-E, challenging Exelon's consideration of new and significant information regarding severe accident mitigation alternatives.[5]

On July 9, 2012 NRDC filed a Motion for Leave to File a New Contention Concerning Temporary Storage and Ultimate Disposal of Nuclear Waste at Limerick.[6] The Motion raised a new contention largely based on the June 8, 2012, decision of the United States Court of Appeals for the District of Columbia Circuit in State of New York v. NRC, 681 F.3d 471 (D.C. Cir. 2012). On August 2, 2012 the NRC Staff and Exelon filed Answers to the motion.[7] NRDC's reply to these answers is currently due August 16, 2012.[8]

On August 7, 2012, however, the Commission issued CLI-12-16, which addressed many of the issues concerning temporary storage and ultimate disposal of nuclear waste raised by NRDC

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[3] Natural Resources Defense Council Petition to Intervene and Notice of Intention to Participate (Nov. 22, 2011).

[4] LBP-12-08, 75 NRC __, __ (slip op. at 7) (Apr. 4, 2012).

[5] See id. at 40.

[6] Motion for Leave to File a New Contention Concerning Temporary Storage and Ultimate Disposal of Nuclear Waste (July 9, 2012) (Agencywide Documents Access and Management System ("ADAMS") Accession No. ML12191A408) ("Motion") and Waste Confidence Contention (July 9, 2012) (ADAMS Accession No. ML12191A408) ("Contention").

[7] See NRC Staff's Response to NRDC's Motion for Leave to File a New Contention Concerning Temporary Storage and Ultimate Disposal of Nuclear Waste at Limerick and NRDC's Waste Confidence Contention (Aug. 2, 2012); Exelon's Answer Opposing NRDC's New Waste Confidence Contention (Aug. 2, 2012).

[8] See Initial Scheduling Order (May 7, 2012) at 7 (unpublished) (granting Intervenors 14 days, rather than the standard seven days, to file a reply to answers to a motion to admit a new contention).

in this docket.[9] The Commission, citing this proceeding[10] and numerous other proceedings where similar contentions were filed, exercised its inherent supervisory authority over adjudications, and directed that these contentions—and any related contentions that may be filed in the near term—be held in abeyance pending further Commission order.[11]

Given the Commission's direction in CLI-12-16 that the proceedings before the boards be held in abeyance, the August 16, 2012 deadline for any NRDC reply is suspended.[12]

It is so ORDERED.

FOR THE ATOMIC SAFETY AND
LICENSING BOARD

/RA/

William J. Froehlich, Chairman
ADMINISTRATIVE JUDGE

Rockville, Maryland
August 8, 2012

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[9] See Calvert Cliffs Nuclear Project, LLC (Calvert Cliffs Nuclear Power Plant, Unit 3), CLI-12-16, 76 NRC __ (slip op.) (Aug. 7, 2012).

[10] See id. at 5 n.10.

[11] Id. at 6.

[12] We note, however, that should the Commission send the waste confidence issue to the Board for decision, NRDC will be given an opportunity to file its reply. See id. at 5 ("To the extent that the NRC takes action with respect to waste confidence on a case-by-case basis, litigants can challenge such site-specific agency actions in our adjudicatory process.").

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

COMMISSIONERS:

Allison M. Macfarlane, Chairman
Kristine L. Svinicki
George Apostolakis
William D. Magwood, IV
William C. Ostendorff

In the Matter of	)	
EXELON GENERATION COMPANY, LLC	)	Docket Nos. 50-352-LR & 50-353-LR
(Limerick Generating Station, Units 1 and 2)	)	

CLI-12-19

MEMORANDUM AND ORDER

Exelon Generation Company, LLC (Exelon) and the NRC Staff have appealed the Atomic Safety and Licensing Board's decision in LBP-12-8,[1] which granted the Natural Resources Defense Council's (NRDC) request for hearing.[2] For the reasons set forth below, we reverse the Board's decision. However, we remand the proceeding to the Board for the limited purpose of considering a waiver petition in accordance with 10 C.F.R. § 2.335(b) through (d), which NRDC may submit by Tuesday, November 27, 2012.

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[1] *Exelon's Notice of Appeal of LBP-12-08* (Apr. 16, 2012) (Exelon Notice of Appeal); *Exelon's Brief in Support of the Appeal of LBP-12-08* (Apr. 16, 2012) (Exelon Appeal); *NRC Staff's Notice of Appeal of LBP-12-08* (Apr. 16, 2012); *NRC Staff's Appeal of LBP-12-08* (Apr. 16, 2012) (NRC Staff Appeal).

[2] LBP-12-8, 75 NRC __ (Apr. 4, 2012) (slip op.).

I. BACKGROUND

In response to a notice of opportunity for hearing,[3] NRDC filed a request for hearing and petition to intervene in this license renewal proceeding, submitting four proposed contentions.[4] Although Exelon and the Staff did not challenge NRDC's standing, they argued that NRDC had not submitted an admissible contention, and therefore opposed the hearing request.[5] In LBP-12-8, the Board admitted a narrowed version of Contention 1-E, which asserts that Exelon's Environmental Report both fails to consider, and inappropriately rejects as insignificant, new and significant information that calls into question the adequacy of the 1989 severe accident mitigation design alternatives (SAMDA) analysis that the Staff completed in support of its approval of Limerick's initial operating licenses.[6] The Board dismissed the remaining portions of Contention 1-E, as well as Contentions 2-E and 3-E, which raise similar challenges to the 1989 SAMDA analysis.[7]

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[3] Notice of Acceptance for Docketing of the Application and Notice of Opportunity for Hearing Regarding Renewal of Facility Operating License Nos. NPF-39 and NPF-85 for an Additional 20-Year Period; Exelon Generation Company, LLC, Limerick Generating Station, 76 Fed. Reg. 52,992 (Aug. 24, 2011).

[4] *Natural Resources Defense Council Petition to Intervene and Notice of Intention to Participate* (Nov. 22, 2011) (Hearing Request). The Secretary of the Commission extended the time for NRDC to submit its hearing request until November 22, 2011. Order (Oct. 17, 2011), at 2 (unpublished).

[5] *See Exelon's Answer Opposing NRDC's Petition to Intervene* (Dec. 20, 2011), at 1 (Exelon Answer to Hearing Request); *NRC Staff's Answer to Natural Resource[s] Defense Council Petition to Intervene and Notice of Intention to Participate* (Dec. 21, 2011), at 1.

[6] *See generally* "Final Environmental Statement Related to the Operation of Limerick Generating Station, Units 1 and 2," NUREG-0974 Supplement (Aug. 1989) (ADAMS accession no. ML11221A204).

[7] *See* LBP-12-8, 75 NRC at __ (slip op. at 40). The Board also dismissed Contention 4-E, which challenges the Environmental Report's discussion of the "no-action alternative." *See id.*

On appeal, Exelon and the Staff ask us to reverse the Board's admission of Contention 1-E, which would result in the denial of NRDC's hearing request. NRDC opposes the appeals.[8]

II. DISCUSSION

Our rules of practice provide an appeal as of right on the question whether—as relevant here—a hearing request should have been "wholly denied."[9] We generally defer to board contention admissibility rulings in the absence of an error of law or abuse of discretion.[10] We apply this standard of review today in ruling on Exelon's and the Staff's appeals.

In order to grant a hearing request, a board must find that the petitioner has standing and has proposed at least one admissible contention.[11] NRDC's standing is not before us on appeal, and we do not address it. However, as discussed below, this case presents a difficult question on the issue of contention admissibility, whose resolution depends on the interplay between two provisions of our license renewal regulations. We ultimately find that the Board erred in admitting Contention 1-E.

Our Part 2 rules of practice govern the admissibility of contentions. Relevant here, section 2.335(a) provides that a contention may not challenge an agency rule or regulation in any adjudicatory proceeding absent a waiver from the Commission; subsections (b) through (d)

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[8] *Natural Resources Defense Council's Response to Appeals by Exelon, Inc. and NRC Staff of LBP-12-08* (Apr. 26, 2012) (NRDC Answer).

[9] 10 C.F.R. § 2.311(d)(1).

[10] *See, e.g.*, *NextEra Energy Seabrook, LLC* (Seabrook Station, Unit 1), CLI-12-5, 75 NRC __, __ (Mar. 8, 2012) (slip op. at 8).

[11] 10 C.F.R. § 2.309(a).

set forth the procedure for obtaining a waiver.[12] At bottom, the parties disagree over whether Contention 1-E impermissibly challenges 10 C.F.R. § 51.53(c)(3)(ii)(L), which requires a license renewal applicant's environmental report to include a consideration of alternatives to mitigate severe accidents "[i]f the staff has not previously considered [them] for the applicant's plant in an environmental impact statement or related supplement or in an environmental assessment."[13]

A. Relevant History

In 1989, the Staff conducted a SAMDA analysis as part of its review of Limerick's operating license application, in response to a remand from a decision by the U.S. Court of Appeals for the Third Circuit the same year.[14] The court had invalidated a Commission policy statement that would have precluded the consideration of SAMDAs at the operating license stage. It found that the policy statement was not a sufficient vehicle to preclude the consideration of SAMDAs, and held that the Commission must take the requisite "hard look" at SAMDAs, giving them "'the careful consideration and disclosure required by [the National Environmental Policy Act (NEPA)].'"[15]

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[12] *Id.* § 2.335(a)-(d). Exelon and the Staff also assert that Contention 1-E fails to meet the general admissibility criteria in 10 C.F.R. § 2.309(f)(1). *See* Exelon Appeal at 22-27 (citing 10 C.F.R. § 2.309(f)(1)(iv)); NRC Staff Appeal at 10-19 (citing 10 C.F.R. § 2.309(f)(1)(iv), (vi)). We need not address this issue today. The applicability of section 2.335(a) is dispositive of the appeals, for the reasons discussed below.

[13] 10 C.F.R. § 51.53(c)(3)(ii)(L).

[14] *See Limerick Ecology Action, Inc. v. NRC*, 869 F.2d 719, 741 (3d Cir. 1989).

[15] *Id.* at 736-37, 739 (quoting *Baltimore Gas & Elec. Co. v. Natural Res. Def. Council*, 462 U.S. 87, 98 (1983)).

Later, as part of our 1996 rulemaking to amend Part 51, we decided to address severe accident mitigation on a site-specific basis.[16] With the goal of increasing efficiency in our review of license renewal applications, the Part 51 amendments codified impact findings for certain "Category 1" environmental issues that generically apply to all plants or a subset of plants.[17] The environmental analysis of Category 1 issues is contained in our Generic Environmental Impact Statement for License Renewal (GEIS).[18] For other environmental issues, or "Category 2" issues, we require individual applicants to include a site-specific environmental analysis in their license renewal applications.[19] We designated severe accident mitigation alternatives (SAMA) analysis as a "Category 2" issue.[20] However, we provided an exception in section

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[16] *See* Final Rule, Environmental Review for Renewal of Nuclear Power Plant Operating Licenses, 61 Fed. Reg. 28,467, 28,480-82 (June 5, 1996) (Part 51 Amendments).

[17] *See id.* at 28,467-68. Category 1 issues are those for which the Staff has determined that: "(1) the environmental impacts associated with the issue . . . apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics; (2) a single significance level (i.e., small, moderate, or large) has been assigned to the impacts . . . ; and (3) . . . additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation." "Generic Environmental Impact Statement for License Renewal of Nuclear Plants—Main Report" (Final Report), NUREG-1437, Vol. 1 (May 1996), at 1-5 (GEIS) (ML040690705).

[18] A license renewal applicant need not include analyses of the environmental impacts of Category 1 issues in its environmental report; the Staff incorporates the GEIS analysis of Category 1 issues as part of the overall cost-benefit balance in the supplemental environmental impact statement (SEIS) for license renewal. 10 C.F.R. §§ 51.53(c)(3)(i), 51.95(c)(4); GEIS at 1-5.

[19] 10 C.F.R. § 51.53(c)(3)(ii); GEIS at 1-5 to 1-6.

[20] *See* 10 C.F.R. pt. 51, subpt. A, app. B (Postulated Accidents); *id.* § 51.53(c)(ii)(3)(L); Part 51 Amendments, 61 Fed. Reg. 28,480. The GEIS addresses severe accident *consequences* for all plants, which we have determined to have a small environmental impact after factoring in their low probability of occurrence. The Category 2 issue, then, focuses on severe accident *mitigation*, to further reduce severe accident risk (probability or consequences). *See* 10 C.F.R. pt. 51, subpt. A, app. B; GEIS at 1-6. *See generally Entergy Nuclear Generation Co. and* (continued . . .)

51.53(c)(ii)(3)(L) for plants for which the Staff already had conducted a severe accident mitigation analysis (which at that time included Limerick Units 1 and 2, Comanche Peak Units 1 and 2, and Watts Bar Unit 1), stating that "severe accident mitigation alternatives need not be reconsidered for these plants for license renewal."[21] At the same time, we recognized in promulgating the Part 51 amendments that, consistent with our obligations under NEPA, we must "review and consider any new and significant information presented during the review of individual license renewal applications."[22] To aid us in this endeavor, we added a requirement that license renewal applicants include in their environmental reports any new and significant information of which they are aware.[23]

Because the Staff already considered SAMAs (albeit SAMDAs, or mitigation alternatives relating to the plant's design) as part of its review of the Limerick operating licenses, Exelon and the Staff both argue that NRDC's attempt to litigate SAMA-related issues now presents an improper challenge to section 51.53(c)(3)(ii)(L).[24] NRDC, on the other hand, argues that these

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(. . . continued)
Entergy Nuclear Operations, Inc. (Pilgrim Nuclear Power Station), CLI-12-1, 75 NRC __, __ (Feb. 9, 2012) (slip op. at 2-5).

[21] Part 51 Amendments, 61 Fed. Reg. at 28,481. *See also* GEIS at 5-106 to 5-107.

[22] Part 51 Amendments, 61 Fed. Reg. at 28,468. *See also id.* at 28,470 (explaining that in response to comments on the proposed rule, including those from the Council on Environmental Quality and the Environmental Protection Agency, "the framework for consideration of significant new information has been revised and expanded").

[23] *See id.* at 28,488; 10 C.F.R. § 51.53(c)(3)(iv).

[24] *See* Exelon Appeal at 11-12 ("The threshold legal issue on appeal is whether the adequacy of Exelon's analysis of new and significant information related to SAMAs is litigable in a license renewal proceeding, absent a waiver from the Commission under [s]ection 2.335."); NRC Staff Appeal at 5 ("Contention 1-E as admitted by the Board is outside the scope of this proceeding because it claims that new and significant information impacts a generic determination in the Commission's regulations without seeking a rule waiver pursuant to 10 C.F.R. § 2.335.").

issues may be challenged in this license renewal proceeding despite the exception in section 51.53(c)(3)(ii)(L), because 10 C.F.R. § 51.53(c)(3)(iv), a subsection of the same regulation, requires Exelon to include in its environmental report any new and significant information.[25] NRDC asserts that Contention 1-E permissibly challenges the adequacy of the new information relating to severe accident mitigation that Exelon identified in its Environmental Report.[26]

B. Analysis of the Board's Ruling

Contention 1-E, as originally proposed, described several areas of purportedly new and significant information that, according to NRDC, Exelon either failed to consider or improperly dismissed as insignificant.[27] The Board rejected all but two.[28] As admitted, Contention 1-E asserts that Exelon's Environmental Report is deficient because it: (1) fails to include new and significant information regarding potential mitigation alternatives that have been considered for other boiling water reactors with Mark II containments; and (2) incorrectly dismisses new economic cost risk data as insignificant because Exelon relies on data from Three Mile Island—a pressurized water reactor.[29] Specifically, NRDC concludes that if Exelon were to consider this

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[25] *See* NRDC Answer at 10 ("A recurring, in fact the central, theme of [Exelon's and the Staff's] appeals is that because an NRC rule, 10 C.F.R. § 51.53(c)(3)(ii)(L), purportedly absolves Exelon of the legal obligation to conduct a SAMA [analysis], Exelon cannot be compelled to [do so] absent a waiver of that rule. The fundamental flaw in this argument is that . . . . [what] is sought by NRDC is that Exelon properly analyze new and significant information related to the continuing applicability of the environmental conclusions stemming from the 1989 SAMDA analysis.").

[26] *See id.* *See generally* License Renewal Application, Limerick Generating Station, Units 1 and 2, Appendix E, Applicant's Environmental Report – Operating License Renewal Stage (June 22, 2011), at 5-1 to 5-9 (ML11179A104) (Environmental Report).

[27] *See* Hearing Request at 16-19.

[28] LBP-12-8, 75 NRC at __ (slip op. at 40).

[29] *Id.* at __ (slip op. at 19-21, 23-25, 40).

information, "individually and especially in combination," it "would plausibly cause a materially different result in the SAMA analysis for Limerick and render the [1989] SAMDA analysis upon which Exelon relies incomplete."[30]

In ruling on the contention's admissibility, the Board distinguished between challenges to the 1989 SAMDA analysis—which, the Board reasoned, were impermissible based on section 51.53(c)(3)(ii)(L)—and challenges to the new and significant information in Exelon's Environmental Report based on section 51.53(c)(3)(iv).[31] The Board thus admitted those portions of Contention 1-E that it found to be proper challenges to the new and significant information in Exelon's Environmental Report, but rejected the portions that it found to be improper challenges to the 1989 SAMDA analysis. In doing so, the Board reasoned that the requirement to include new and significant information essentially trumps the codified exception that certain plants, like Limerick, for which the Staff already had considered mitigation alternatives under NEPA, need not include another SAMA analysis in their environmental reports.[32] Accordingly, for the admitted portions of Contention 1-E that claim the existence of new and significant information, the Board held that NRDC was not required to submit a petition for waiver or satisfy the waiver criteria in section 2.335(b).[33]

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[30] *See Declaration of Thomas B. Cochran, Ph.D., Matthew G. McKinzie, Ph.D. and Christopher J. Weaver, Ph.D., on Behalf of the Natural Resources Defense Council* (Nov. 22, 2011), at 3 (NRDC Declaration) (appended to Hearing Request).

[31] *See* LBP-12-8, 75 NRC at __ (slip op. at 11-27).

[32] *See, e.g.*, *id.* at __ (slip op. at 19) (observing that "[d]etermining whether information regarding SAMAs is 'new' and 'significant' does not involve . . . performing an entirely new SAMA analysis").

[33] *See id.* at __ (slip op. at 27).

On appeal, Exelon and the Staff urge us to apply precedent from the *Vermont Yankee* and *Pilgrim* license renewal proceedings.[34] In those cases, we resolved a similar issue concerning the interplay between two subsections of 51.53(c)(3) and, particularly, whether purported new and significant information could be litigated in an adjudicatory proceeding absent a waiver.[35] The contention in *Vermont Yankee* and *Pilgrim*[36] involved a challenge to a "Category 1" environmental issue, meaning that the Staff had considered the underlying issue in the GEIS and determined that licensees of all plants, or a subset of plants, need not consider the issue anew in their license renewal applications.[37] There, the petitioner argued that new and significant information rendered the GEIS analysis of the environmental impacts of spent fuel pool storage inadequate, and asserted that the applicants therefore were required to discuss the issue in their environmental reports.[38]

We upheld the *Vermont Yankee* and *Pilgrim* Boards' rejection of the contention as an improper challenge to 10 C.F.R. § 51.53(c)(3)(i).[39] We found that the new and significant information requirement in 10 C.F.R. § 51.53(c)(3)(iv) did not override, for the purposes of litigating the issues in an adjudicatory proceeding, the exclusion of Category 1 issues in

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[34] *See* Exelon Appeal at 21; NRC Staff Appeal at 9-10.

[35] *See Entergy Nuclear Vermont Yankee, LLC, and Entergy Nuclear Operations, Inc.* (Vermont Yankee Nuclear Power Station), CLI-07-3, 65 NRC 13, 16 (2007) (*Vermont Yankee/Pilgrim*).

[36] The petitioner filed the same contention in both proceedings. *Id.* at 16, 18.

[37] *Id.* at 16-17.

[38] *Id.* at 18-19.

[39] *See id.* at 20 ("Fundamentally, any contention on a 'Category 1' issue amounts to a challenge to our regulation that bars challenges to generic environmental findings.").

10 C.F.R. § 51.53(c)(3)(i) from site-specific review.[40] As we explained, "[a]djudicating Category 1 issues site by site based merely on a claim of 'new and significant information,' would defeat the purpose of resolving generic issues in a GEIS."[41] Therefore, we determined that a waiver was required to litigate any new and significant information relating to a Category 1 issue.[42] Because the petitioner had not requested a waiver, we affirmed the Boards' rejection of the contention.[43]

Although the Board in this proceeding took our decision in *Vermont Yankee* and *Pilgrim* into account, the Board distinguished that decision from the circumstances presented here.[44] The Board placed particular emphasis on the fact that the *Vermont Yankee*/*Pilgrim* decision involved litigation of an issue that Part 51 (which codifies the GEIS findings) "explicitly declares [to be] Category 1," thereby excluding it from case-by-case litigation.[45] Observing that Contention 1-E raises issues related to mitigation of severe accidents—a site-specific, Category 2 issue—the Board determined that the *Vermont Yankee*/*Pilgrim* decision could not be applied

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[40] *See id.* at 21.

[41] *Id.* The *Vermont Yankee* and *Pilgrim* Boards had based their decision on our ruling in *Turkey Point*, which also involved an attempt to litigate a Category 1 issue in a license renewal proceeding. *See id.* at 19-20 (citing *Florida Power and Light Co.* (Turkey Point Nuclear Generating Plant, Units 3 and 4), CLI-01-17, 54 NRC 3 (2001)). In *Turkey Point*, we affirmed the Board's rejection of the contention, noting that the petitioner had not requested a waiver. *See Turkey Point*, CLI-01-17, 54 NRC at 22-23. In *Vermont Yankee*/*Pilgrim*, we noted with approval the Boards' reliance on *Turkey Point*. *See Vermont Yankee/Pilgrim*, CLI-07-3, 65 NRC at 16, 20-21.

[42] *Vermont Yankee/Pilgrim*, CLI-07-3, 65 NRC at 20.

[43] *Id.* at 19-21.

[44] *See* LBP-12-8, 75 NRC at __ (slip op. at 13).

[45] *Id.*

to preclude NRDC's attempt to litigate a SAMA issue unless Exelon or the Staff "establish[ed] that SAMAs are . . . Category 1 issues for Limerick."[46]

The Board was not persuaded, however, by Exelon's and the Staff's arguments that the provision in section 51.53(c)(3)(ii)(L) that exempts Exelon from preparing a fresh SAMA analysis for Limerick is the functional equivalent of a Category 1 issue. The Board noted that for another Category 2 issue—the environmental impacts of groundwater quality degradation at plants with cooling ponds at inland sites—the GEIS and Part 51 expressly label groundwater quality degradation Category 1 for plants with cooling ponds in salt marshes.[47] Based on this example, the Board reasoned that the absence of such an express Category 1 designation for plants falling within the 51.53(c)(3)(ii)(L) exception implies that we did not intend the same "Category 1" treatment for Limerick or similarly exempt plants.[48] As the Board explained, "[i]f the Commission intended SAMAs to be a Category 1 issue[,] . . . it would have said so explicitly."[49] Thus the Board concluded that NRDC may litigate its SAMA contention without a waiver, notwithstanding the fact that section 51.53(c)(3)(ii)(L) exempts Exelon from having to include a discussion of SAMAs in its Environmental Report for the Limerick license renewal application.[50]

At first blush, the Board's analysis highlights a potential ambiguity in our regulations. On the one hand, Exelon is permitted, by rule, not to prepare a site-specific supplemental SAMA analysis in conjunction with the Limerick license renewal application. On the other hand, our

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[46] *Id.*

[47] *See id.* at __ (slip op. at 13-14).

[48] *Id.* at __ (slip op. at 14).

[49] *Id.* (emphasis omitted).

[50] *See id.* at __ (slip op. at 27).

rules also provide that the license renewal application must contain any significant new information relevant to the environmental impacts of license renewal of which the applicant is aware; new information, as a general matter, may be challenged in individual adjudications.[51] Confronted with this apparent ambiguity, the Board reconciled the provisions by allowing NRDC to litigate SAMAs in this proceeding without a waiver. But after careful analysis of the regulatory history underlying this question, we find that the rules are better interpreted to require a waiver in the circumstances presented here.

We agree with Exelon and the Staff that our decision in the *Vermont Yankee* and *Pilgrim* proceedings is analogous to the question before us today. As the Board observed, *Vermont Yankee*/*Pilgrim* arguably is distinguishable because it involved a "Category 1" generic issue, whereas SAMAs are designated as "Category 2" site-specific issues. However, our decision in *Vermont Yankee*/*Pilgrim* fundamentally was predicated on the fact that the contention amounted to a challenge to an NRC regulation, contrary to section 2.335(a).[52] Similarly, Contention 1-E, reduced to its simplest terms, amounts to a challenge to section 51.53(c)(3)(ii)(L). The assumption underlying Contention 1-E is that Exelon's 1989 SAMDA analysis is out-of-date, which Exelon then must remedy in its Environmental Report, even though this is something that section 51.53(c)(3)(ii)(L) otherwise exempts Exelon from having to do.

For Limerick and similarly-situated plants for which SAMAs were already considered in an Environmental Impact Statement or Environmental Assessment, the SAMA issue has been

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[51] *See, e.g.*, *Duke Energy Corp.* (McGuire Nuclear Station, Units 1 and 2; Catawba Nuclear Station, Units 1 and 2), CLI-02-28, 56 NRC 373, 379 (2002) (characterizing an originally-admissible contention as claiming "that there was new, significant information that [the applicant] should have taken into account or acknowledged when performing its SAMA cost-benefit analyses.").

[52] *Vermont Yankee/Pilgrim*, CLI-07-3, 65 NRC at 18 n.15, 20.

resolved by rule. Indeed, Limerick is specifically named in the Statements of Consideration as a plant for which SAMAs "need not be reconsidered . . . for license renewal."[53] Consequently, the exception in section 51.53(c)(3)(ii)(L) operates as the functional equivalent of a Category 1 issue, removing SAMAs from litigation in this, as well as certain other, case-by-case license renewal adjudications.

At the same time, however, Exelon has put forward in its license renewal application new information regarding its SAMDA analysis. Exelon claims that this information—which it argues reinforces the validity of its existing SAMDA analysis—may not be challenged in this adjudication, given that no further analysis is permitted by rule. For its part, NRDC finds insufficient the information provided by Exelon, and therefore seeks to challenge the validity of the decades-old SAMDA analysis. To date, we have not been presented with precisely this factual scenario. In our view, NRDC may challenge the adequacy of the new information provided in the Limerick Environmental Report. However, based on the circumstances present here and given that our rules expressly provide that a supplemental SAMA analysis need not be performed in this case, the proper procedural avenue for NRDC to raise its concerns is to seek a waiver of the relevant provision in section 51.53(c)(3)(ii)(L).[54]

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[53] Part 51 Amendments, 61 Fed. Reg. at 28,481.

[54] That is not to say that a supplemental SAMA analysis *may never* be performed for Limerick or another facility exempted by virtue of section 51.53(c)(3)(ii)(L). We would expect that, if the Staff had in hand new information that could render invalid the original site-specific analysis, then such information should be identified and evaluated by the Staff for its significance, consistent with our NEPA requirements. *See* 10 C.F.R. § 51.95(c)(3). We also note that we have asked "the staff to review generically an applicant's duty to supplement or correct its environmental report." *Pacific Gas and Electric Co.* (Diablo Canyon Nuclear Power Plant, Units 1 and 2), CLI-12-3, 75 NRC __, __ (June 7, 2012) (slip op. at 8 n.32).

As in any case where the viability of an existing rule is questioned in an adjudication, our waiver provision in section 2.335(b) provides an avenue for a petitioner who seeks to litigate a contention in an adjudicatory proceeding that otherwise would be outside the permissible scope of the proceeding. Section 2.335(b) requires a showing of "special circumstances" demonstrating that application of the rule—here, the exception in section 51.53(c)(3)(ii)(L)—would not serve the purpose for which it was adopted.[55] Alternatively, the petitioner may seek rulemaking to rescind the exception in section 51.53(c)(3)(ii)(L), in accordance with 10 C.F.R. § 2.802.[56] And of course, a petitioner always has the option to participate outside of the adjudication by submitting comments on the Staff's draft SEIS.[57] For the reasons discussed above, we find that, in the absence of a waiver, the Board erred in admitting Contention 1-E.

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[55] 10 C.F.R. § 2.335(b). *See also Dominion Nuclear Connecticut, Inc.* (Millstone Nuclear Power Station, Units 2 and 3), CLI-05-24, 62 NRC 551, 559-60 (2005) (outlining a four-factor test based on section 2.335(b)). Before the Board, NRDC explained that it had not submitted a waiver petition because it believed section 2.335(b) applies to admitted parties only. *See* Hearing Request at 25 n.7; *Natural Resources Defense Council ("NRDC") Combined Reply to Exelon and NRC Staff Answers to Petition to Intervene* (Jan. 6, 2012), at 11 n.6. Our case law demonstrates that petitioners, not just parties, may request a waiver in our adjudicatory proceedings. *See, e.g.*, *Pacific Gas and Electric Co.* (Diablo Canyon Nuclear Power Plant, Units 1 and 2), CLI-11-11, 74 NRC __, __ (Oct. 12, 2011) (slip op. at 23-34); *Vermont Yankee/Pilgrim*, CLI-07-3, 65 NRC at 20-21; *Turkey Point*, CLI-01-17, 54 NRC at 21-23. As Exelon points out, there are places in our rules where "party" is used not as a term of art, but rather as a substitute for "participant." *See* Exelon Appeal at 16-17 n.72; Exelon Answer to Hearing Request at 20 n.113 (citing *Massachusetts v. United States*, 522 F.3d 115, 129 (1st Cir. 2008)). That is the case with section 2.335(b). Indeed, we recently approved corrections and clarifications to 10 C.F.R. Part 2, including a revision to section 2.335(b) that replaces "party" with "participant." *See* Amendments to Adjudicatory Process Rules and Related Requirements; Final Rule, 77 Fed. Reg. 46,562, 46,583 (Aug. 3, 2012).

[56] *See* 10 C.F.R. § 2.802(a) ("Any interested person may petition the Commission to issue, amend or rescind any regulation.").

[57] *See id.* §§ 51.73, 51.74. *See also* Part 51 Amendments, 61 Fed. Reg. at 28,470 ("[T]he NRC will review comments on the draft SEIS and determine whether such comments introduce new and significant information not considered in the GEIS analysis. All comments on the applicability of the analyses of impacts codified in the rule and the analysis contained in the draft (continued . . .)

That said, however, the circumstances presented here lead us to remand the proceeding to the Board for the limited purpose of permitting NRDC an opportunity to petition for waiver of section 51.53(c)(3)(ii)(L) as it applies to the Limerick SAMDA analysis. We include in the remand Contentions 1-E, 2-E and 3-E, to the extent the Board dismissed them as challenges to the rule.[58]

Ordinarily, our review of the Board's dismissal of Contentions 2-E and 3-E would await the end of the case.[59] But the very analysis that we reverse today runs throughout these claims as well.[60] We find that it would be inefficient to wait until the Board's final decision in this matter only to reach the same result.

(. . . continued)
[SEIS] will be addressed by NRC in the final [SEIS] in accordance with 40 CFR 1503.4, regardless of whether the comment is directed to impacts in Category 1 or 2."); GEIS at 1-10 to 1-11. NRDC filed comments on the SAMA analysis during the Staff's environmental scoping process. *See* Fettus, Geoffrey H., Senior Project Attorney, NRDC, et al., letter to Cindy Bladey, U.S. Nuclear Regulatory Commission (Oct. 28, 2011) (ML11307A456).

[58] We do not include NRDC's claims relating to population data, core damage frequency, cleanup costs, or the quality of the human environment that the Board dismissed for insufficient support. *See* LBP-12-8, 75 NRC at __ (slip op. at 18, 23, 26-27). Additionally, we do not include Contention 4-E, because it concerns the no-action alternative, an unrelated issue. *See id.* at __ (slip op. at 34-39); Hearing Request at 23.

[59] *See generally* 10 C.F.R. §§ 2.311, 2.341.

[60] *See, e.g.*, LBP-12-8, 75 NRC at __ (slip op. at 10-27, 30, 34). The balance of Contention 1-E involves the use of additional population data, the use of historical data to calculate core damage frequency, cleanup cost estimates, and the analysis of impacts to the quality of the human environment. The issues in Contentions 1-E, 2-E, and 3-E overlap to a certain extent, but differ in their ultimate conclusions. In addition to the issues identified in Contention 1-E, Contention 2-E also includes claims involving meteorological data and evacuation time estimates. Contention 2-E argues that because the 1989 SAMDA analysis relies on inadequate and outdated data and methodologies, the Environmental Report does not provide a reliable basis for the conclusion that there are no cost-beneficial mitigation alternatives. Contention 3-E includes the issues identified in Contentions 1-E and 2-E, as well as claims involving severe accident scenarios and probabilistic risk assessment methodology. Contention 3-E argues that because the 1989 SAMDA analysis relies on inadequate and outdated data and methodologies,
(continued . . .)

In view of this ruling, we do not consider Exelon's or the Staff's remaining challenges to the Board's application of the general contention admissibility factors in 10 C.F.R. § 2.309(f)(1)—either Exelon's argument that NRDC's economic cost risk claim does not raise a genuine dispute with the application,[61] or the Staff's arguments that NRDC has not raised an issue material to the findings the NRC must make to support its decision on the application.[62] Until the waiver question has been decided, we dismiss these portions of Exelon's and the Staff's appeals without prejudice. Exelon and the Staff may renew their arguments following the decision on any waiver petition that may be filed by NRDC.

(. . . continued)
the Environmental Report incorrectly concludes that the 1989 analysis qualifies for the exception in 10 C.F.R. § 51.53(c)(3)(ii)(L). *See* Hearing Request at 16-23.

[61] *See* Exelon Appeal at 22-27 (citing 10 C.F.R. § 2.309(f)(1)(iv)).

[62] *See* NRC Staff Appeal at 10-19 (citing 10 C.F.R. § 2.309(f)(1)(iv), (vi)).

III. CONCLUSION

Contention 1-E, as admitted by the Board, amounts to an impermissible collateral attack on our regulations. We therefore find that the Board erred in admitting the contention in the absence of a waiver, and we *reverse* the Board's decision granting NRDC's intervention petition. For the reasons discussed above, we *remand* the proceeding to the Board for the limited purpose of considering a waiver petition in accordance with section 2.335(b) through (d), which NRDC may submit by Tuesday, November 27, 2012.

IT IS SO ORDERED.

For the Commission

NRC SEAL

/RA/

____
Annette L. Vietti-Cook
Secretary of the Commission

Dated at Rockville, Maryland,
this 23rd day of October, 2012.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:	)	
	)	
EXELON GENERATION COMPANY, LLC	)	**Docket No. 50-352-LR**
	)	**Docket No. 50-353-LR**
(Limerick Generating Station, Units 1 and 2)	)	
		November 21, 2012
(License Renewal Application)		

NATURAL RESOURCES DEFENSE COUNCIL'S PETITION, BY WAY OF MOTION, FOR WAIVER OF 10 C.F.R. § 51.53(c)(3)(ii)(L) AS APPLIED TO APPLICATION FOR RENEWAL OF LICENSES FOR LIMERICK UNITS 1 AND 2

In accordance with the Commission's October 23, 2012 Memorandum and Order (CLI - 12-19) (hereafter "Comm. Op."), *see* 2012 WL 5266118, and 10 C.F.R. § 2.335(b)-(d), the Natural Resources Defense Council ("NRDC") respectfully submits this petition for waiver of 10 C.F.R. § 51.53(c)(3)(ii)(L). This waiver request is supported by the attached Declaration of Christopher Weaver, Ph.D, on behalf of NRDC ("NRDC Decl.") and NRDC's Counsel, Geoffrey H. Fettus ("Counsel Decl.").[1]

I. INTRODUCTION

On October 23, 2012, the Commission reversed the Atomic Safety and Licensing Board's ("ASLB") April 4, 2012 Memorandum and Order (ASLBP No. 12-916-04-LR-BD01) (hereafter "ASLB Op."), which had admitted two bases for one of NRDC's November 22, 2011 Contentions concerning Exelon Generating Company LLC's ("Exelon") license renewal

[1] For convenience we are also attaching NRDC's Petition to Intervene and Contentions, along with the supporting technical declaration filed with that Petition ("NRDC Cont.).

application for the Limerick Generating Station, Units 1 and 2 ("Limerick"). The ASLB had ruled that, in light of the plain language of 10 C.F.R. § 51.53(c)(3)(iv) – which provides that the environmental review of a nuclear plant license renewal application must consider "any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware" – two basis for NRDC's Contention 1E regarding significant new information related to Exelon's consideration of Severe Accident Mitigation Alternatives[2] for Limerick should be admitted. ASLB Op. at 18-21. Reversing this determination, the Commission ruled that this provision is subservient to 10 C.F.R. § 51.53(c)(3)(ii)(L), which, in the Commissions' view, exempts Exelon from any SAMDA analysis requirements in connection with the relicensing, including the need to defend its Environmental Report ("ER") analysis of new and significant information that might bear on the adequacy of the 1989 SAMDA that was included in a Supplement to the Environmental Impact Statement for the Limerick Operating License. Comm. Op. at 11-15.

However, the Commission invited NRDC to submit a petition for waiver of 10 C.F.R. § 51.53(c)(3)(ii)(L), pursuant to 10 C.F.R. § 2.335(b). Comm. Op. at 13 (emphasis added). Accordingly, while continuing to maintain that no waiver of 10 C.F.R. § 51.53(c)(3)(ii)(L) is necessary, NRDC hereby seeks such a waiver, respectfully requesting that the Commission grant this request to waive the application of the regulation to permit two of NRDC's Contentions to be admitted on several bases.

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[2] Severe Accident Mitigation Alternatives, or "SAMAs" are also referred to as Severe Accident Mitigation Design Alternatives, or "SAMDAs," and will be so referred to here.

In particular, as detailed below, NRDC seeks a waiver regarding the two bases of Contention 1E admitted by the ASLB: (a) Exelon has omitted from its ER a required analysis of new and significant information regarding potential new severe accident mitigation alternatives previously considered for other BWR Mark II Containment reactors (Contention 1E-1); and (b) Exelon's reliance on data from Three Mile Island ("TMI") in its analysis of the significance of new information regarding economic cost risk constitutes an inadequate analysis of new and significant information (Contention 1E-2).

NRDC also seeks a waiver regarding Contention 3E, as to the requirement that Exelon utilize modern techniques for assessing whether the newly considered severe accident mitigation alternatives are cost-beneficial. *See* NRDC Cont. at 22 (¶¶ 1 and 3).[3]

II. STATUTORY AND REGULATORY FRAMEWORK

A. The National Environmental Policy Act

Our Nation's "basic national charter for protection of the environment," 40 C.F.R. § 1500.1(a), NEPA's purpose is to "help public officials make decisions that are based on understanding of environmental consequences, and take actions that protect, restore, and enhance the environment." *Id.* at § 1500.1(c). NEPA's "twin aims" are to force every agency "to

[3] The ASLB had denied the admissibility of Contention 3E *in toto* on the ground that the Contention is impermissible in light of 10 C.F.R. § 51.53(c)(3)(ii)(L), ASLB Op. at 31-34, but the Commission invited NRDC to seek a waiver of that regulation as to this contention. The aspect of Contention 3E that is not already addressed by Contention 1E, as admitted by the ASLB, concerns the discrete issue of Exelon's failure to use a probabilistic safety assessment severe accident consequences code system comparable to the MELCOR Accident Consequence Codes Systems 2 ("MACCS2") in its analysis, as detailed in the first and third bases of this Contention. NRDC Cont. at 22, ¶¶ 1, 3. The portion of 3E that survives the ASLB's rulings and is eligible for waiver is the contention that any new analysis of additional mitigation alternatives and any new consideration of off-site economic impacts must use an advanced probabilistic safety assessment of severe accident consequences like MACCS2. The portion of 3E that was related to flaws in the 1989 SAMDA is not the subject of this waiver request.

consider every significant aspect of the environmental impact of a proposed action," and to "inform the public that it has indeed considered environmental concerns in its decisionmaking process." *Baltimore Gas & Elec. Co. v.NRDC*, 462 U.S. 87, 97 (1983). Under NEPA, federal agencies are required to prepare an Environmental Impact Statement (EIS) for all "major Federal actions significantly affecting the quality of the human environment . . . ." 42 U.S.C. § 4332(C). Among other issues, an EIS must analyze the "environmental impact of the proposed action" and reasonable alternatives. *Id.* at § 4332(C)(I).

The completion of an EIS for a proposed action does not end an agency's responsibility to weigh the environmental impacts of a proposed action. *Marsh v. Ore. Natural Res. Council*, 490 U.S. 360, 371-72 (1989). As the Supreme Court recognized in *Marsh*, it would be incongruous with NEPA's "action-forcing" purpose to allow an agency to put on "blinders to adverse environmental effects," just because the EIS has been completed. *Id*. Accordingly, an agency must supplement its EIS if there is new information showing that the remaining federal action will affect the quality of the human environment "in a significant manner or to a significant extent not already considered." *Id.* at 374; *see also Warm Springs Dam Task Force v. Gribble*, 621 F.2d 1017, 1024 (9th Cir. 1980) ("When new information comes to light the agency must consider it, evaluate it, and make a reasoned determination whether it is of such significance as to require implementation of formal NEPA filing procedures"); *Friends of the Clearwater v. Dombeck*, 222 F.3d 552, 558 (9th Cir. 2000) (finding "no evidence in the record" that Forest Service had considered new information bearing on sufficiency of programmatic EIS to support individual timber sale).

Consistent with these duties, the Council on Environmental Quality's ("CEQ") implementing NEPA regulations require that even after a NEPA process is completed, where an agency learns of "significant new circumstances," or new "information relevant to environmental concerns and bearing on the proposed action or its impacts," 40 C.F.R. § 1502.9(c), it must supplement its NEPA review. This is a continuing obligation, and a NEPA process may require *more than one supplement* if new information comes to light even after an initial supplement is prepared. *E.g., Marsh*, 490 U.S. at 368 ("if all of the information contained in the [two documents] was both new and accurate, the Corps would have been required to prepare a *second supplemental* EIS") (emphasis added); *Deukmejian v. NRC*, 751 F.2d 1287, 1298 (D.C. Cir. 1984) (explaining that "The [NRC's] obligations under NEPA [include] a continuing duty to supplement EISs which have already become final whenever the discovery of significant new information renders the original EIS inadequate").

B. The Commission's NEPA Framework For Relicensing Nuclear Power Plants

The scope of the NEPA review for the relicensing of nuclear power plants by the NRC is set out in 10 C.F.R. Part 51 and the NRC's "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" ("GEIS") (NUREG-1437) (May 1996). NRC's NEPA regulations require an EIS for any major licensing action significantly affecting the quality of the human environment. 10 C.F.R. §§ 51.71, 51.91. Before the EIS is prepared, however, NRC's regulations require that the license applicant must prepare what amounts to a first draft of the EIS, *i.e.*, the environmental report ("ER"), 10 C.F.R. § 51.53(c)(1), *Duke Power Co.* (Catawba Nuclear Station, Units 1 and 2), CLI-83-19, 17 NRC 1041, 1049 (1983), which generally must address all the same impacts, alternatives, and other environmental issues that will be addressed later in the NRC's EIS. *Compare* 10 C.F.R. § 51.53(c)(2) *with* 10 C.F.R. § 51.71.

As provided in the NRC regulations, some environmental issues that might otherwise be germane in a license renewal proceeding have been resolved generically for all plants in the GEIS. These "Category 1" issues are "beyond the scope of a license renewal hearing." *Fla. Power and Light Co.*, 54 NRC at 3, 15 (2001); *see* 10 C.F.R. § 51.53(c)(3)(i).

For other issues, referred to as Category 2 issues, an ER "must contain environmental analyses of the[ir] environmental impacts." 10 C.F.R. Pt. 51.53(c)(3)(ii). This includes the consideration of "alternatives to mitigate severe accidents," including the "consequences of atmospheric releases, fallout onto open bodies of water, releases to ground water, and societal and economic impacts from severe accidents." *Id.* at Table B-1, Postulated Accidents; *see also, e.g. Limerick Ecology Action, Inc. v. NRC ("LEA")*, 869 F.2d 719, 741 (3d Cir. 1989) (holding that SAMDAs "must be given careful consideration" in the NEPA process).

Central to the current dispute, the obligation for an Applicant and NRC Staff to consider severe accident mitigation alternatives contains a carve-out for plants seeking a renewed license if severe accident mitigation alternatives have been previously considered for that plant. Thus, 10 C.F.R. § 51.53(c)(3)(ii)(L) provides that these alternatives need only be considered "[i]f the staff has not previously considered severe accident mitigation alternatives for the applicant's plant in an [EIS] or related supplement." There are only three plants that arguably fall into this exception – Limerick, Comanche Peak, and Watts Barr.

Nonetheless, consistent with the CEQ regulations, the Commission's own NEPA regulations also provide that supplements to either a Draft EIS, or a Final EIS, will be prepared where there are, *inter alia*, "new and significant circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts." 10 C.F.R. §§ 51.72(a); 51.92(a). In the relicensing context, this obligation is codified at 10 C.F.R. § 51.53(c)(iv), which provides that the EIS for a license renewal "must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware." *See also, e.g., Union Elec. Co. et al.,* CLI-11-05, 2011 WL 4027741, 12 (Sept. 9, 2011) (further NEPA review required where new information presents "a seriously different picture of the environmental impact of the proposed project from what was previously envisioned").

Previously the ASLB found, correctly in our view, that a Commission rule narrowly exempting the three particular plants from repeating a SAMA analysis that had only been performed at the initial licensing stage could not reasonably be construed as nullifying a fundamental NEPA obligation, binding on all license renewal applicants, to consider "new and significant information" on severe accident mitigation that may have come to light in the intervening decades since their initial licensing. However, in its recent decision, the Commission concluded that, in a license renewal proceeding, consideration of new and significant information related to a previously conducted analysis of severe accident mitigation alternatives would be in conflict with the exception written into § 51.23(c)(3)(ii)(L) and thus such new and significant information could not be considered absent a waiver being granted pursuant to 10 C.F.R. § 2.335.

C. The Commission's Regulatory Framework For Challenging License Renewal Applications

In order to challenge a relicensing application, a party generally must file Contentions setting forth, *inter alia*, the specific issues to be raised, a brief explanation of the bases for those issues, and sufficient evidence supporting those bases to demonstrate that the issue is material to the matters to be decided in a relicensing proceeding and is within the scope of the proceeding. 10 C.F.R. § 2.309(f). Among the issues that may *not* be raised in such a proceeding is a challenge to any "rule or regulation of the Commission, or any provision thereof." 10 C.F.R. § 2.335(a).

If a party seeks to challenge a rule or regulation, then it must file a separate "waiver petition" requesting that the rule or regulations be "waived or an exception made for the particular proceeding," based upon "special circumstances with respect to the subject matter of the particular proceeding." 10 C.F.R. § 2.335(b). The petition must demonstrate that those special circumstances "are such that the application of the rule or regulation (or a provision of it)" in the particular instance "would not serve the purposes for which the rule or regulation was adopted." *Id.*[4]

III. PROCEDURAL BACKGROUND

A. The Commission's Prior Consideration of SAMAs for Limerick

In 1980, in the wake of the TMI accident, the NRC issued a policy requiring the consideration of "severe accidents in future NEPA reviews." *LEA*, 869 F.2d at 726. Five years later, the agency issued a Final Policy that "excluded consideration of severe accident mitigation design alternatives from individual licensing proceedings." *Id.* at 727.

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[4] In promulgating the Category 1 and 2 regulations, the Commission noted that if presented with "new, site-specific information which demonstrates that the analysis of an impact codified in the rule is incorrect with respect to the particular plant, the NRC staff will seek Commission approval to waive the application of the rule with respect to that analysis in that specific renewal proceeding." 61 Fed. Reg. 28,467, 28,470 (1996). Moreover, as the Commission noted in reversing the ASLB's admission of NRDC's contentions here, NRC Staff has an obligation to consider "*new information that could render invalid the original site-specific analysis* . . . ." Comm. Op. at 13, n.54 (emphasis added).

In the meantime, in 1981 LEA and others intervened in the licensing proceeding for Limerick. LEA raised several issues, including whether the NRC had adequately considered severe accident mitigation alternatives at the facility. In the Final Environmental Statement ("FES") the staff rejected these arguments, and, as to severe accident mitigation alternatives in particular, "'concluded that there are *no special or unique circumstances* about the Limerick site and environs that would warrant consideration of'" such alternatives. 869 F.2d at 732 (quoting FES at 5-126 (emphasis added). On appeal, the Board also relied on the conclusion that there were "*no special or unique circumstances* about the Limerick site" that warranted further review. *Id.* (emphasis added).

LEA filed a Petition for Review in the Third Circuit. LEA, 869 F.2d 719. The Court of Appeals first concluded that the Policy Statement did not preclude consideration of the issue, *id.* at 733-736, and then also rejected the argument that no special or unique circumstances at Limerick warranted consideration of severe accident mitigation alternatives there. *Id.* at 738-39. In particular, the Court found that: (a) "the Commission itself has noted [that] the impact of SAMDAs on the environment will differ with the particular plant's design, construction and location"; and (b) "the risk will vary with the potential consequences," which "will vary *tremendously* across all plants." *Id.* (emphasis added).

The NRC subsequently issued a 1989 document entitled a "Supplement" to the FES for Limerick to address severe accident mitigation alternative issues, but the Supplement "discovered no substantial changes in the proposed action as previously evaluated . . . that are relevant to environmental concerns nor significant new circumstances or information relevant to environmental concerns." NUREG-0974 at iii. Thus, the Commission found "no new information that would call into question the FES conclusion" that there is no basis to further consider" severe accident mitigation alternatives at Limerick. *Id.* at 1.

B. The Present Proceeding

In response to a notice of opportunity for hearing, 76 Fed. Reg. 52,992 (2011), on November 22, 2011 NRDC submitted a petition to intervene and notice of intent to participate in the Limerick relicensing proceeding, submitting four contentions. *See* Att. A ("NRDC Cont."). Contention 1E contends that Exelon's analysis, in its ER for the relicensing, of new and significant information related to the 1989 SAMDA was inadequate because it failed to properly analyze the significance of new information that Exelon conceded existed and because it failed to acknowledge other new information that was also significant. *Id.* at 16-19. As detailed in NRDC's expert declarations, other Boiling Water Reactor ("BWR") plants have identified numerous severe accident mitigation alternatives that are cost-beneficial or potentially cost-beneficial such as, for example, portable generators for emergency power supply; providing alternative sources of water to address emergencies; and improvements to the connections between electric power systems to allow more flexible supply of critical power needs during an emergency. NRDC Decl. ¶¶ 12-14. Indeed, as the ASLB recognized, "NRDC has shown there are numerous new SAMA candidates which should be evaluated for their significance." ASLB Op. at 21.

In Contention 1E, NRDC also argued that Exelon has improperly relied on data from an analysis done at TMI concerning the economic impacts of a severe accident. NRDC Cont. at 18. NRDC explained that use of that analysis was not appropriate since TMI is a markedly different and less economically developed site than Limerick, which includes densely populated areas including Philadelphia, PA. *Id.* NRDC also explained that the comparison is inappropriate because TMI is a Pressurized Water Reactor ("PWR"), with correspondingly different accident scenario source terms than the BWR at Limerick. *Id.*; *see also* NRDC Decl. ¶¶ 17-24.

In addition, in Contention 3E NRDC argued, *inter alia*, that the ER is inadequate in relying on the methodology used in the 1989 SAMDA analysis, both for that analysis and for consideration of any newly identified mitigation alternatives, in light of techniques that have been developed since that SAMDA was conducted to assess whether alternatives are cost-beneficial. NRDC Cont. at 21-23. In particular, Contention 3E asserted, *inter alia*, that the 1989 SAMDA was legally deficient because it failed to use a probabilistic safety assessment severe accident consequences code system comparable to the MELCOR Accident Consequence Codes Systems ("MACCS") 2. *Id.* Contention 3E was based, in part, on the continuing obligation imposed by NEPA on federal agencies, to update and correct previous information when the agency becomes aware of new information that demonstrates the inadequacy of a prior analysis. *See, e.g., Deukmejian v. NRC*, 751 F.2d at 1298. Thus, this aspect of Contention 3E sought, *inter alia*, to require Exelon and NRC Staff to use the more accurate and reliable methods available today for assessing the consequences of a severe accident, including economic consequences, and assessing the costs and benefits of the additional mitigation alternatives that are appropriate for BWRs – which has never been done for Limerick.[5]

[5] NRDC only seeks waiver of 10 C.F.R. § 51.53(c)(3)(ii)(L) as it applies to two aspects of Contention 1E, *i.e.*, the failure to consider the wider range of mitigation alternatives now identified for BWRs, and the failure to conduct a reliable off-site economic consequences analysis, and one aspect of Contention 3E, *i.e.*, the need to use a modern methodology to assess the cost-benefit of new mitigation alternatives for Limerick, as it is this aspect of that Contention that qualifies for a waiver. As to other issues NRDC raised in its Contentions that were rejected by the ASLB and thus were not before the Commission, NRDC simply reserves the right to

The applicant and NRC staff opposed the motion to intervene, arguing, *inter alia*, that issues related to severe accident mitigation alternatives were precluded by 10 C.F.R. § 51.53(c)(3)(ii)(L).

On April 4, 2012 the Board rejected many of the applicant's and NRC's arguments and admitted a modified version of Contention 1E. ASLB Op. With respect to the threshold argument that any contention concerning SAMAs is precluded by 10 C.F.R. § 51.53(c)(3)(ii)(L), the Board concluded that the "regulation[ ] cannot trump statutory mandates," *id.* at 15, and that NEPA mandates an analysis based on "the best information available today." *Id.* The Board further recognized that Exelon had, in fact, "identified new information relating to severe accident mitigation," and had included such information in its ER. *Id.* at 30.

Thus, the Board concluded that in the relicensing proceeding Exelon must abide by the regulatory requirement to consider "any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware." 10 C.F.R. § 51.53(c)(3)(iv). On that basis the Board admitted a modified Contention 1E focused on the consideration of two of the bases presented by NRDC. *First*, it found that NRDC had raised an admissible contention regarding the extent to which Exelon should have addressed in its ER the "new severe accident mitigation alternatives previously considered for other BWR Mark II Containment reactors." ASLB Op. at 27. *Second*, the Board found admissible the issue of "whether Exelon's use of data from TMI in its analysis provides an adequate consideration of new and significant information regarding economic cost risk." *Id.* at 25, 27.

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pursue those issues at the appropriate time.

The Commission reversed. Comm. Op. As an initial matter, the Commission recognized what it considered to be "ambiguity in our regulations." *Id.* at 11. While the Commission characterized 10 C.F.R. § 51.53(c)(3)(ii)(L) as exempting Exelon from site-specific supplemental SAMDA analysis in the relicensing proceeding, it also recognized that the regulations mandate that "the license renewal application must contain any significant new information relevant to environmental impacts," which "may be challenged in individual adjudications." Comm. Op. at 11-12. The Commission also noted that "*Exelon has put forward in its license renewal application new information regarding it SAMDA analysis*." *Id.* at 13 (emphasis added). Particularly in light of that fact, and NRDC's claim that "the information provided by Exelon" is insufficient, the Commission ruled that "*NRDC may challenge the adequacy of the new information provided in the Limerick Environmental Report*." *Id.* (emphasis added).

However, the Commission concluded that in light of 10 C.F.R. § 51.53(c)(3)(ii)(L), "the proper procedural avenue for NRDC to raise its concerns is to seek a waiver of the relevant provision in" that section. *Id.* The Board further invited NRDC to include other Contentions that had been rejected on the basis of 10 C.F.R. § 51.53(c)(3)(ii)(L). *Id.*

IV. <u>ARGUMENT</u>

A. NRDC Is Entitled To Pursue Its Contention That Exelon Must Consider A Reasonable Range of Severe Accident Mitigation Alternatives As Mandated By NEPA.

At the outset, NRDC notes its strenuous disagreement with the Commissions' ruling that the only way NRDC can seek to bring Exelon into compliance with NEPA in connection with the Limerick relicensing is to apply for a waiver of 10 C.F.R. § 51.53(c)(3)(ii)(L). However, the bottom line is that, to be consistent with NEPA, the Commission must *either* conclude that a waiver is not necessary, or waive 10 C.F.R. § 51.53(c)(3)(ii)(L), for to decide that NRDC may not pursue these issues under *either* approach would violate NEPA.[6]

Consistent with NEPA, NRC's regulations provide that in conducting environmental review – be it in an initial EIS, a supplemental review, or a further supplemental stage – the Commission must consider "*any new and significant information* regarding the environmental impacts of license renewal of which the applicant is aware." 10 C.F.R. § 51.53(c)(3)(iv) (emphasis added). This regulation fulfills the NEPA obligation to supplement a NEPA review in appropriate circumstances, even when a prior NEPA review has been completed. *E.g., Marsh v. Oregon Natural Res. Council*, 490 U.S. at 365.

This NEPA mandate – which simply may not be abrogated by a contrary NRC regulation – requires that if presented with appropriate new and significant information regarding alternatives, including, as here, alternatives to help mitigate environmental harms such as the serious environmental harms associated with a severe accident at Limerick, the Commission *must consider that information*. Thus, while in NRDC's view the ASLB correctly concluded that because "[r]egulations cannot trump statutory mandates," ASLB Op. at 15, NRDC's contention based on such new information must be permitted into the proceeding, irrespective of 10 C.F.R. § 51.53(c)(3)(ii)(L), *at bare minimum a waiver of the regulation must be granted on that basis alone*.[7]

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[6] NRDC reserves the right at the appropriate time to challenge the Commission's decision that a waiver is required here.

[7] Indeed, the Commission's October 23, 2012 ruling strongly suggests that the waiver should be granted. The Commission noted that "Exelon has put forward in its license renewal application new information regarding its SAMDA analysis." Comm. Op. at 13. The Commission then recognized that "NRDC finds insufficient the information provided by Exelon,

Under these circumstances, the waiver petition should be granted. Indeed, were the Commission to deny the waiver petition, the result would be that, irrespective of the existence of new and significant information regarding mitigation alternatives for severe accidents, the NRC, and by extension Exelon, could not be required to come into compliance with NEPA.[8]

B. NRDC Satisfies The Criteria For A Waiver Of 10 C.F.R. § 51.53(c)(3)(ii)(L) With Respect To Contention 1E As Admitted By The ASLB And Contention 3E.

In *Dominion*, CLI-05-24, which involved a request for a waiver of the NRC's emergency planning regulations, the Commission articulated a four-part waiver test: (i) strict application of the rule sought to be waived "would not serve the purposes for which [it] was adopted"; (ii) the movant has alleged "special circumstances" that were "not considered, either explicitly or by necessary implication, in the rulemaking proceeding leading to the rule sought to be waived"; (iii) those circumstances are "unique" to the facility rather than "common to a large class of facilities"; and (iv) a waiver of the regulation is necessary to reach a significant issue. *Id.* at 560;

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and therefore seeks to challenge the validity of the decades-old SAMDA analysis." *Id.* Recognizing that, "[t]o date, we have not been presented with precisely this scenario," the Commission stated that "*NRDC may challenge the adequacy of the new information provided in the Limerick Environmental Report.*" *Id.* (emphasis added). Then, in light of the Commissions' view that 10 C.F.R. § 51.53(c)(3)(ii)(L) would otherwise bar such a challenge, the Commission concluded that "the proper procedural vehicle for NRDC to raise its concerns is to seek a waiver" of that rule. *Id.*

[8] It is also critical to emphasize that at this stage NRDC need not demonstrate that it meets the significant new information standard, as the merits of NRDC's contentions are not at issue, but rather only whether the waiver criteria are satisfied.

see also, e.g. In re Millstone Nuclear Power Station Units 1 and 2, 62 N.R.C. 551, 559-60 (2005). NRDC's Contentions satisfy this test.[9]

1. Application of 10 C.F.R. § 51.53(c)(3)(ii)(L) in the manner interpreted by the Commission would not serve the purposes for which the regulation was adopted.

10 C.F.R. § 51.53(c)(3)(ii)(L) provides that, although severe accident mitigation is a Category 2 issue, and thus generally must be considered on a site-specific basis during relicensing, this requirement is only applicable "[i]f the staff has *not previously considered* severe accident mitigation alternatives for the applicant's plant in an environmental impact statement or related supplement." 10 C.F.R. § 51.53(c)(3)(ii)(L) (emphasis added). Put another way, the regulation provides that where SAMDA's were "previously considered," they need not be considered on a site-specific basis during relicensing. As interpreted by the Commission, 10 C.F.R. § 51.53(c)(3)(ii)(L) therefore exempts Limerick from the obligation to revisit SAMDAs in connection with relicensing, because a SAMDA analysis was conducted in a 1989 supplement to the original EIS.

Assuming for purposes of this waiver request that this interpretation of 10 C.F.R. § 51.53(c)(3)(ii)(L) is correct, NRDC respectfully submits that the application of the regulation here would not serve the purpose for which the regulation was adopted. As noted, the Commission developed its Category 1 and 2 regulations to distinguish between issues that "have been resolved generically for all plants," *Turkey Point*, 54 NRC at 15 (Category 1), and those

[9] Since these precedents concerned safety issues, the fourth prong of the analysis was focused on whether a significant "safety problem" was at issue, but where, as here, the waiver request involves an environmental concern this last factor focuses on the significance of the potential environmental impacts involved. *See In re Pacific Gas & Elec.*, LPB-10-15, at 35-36, 38 (ASLB Aug. 4, 2010).

that may "requir[e] further analysis" in light of "significant new information." 10 C.F.R. § 51, preamble to App. B to Subpart A (Category 2). The Commission intended that consideration of mitigation alternatives, as to which the regulations provide for consideration of "alternatives to mitigate severe accidents," be considered a Category 2 issue, and thus be adequately considered in the ER for relicensing.

Indeed, the Proposed Rule had put this issue into Category 1, and it was in response to comments that the Commission made it a Category 2 issue, recognizing that *severe accident mitigation should generally be addressed on a site-specific basis*. 61 Fed. Reg. at 28,480. Thus, in the regulatory preamble the Commission stated that the *purpose* of the regulatory exception here was simply to limit the analysis during relicensing to exclude "consideration of *such alternatives* regarding plant operation" that were previously considered. *Id.* (emphasis added). Accordingly, despite its language, the *purpose* of 10 C.F.R. § 51.53(c)(3)(ii)(L) was simply to exempt companies such as Exelon from being forced to reconsider *specific alternatives previously considered*, from which it necessarily follows that any *new* alternatives that would mitigate severe accidents should be subject to the standard for "new and significant information." 10 C.F.R. § 51.53(c)(3)(iv); *see* Counsel Decl. ¶¶ 1-3.

That this is the purpose of 10 C.F.R. § 51.53(c)(3)(ii)(L) is further confirmed by other portions of the regulatory preamble to these regulations. In multiple portions the Commission provided assurances that "any new and significant information presented during the review of individual license renewal application" *will be considered*. *E.g.* 61 Fed. Reg. at 28,468; *see also id.* at 28,472 ("For individual plant reviews, information codified in the rule, information developed in the GEIS, and *any significant new information introduced during the plant-specific review* . . . will be considered in reaching conclusions in the supplemental EIS")(emphasis added); *id.* at 28,470.[10]

This view of the purpose of the regulation is further confirmed by the Court's ruling in *NJ Dept of Env. Prot. v. NRC*, 561 F.3d 132, 135 (3d Cir. 2009), where the Court explained that the purpose of the Category 2 regulations, including this one, is to require "evaluations of site-specific Category 2 issues – including a consideration of 'severe accident mitigation alternatives' (SAMAs) for *those issues that have not previously been considered*." *Id.* (emphasis added). Thus, since the purpose of the exemption for previously conducted SAMDAs, as explained both in the regulatory preamble and the case law, was to simply exempt "those *issues*" previously considered, rather than to wholly exempt from any future environmental impact statement consideration of severe accident mitigation alternatives that had not been previously considered,

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[10] After the rule was published several other plants complained that the Commission had erred in making severe accident mitigation alternatives a Category 2 issue, on the grounds that soon all plants will have considered the issue in an Individual Plant Examination ("IPE") or an Individual Plant Examination of External Events ("IPEE"). 61 Fed. Reg. 66,547, 66,540 (Dec. 18, 1996). The Commission rejected this argument, reiterating that these issues must be considered in site-specific NEPA reviews, as an IPE or IPEE cannot substitute for NEPA review. *Id.* Several years later, the Nuclear Energy Institute submitted a formal rulemaking petition seeking to make severe accident mitigation alternatives a Category 1 issue, and, again, the Commission expressly rejected that proposal. 66 Fed. Reg. 10,834 (Feb. 20, 2001).

Moreover, as noted, *see supra* at 8, n.4, the preamble also suggests that if a commenter puts forward "new, site specific information which demonstrates that the analysis of an impact codified in the rule is incorrect with respect to the particular plant, the NRC staff *will seek Commission approval to waive the application of the rule* with respect to that analysis in that specific renewal proceeding." 61 Fed. Reg. at 28,470. Thus, since the ASLB has already concluded that NRDC meets this standard, NRC staff should be joining NRDC in presenting this waiver petition.

it would not serve the purpose of 10 C.F.R. § 51.53(c)(3)(ii)(L) to apply it in a way that would prevent NRC from considering newly identified mitigation alternatives, from evaluating those newly identified mitigation alternatives in light of their off-site economic consequences and from using the most advanced and established methodologies for evaluating the costs and benefits of those newly identified mitigation alternatives and that would prevent NRDC from challenging Exelon's ER for its failure to properly fulfill these obligations. NRDC Counsel Decl. ¶¶ 1-3.[11]

Finally, the regulatory preamble also recognizes that, in light of inevitable changes that occur over time, "10 years is a suitable period" to delimit the outer bounds of when the Commission will assume that changes in condition and technology do not warrant additional NEPA review. 61 Fed. Reg. at 28,471. The last consideration of mitigation alternatives for severe accidents at Limerick occurred in 1989 – more than twenty years ago. Accordingly, it would plainly be inconsistent with the purpose of these regulations to limit the scope of these severe accident mitigation alternatives, the offsite economic impacts of severe accidents, and the methodology for assessing the costs and benefits of such mitigation alternatives to alternatives to those that were considered so long ago.

Indeed, for the reasons explained above, *see supra* at 13-14, the Commission cannot reasonably conclude that purposes of 10 C.F.R. § 51.53(c)(3)(ii)(L) would be served by applying

[11] It bears noting in this regard that, consistent with NEPA, the NRC's regulations require that an ER consider "appropriate alternatives to recommended courses of action," including "alternatives available for reducing or avoiding adverse environmental effects." 10 C.F.R. § 51.45(b)(3) and (b)(5); *see also* 10 C.F.R. § 51.103 (requiring discussing of alternatives in the Record of Decision, including, *inter alia*, the "preferences among alternatives" and "whether the Commission has taken all practicable measures . . . to avoid or minimize environmental harm from the alternative selected"). This of course includes alternatives that mitigate against severe accidents. *E.g. LEA*, 869 F.2d at 741.

the regulation to exclude consideration of new and significant information, in light of the overarching NEPA mandate to consider such information even when prior NEPA review has been completed. *E.g., Marsh v. Oregon Natural Res. Council*, 490 U.S. at 365. Rather, to reach a result that does not defy NEPA the Commission *must* conclude that the purpose of the regulation would not be served by applying it to reject NRDC's Contentions based on such information.

Accordingly, it would be contrary to the purpose of 10 C.F.R. § 51.53(c)(3)(ii)(L) to deny the following NRDC Contentions (for portions of 1E, as modified by the ASLB, and portions of 3E):

a. Exelon has omitted from its ER a required analysis of new and significant information regarding potential new severe accident mitigation alternatives previously considered for other BWR Mark II Containment reactors (Contention 1E-1)

NRDC's Contention 1E, and supporting declaration, contends that the ER is deficient because it ignores new severe accident mitigation alternatives previously considered for other BWR Mark II Containment reactors. NRDC Cont. at 16-19; *see also* ASLB Op. at 40; NRDC Decl. ¶¶ 5-13. For the foregoing reasons it would not serve the purposes of 10 C.F.R. § 51.53(c)(3)(ii)(L) for this regulation to bar consideration of this basis for Contention 1E here. *See also* NRDC Counsel Decl. ¶ 1.

b. Exelon's reliance on data from TMI in its analysis of the significance of new information regarding economic cost risk constitutes an inadequate analysis of new and significant information (1E-2).

NRDC's Contention 1E, and supporting declaration, also contends that the ER is deficient in relying on data from TMI in order to consider the significance of the new information concerning economic cost risks. NRDC Cont. at 18 (¶ 5); *see also* ASLB Op. at 40;

NRDC Decl. ¶¶ 17-24. For the foregoing reasons, it would not serve the purposes of 10 C.F.R. § 51.53(c)(3)(ii)(L) for this regulation to bar consideration of this basis for Contention 1E here either. *See also* NRDC Counsel Decl. ¶ 2.

c. A legally sufficient analysis of newly identified severe accident mitigation alternatives for Limerick must utilize modern techniques for assessing whether those alternatives are cost-beneficial, and Exelon's ER erroneously concluded that new mitigation alternatives can be evaluated without use of those modern techniques (3E)

As noted, the Commission invited NRDC to seek a waiver of 10 C.F.R. § 51.53(c)(3)(ii)(L) not only as to the two modified bases for Contention 1E that were admitted by the ASLB, but also as to Contention 3E. NRDC seeks a waiver as to one basis for Contention 3E not covered by Contention 1E – the adequacy of the ER vis-à-vis techniques used to assess whether SAMDA's are cost-beneficial. NRDC Cont. at 22 (¶¶ 1, 3). In particular, this basis for Contention 3E contends that the 1989 SAMDA failed to use a probabilistic safety assessment severe accident consequences code system comparable to the MELCOR Accident Consequence Codes Systems ("MACCS") 2. *Id.* This basis for Contention 3E seeks to require Exelon and NRC Staff to use the more accurate and reliable methods available *today* for assessing the consequences of a severe accident, including economic consequences, and assessing the costs and benefits of the additional mitigation alternatives that are appropriate for BWRs. *Id.* For the foregoing reasons, it would also not serve the purposes of 10 C.F.R. § 51.53(c)(3)(ii)(L) for this regulation to bar consideration of this basis for Contention 3E. *See also* NRDC Counsel Decl. ¶ 3.

* * *

In sum, having interpreted 10 C.F.R. § 51.53(c)(3)(ii)(L) to preclude admission of NRDC's contentions, the Commission must waive the regulation to insure that the purpose of the regulations – which are designed to implement NEPA – are fulfilled. Otherwise, in contradiction of NEPA dictates, assertions by Exelon in its ER concerning the economic impacts of severe accidents and the scope of mitigation alternatives will be unchallengeable, and, as a result, Limerick will be allowed to be relicensed even though, unlike every other BWR in the country, it did not have to consider either the economic impacts of a severe accident, the full range of potential mitigation alternatives or the use of much more updated and robust accident consequences analysis. The notion that NRC would in that event make a decision with regard to major federal action without considering the significance of new information that might well modify the proposal to substantially reduce its environmental impacts is so antithetical to NEPA's fundamental mandates that the regulation must be waived to fulfill the fundamental purposes of the Commission's NEPA implementing regulations.

2. There are special circumstances unique to Limerick that warrant the waiver and were not considered in the rulemaking leading to 10 C.F.R. § 51.53(c)(3)(ii)(L).

NRDC also plainly meets the "special circumstances" test here with respect to all three Contentions. As a threshold matter, this issue was arguably resolved in the *LEA* case, where the 3d Circuit considered the argument that the Commission need not consider mitigation for severe accidents at Limerick *specifically* because there were no special circumstances warranting such an individual review. As noted, the Commission had concluded that "there [we]re *no special or unique circumstances*" warranting consideration of these alternatives at Limerick, and the Board similarly concluded that there were "*no special or unique circumstances* about the Limerick site" that warranted further review. 859 F.2d at 732 (emphasis added). The Third Circuit *rejected this conclusion*, finding that addressing severe accident mitigation at Limerick *is unique*, because, *inter alia*, these issues "*vary tremendously* across all plants," and at Limerick in particular in light of its "particular plant's design, construction and location." *Id.* at 738; *see also id.* at 738 (population "affects the magnitude and location of potential consequences from radiation releases," which "*is particularly true for plants such as Limerick which were built near densely populated areas*") (emphasis added).

In any event, it is evident that NRDC's Contentions raise issues that are both unique to Limerick and were not considered in the 10 C.F.R. § 51.53(c)(3)(ii)(L) rulemaking. NRDC's fundamental concern, reflected in its Contentions, is that there are a number of potentially cost-beneficial measures to address severe accidents at Limerick that, to date, Exelon has refused to consider; that the evaluation of the costs and benefits of these mitigation alternatives must include offsite economic consequences that reflect the Limerick site; and that the methodology used to assess the cost and benefits of these additional mitigation alternatives must be the most advanced techniques available for such analyses . Thus, NRDC's Contentions are that the ER is deficient because, to date, Exelon has refused to consider the costs and benefits of these measures at Limerick; has relied on inappropriate economic data from TMI to substitute for a site-specific analysis of off-site economic consequences; and has refused to utilize appropriate methodologies to evaluate these severe accident mitigation alternatives.

Every other BWR nuclear power plant in the country that has undergone relicensing has conducted an analysis of severe accident mitigation alternatives that is more inclusive of potential alternatives, includes the offsite economic consequences of a severe accident and *utilizes the advanced computer methodology of MACCS2 to determine costs and benefits*. NRDC Decl. ¶¶ 5-13. Thus, the Contentions apply only to Limerick, and, more importantly, absent the waiver sought here, the Limerick plant will be the *only* BWR nuclear power plant that will be relicensed without the operator or the NRC giving NEPA consideration to the most recent mitigation alternatives, assessment methodologies, and economic considerations regarding severe accident mitigation alternatives. Rather, while all other plants conduct such analyses, and provide them to the public for public comment, the millions of people living near Limerick during the license extension period will be forced to rely on an analysis conducted up to forty years ago, in 1989. NRDC Counsel Decl. ¶ 4.

Absent a waiver, by the time Limerick Unit 2 completes its license renewal period, in 2049, its required NEPA analysis of severe accident mitigation alternatives will conceivably have gone for sixty years without facing a requirement for updating in the light of new and significant information, and without affording the public its due process right under NEPA to challenge the licensee's use of such information and/or failure to apprehend its importance to identification of cost-effective measures for mitigating the environmental consequences of a severe accident. Such anomalous, highly prejudicial, and NEPA-noncompliant outcomes are a possible and readily forseeable result of failing to waive application of Subpart L to the relicensing of Limerick, and thus also comprise the "special circumstances" satisfying this prong of the waiver analysis.

These issues certainly were not considered in the 10 C.F.R. § 51.53(c)(3)(ii)(L) rulemaking. To the contrary, as discussed above, the Commission was focused first and foremost on insuring that these kind of alternatives *are* considered in relicensing proceedings (which is why they became Category 2 issues), and, secondarily, sought to avoid duplicative NEPA processes by exempting specific mitigation alternatives that had previously been considered from being subject to reconsideration. *See supra* at 17-19. Nothing in the regulatory preamble suggests that the Commission contemplated that the regulation would forever preclude Exelon from being required to consider new mitigation alternatives during relicensing.[12]

Exelon's own contradictory approach to this issue is also a special circumstance plainly not contemplated when this regulation was adopted. NRDC Counsel Decl. ¶ 4. It is critical to recognize in this regard that the ER *does discuss alternatives to mitigate for severe accidents*. *See* ER at 5-1 to 5-9. In conducting this analysis, Exelon recognized that it has an obligation to "identify any new and significant information of which" it is aware. *Id.* at 5-2. According to Exelon, it was because it did *not identify* any information that met the standard that no specific design alternatives were identified or discussed. *Id.* at 5-9.

However, NRDC's Contentions focus both on the flaws in the way the ER analyzed the significance of the new information, and the failure to consider all the relevant new information related to severe accident mitigation alternatives. Had Exelon claimed that the "new and significant information" standard in 10 C.F.R. § 51.53(c)(3)(iv) does not apply *at all* in light of 10 C.F.R. § 51.53(c)(3)(ii)(L), then it would not have conducted this review, and its position regarding the need to consider NRDC's information would at least be consistent with its approach to preparing the ER. *See also* NRDC Counsel Decl. ¶ 4.

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[12] The fact that the issue is unique is also highlighted by the fact that although three plants are arguably covered by the exception – Limerick, Comanche Peak, and Watts Bar. 61 Fed. Reg. at 28,481 – only Limerick is a BWR, while the other two are Pressurized Water Reactors. Accordingly, the mitigation measures at issue only apply to Limerick.

In adopting 10 C.F.R. § 51.53(c)(3)(ii)(L) the Commission certainly did not contemplate that in a license renewal, an applicant could, on the one hand, recognize that 10 C.F.R. § 51.53(c)(3)(iv) *does apply*, and on the other hand claim that an intervenor has no right to challenge the adequacy of that analysis. Rather, such an approach is plainly contrary to both the regulations and NEPA mandates, particularly where, as here, the new and significant information is *uniquely relevant to this one plant*, since all other plants are looking at *the full range of relevant mitigation alternatives*, are conducting analyses of off-site economic consequences, and are using the most up-to-date the methodology for analyzing the costs and benefits of severe accident mitigation alternatives

Accordingly, NRDC meets this part of the test as well.

3. Waiver of the regulation is necessary here to address a significant environmental concern.

Finally, the issues NRDC seeks to raise also plainly address a significant environmental concern. *See In re Pacific Gas & Elec.*, LPB-10-15, at 35-36, 38 (ASLB Aug. 4, 2010) (finding that this factor "should be construed in this instance to permit a waiver if it is necessary to reach a significant environmental issue"). By definition, NRDC's Contentions concern how to best mitigate for "severe" accidents. Courts, including *LEA*, have repeatedly *rejected* the notion that a small risk of a severe accident is an insignificant problem that need not be addressed in the NEPA process. *LEA*, 869 F.2d at 738 ("risk equals the likelihood of an occurrence times *the severity of the consequences*") (emphasis added); *see also New York v. Nuclear Regulatory Comm'n*, 681 F.3d 471, 478-79 (D.C. Cir. 2012); *cf. Mountain States Legal Found. v. Glickman*, 92 F.3d 1228, 1235 (D.C. Cir. 1996) ("the more drastic the injury that government actions makes more likely, the lesser the increment in probability necessary to establish standing").

As explained in NRDC's Declaration, during the life of a relicensed Limerick plant the surrounding population within 50 miles will grow to over 9 million people, including more than 400,000 people living within 10 miles of the site. NRDC Decl. ¶¶ 14-16. It is vital that appropriate mitigation alternatives be considered to ameliorate the risks to these residents.

The alternatives NRDC contends Exelon must consider are all designed to address these risks, which is why they have been considered for other BWR Mark II Containment plants. Severe accidents could result from external events such as tornadoes, floods, earthquakes, fires, or even sabotage, and could result in substantial damage to the reactor core. Where there are inadequate means to achieve backup power in the event of a power failure, for example, that power failure could lead to a severe accident, as at Fukushima. Or where inadequate training allows operation of a reactor while auxillary feed pumps are closed for maintenance, an error in the primary pumps can lead to a severe accident, as occurred at TMI. The mitigation alternatives NRDC has identified from the SAMA analyses for other BWRs are designed either to reduce the likelihood of severe accidents or to mitigate the severity of their consequences should they nonetheless occur, NRDC Decl. ¶¶ 16, and thus because, absent the waiver, Exelon will not be required to consider these measures, the waiver is plainly necessary to address significant environmental issues regarding cost-beneficial mitigation alternatives. *See also* NRDC Counsel Decl. ¶ 5.

V. CONCLUSION

For the foregoing reasons NRDC respectfully requests that the Commission grant this waiver petition, and admit Contention 1E-1 and 1E2, as admitted by the ASLB, as well as that aspect of Contention 3E that concerns appropriate techniques to analyze SAMDAs, by waiving application of 10 C.F.R. § 51.53(c)(3)(ii)(L).

Respectfully Submitted,

s/ (electronically signed)
Howard M. Crystal
Meyer Glitzenstein & Crystal
1601 Connecticut Ave., N.W., Suite 700
Washington, D.C. 20009
(202) 588-5206
hcrystal@meyerglitz.com

s/ (electronically signed)
Anthony Z. Roisman
National Legal Scholars Law Firm, P.C.
241 Poverty Lane, Unit 1
Lebanon, NH 03766
603-443-4162
aroisman@nationallegalscholars.com

s/(electronically signed)
Geoffrey H. Fettus
Natural Resources Defense Council
1152 15th Street, NW, Suite 300
Washington, D.C. 20005
202-289-2371
gfettus@nrdc.org

Filed this date of November 21, 2012

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
EXELON GENERATION COMPANY, LLC	)	Docket Nos. 50-352-LR 50-353-LR
(Limerick Generating Station, Units 1 and 2)	)	December 14, 2012

EXELON'S COUNTER AFFIDAVIT SUPPORTING EXELON'S RESPONSE OPPOSING NRDC'S PETITION FOR WAIVER OF 10 C.F.R. § 51.53(C)(3)(ii)(L)

I. PERSONAL BACKGROUND INFORMATION

I, Jeffrey R. Gabor ("JG"), state as follows:

1. (JG) I am Vice President of the Risk Management Group for ERIN Engineering and Research, Inc ("ERIN Engineering"). My qualifications are summarized in the attached *curriculum vitae.* Briefly, I have over 30 years of experience in nuclear power plant safety, including extensive experience in severe accident management and analysis pertaining particularly to Boiling Water Reactors ("BWR"s), such as the Limerick Nuclear Generating Station ("Limerick"). I hold a Bachelor of Science degree in Nuclear Engineering and a Master of Science degree in Mechanical Engineering from the University of Cincinnati, Ohio.
2. (JG) With respect to my experience with Severe Accident Mitigation Alternatives ("SAMA"s), I have supported over half of all U.S. nuclear plant license renewal SAMA analyses to date and am otherwise extremely involved with the nuclear industry. I was a primary author of NEI 05-01, "Severe Accident Mitigation Alternatives (SAMA)

Guidance Document" (Nov. 2005), which the NRC Staff recommends as guidance for license renewal applicants who are required to prepare a SAMA analysis as part of their application.[1] I also am experienced in developing SAMA files for computer model analysis and related personnel training.

3. (JG) I also have extensive experience in Probabilistic Risk Assessments ("PRA"). I was the lead technical analyst for severe accident response on numerous BWR PRAs, including Millstone Unit 1, Duane Arnold, Pilgrim, Nine Mile Point Units 1 and 2, Fermi, Vermont Yankee, Cofrentes (Spain), and Browns Ferry. I was a principal author of the BWR Modular Accident Analysis Program ("MAAP"), a computer code that simulates reactor accidents for PRA applications and which has a BWR-specific version. I am a member of the Mitigating Systems Performance Index PRA Quality Task Group, and have made numerous technical presentations to the U.S. Nuclear Regulatory Commission ("NRC") and its Advisory Committee on Reactor Safeguards, as well as the U.S. Department of Energy.

I, Donald E. MacLeod ("DM"), state as follows:

4. (DM) I am an expert in PRA with extensive experience in SAMA analysis. I have over fifteen years of experience with ERIN Engineering, specialize in Probabilistic Risk Assessment, and hold a Bachelor of Science degree in Nuclear Engineering from Rensselaer Polytechnic Institute.

5. (DM) My experience in SAMA analyses includes holding the role of lead analyst performing SAMA analyses for many U.S. nuclear plants, and co-developing several others. Specifically, I was lead analyst performing SAMA analyses for Three Mile

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1 LR-ISG-2006-03, "Final License Renewal Interim Staff Guidance LR-ISG-2006-03: Staff Guidance for Preparing Severe Accident Mitigation Alternatives Analyses" at 1 (Aug. 2, 2007).

Island, Shearon Harris, Wolf Creek, V.C. Summer, Brunswick, H.B. Robinson, Monticello, Palisades, Susquehanna, South Texas Project, and Palo Verde. I co-developed SAMA analyses for Peach Bottom, Salem Generating Station, Hope Creek, Diablo Canyon, and Crystal River. Particular to Limerick, I was the lead analyst in developing an update of the plant's Human Reliability Analysis.

I, Donald E. Vanover ("DV"), state as follows:

6. (DV) I am an expert in PRA with extensive experience in developing and updating PRA models for several BWR and PWR reactors. My qualifications are summarized in the attached *curriculum vitae.* Briefly, I have over 25 years of experience in nuclear power plant safety, including extensive experience with all aspects of the Limerick PRA models. While with ERIN Engineering since 1995, I have been involved in numerous applications of PRA models to meet current regulatory requirements, and also in support of license amendment requests to the NRC. I hold a Bachelor of Science degree and a Master of Science degree in Mechanical Engineering from the University of Delaware.

7. (DV) My experience in PRA has also led to the development of several industry guidance documents published by EPRI including guidance for the treatment of PRA model uncertainty. My experience in SAMA analysis includes being a principal contributor to the SAMA analyses performed for Peach Bottom, Susquehanna, and Vogtle.

I, Eugene Kelly ("EK"), state as follows:

8. (EK) I am an expert in licensing and design basis, with extensive experience in power plant operation and testing, engineering and design, and licensing. I have over 38 years of nuclear power plant experience, including 13 years at Limerick, with specialized expertise in engineering programs and testing. I also have 17 years of regulatory and

licensing experience with the NRC, including holding the position of Senior Resident Inspector at Limerick. I hold a Bachelor of Science degree in Physics from Villanova University and a Master's of Science in Mechanical Engineering from the University of Pennsylvania.

9. (EK) My experience in engineering programs includes managing the Engineering Programs branch at Limerick, chairing the INPO Programs excellence working group, and serving as the technical manager responsible for the Limerick License Renewal Application. Specifically, I was responsible for all tests and inspections at Limerick associated with engineering programs, including service water cooling systems and buried piping. I also piloted a risk-informed surveillance test frequency program that was licensed for Limerick and serves as the basis for an industry-wide surveillance test initiative that uses PRA and risk techniques and insights to create test programs for a wide variety of systems and components. As the technical lead for the Limerick license renewal project, I was responsible for the development of all 45 aging management programs including those for Open Cycle Cooling Water and Buried Piping and Tanks.
10. (EK) In my prior position as the NRC Region I manager of the Engineering Systems Branch, I was responsible for inspections of over 30 nuclear plants throughout the Northeast United States including team inspections of Generic Letter 89-13 service water testing programs. This NRC branch was also responsible for the oversight of PRA techniques and applications at over 30 nuclear plants.
11. (EK) My technical training and experience includes specialized expertise in heat transfer, fluid dynamics, risk management and safety analysis.

II. PURPOSE AND SCOPE

12. (All) We have reviewed the Declaration of Christopher J. Weaver, Ph.D., on Behalf of the Natural Resources Defense Council [NRDC] in Support of Motion for Waiver submitted on behalf of NRDC, and the other arguments NRDC makes in its "Petition, By Way of Motion, For Waiver of 10 C.F.R. § 51.53(C)(3)(ii)(L) As Applied to Application for Renewal of Licenses for Limerick Units 1 and 2" (Nov. 21, 2012) ("Waiver Petition"). We offer our statements in this Counter Affidavit to support Exelon's response opposing NRDC's Waiver Petition.

III. TECHNICAL ARGUMENT

A. There are no major design changes or major plant modifications among the SAMAs that NRDC identified.

13. (DM, JG) NRDC identifies approximately 50 SAMAs in Paragraph 11 of the Weaver Declaration that its expert identified as cost-beneficial or potentially cost-beneficial at other BWRs. Paragraph 10 of the Weaver Declaration states:

> "Of the SAMA analyses I surveyed for BWRs, on average four cost-beneficial or potentially cost-beneficial SAMAs were found for each site, with a maximum of 11 cost-beneficial or potentially cost-beneficial SAMAs. Browns Ferry, Nine Mile Point and Peach Bottom had no cost-beneficial or potentially cost-beneficial SAMA candidates identified. Whether any of these cost-beneficial mitigation alternatives would be cost-beneficial at Limerick has not been determined, or even considered, in Exelon's Environmental Report."

14. (DM) The Weaver Declaration characterizes these SAMAs only as cost-beneficial or potentially-cost-beneficial. It does not categorize them by whether they are procedural and programmatic in nature, minor design or hardware modifications, or major design or hardware modifications. The reason I use these categories is because the June 1996 rulemaking for 10 C.F.R. § 51.53(c)(3)(ii)(L) states that future SAMA analyses may

identify cost-beneficial improvements but that they "generally would be procedural and programmatic fixes with any hardware changes being only minor in nature and few in number."[2] In my opinion, procedural and programmatic fixes include changes to written operating procedures, staffing requirements, and personnel training.

15. (DM) The June 1996 rulemaking, on the same page, also states that: "The Commission believes it unlikely that any site-specific consideration of severe accident mitigation alternatives for license renewal will identify major plant design changes or modifications that will prove to be cost-beneficial for reducing severe accident frequency or consequences."

16. (DM) I have reviewed the approximately 50 SAMAs in Paragraphs 11 of the Weaver Declaration of cost-beneficial or potentially cost-beneficial at other BWRs. All of these SAMAs are either: (a) procedural and programmatic fixes, such as changes to written procedures and operator training, or (b) minor design or hardware changes, such as adding portable equipment, cross-ties of existing systems, or adding cables. The minor design or hardware changes for any of those BWRs are few in number; the largest number of potentially cost-beneficial minor plant changes for any of the sites identified is five.

17. (DM) None of the 50 SAMAs identified in Paragraph 11 of the Weaver Declaration is a major design or plant modification. While there is not a commonly used definition for a major modification in the context of a SAMA analysis, I evaluated the SAMAs in paragraphs 11 of the Weaver Declaration assuming that a major modification is a plant change that results in the permanent installation of a new structure, system, or a

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[2] *See* Environmental Review for Renewal of Nuclear Power Plant Operating Licenses, 61 Fed. Reg. 28,467, 28,481 (June 5, 1996).

redundant train of an existing system that changes the footprint of the facility. I have prepared a column labeled "Major Modification?" in Table A which explains why each of the SAMAs that NRDC identifies is not a major modification. Table A is attached to this Counter Affidavit. Using the same definition for "major modification,"

18. (DM) I also reviewed the SAMAs identified in paragraph 12 of the Weaver Declaration and determined that neither of those SAMAs are "major modifications." The enhancement related to the RCIC control capabilities consists of the replacement of valves, control logic, and the addition of a low capacity generator to an existing system. The proposed process to measure changes in safety related pipe wall thickness is a programmatic change.

B. <u>The approximately 50 SAMAs listed in the Weaver Declaration are not "new and significant" for Limerick.</u>

19. (DV) NRDC does not explain how the approximately 50 SAMAs listed in the Weaver Declaration, if implemented at Limerick, would present a seriously different picture of the environmental impact of plant operation. NRDC argues on page 7 of its Waiver Petition that to be significant, new information must present "a seriously different picture" of the environmental impact of the proposed project from what was previously envisioned. I am not aware of the NRC previously quantifying "significance." However, I have reviewed of PRA standards and relevant guidance documents to develop a basis for what is significant in the SAMA context.

20. (DV) For the reasons stated below, I have selected a 50% reduction in the maximum averted cost-risk ("MACR") as the threshold for what may be "significant."

21. (DV) There are a few notable documents that provide numerical criteria that may be applied to determine the threshold for significance. The first one is the American Society

of Mechanical Engineers ("ASME")/American Nuclear Society ("ANS") PRA Standard[3] which includes the following definition of a significant basic event.

> *significant basic event:* a basic event that contributes significantly to the computed risks for a specific hazard group. For internal events, this includes any basic event that has an FV [Fussell-Vesely] importance greater than 0.005 or a RAW [Risk Achievement Worth] importance greater than 2.

Similar numerical criteria also appear in NUMARC 93-01[4], which includes the following guidance.

> An SSC would probably be considered risk significant if its Risk Reduction Worth exceeds 0.5 percent of the overall Core Damage Frequency (Risk Reduction Worth >1.005).
>
> […]
>
> An SSC [structure, system or component] would probably be considered risk significant if its Risk Achievement Worth shows at least a doubling of the overall Core Damage Frequency and should be provided to the expert panel as an input in risk determination.

Finally, NEI 00-04[5] provides detailed guidance on categorizing structures, systems and components for licensees that choose to adopt 10 CFR § 50.69, *Risk-Informed Categorization and Treatment of Structures, Systems and Components for Nuclear Power Reactors*. In the discussion of using risk analyses for SSC categorization, the following guidance is provided.

> The risk importance process uses two standard PRA importance measures, risk achievement worth (RAW) and Fussell-Vesely (F-V), as screening tools to identify candidate safety-significant SSCs. The criteria chosen for safety significance using these importance measures are based on previously accepted values for similar applications.
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> […]

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3 *Addenda to RA-S-2008, Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications*, ASME/ANS RA-Sa-2009, February 2009.

4 NUMARC 93-01, *Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants*, Rev. 2, April 1996.

5 NEI 00-04, *10 CFR 50.69 SSC Categorization Guideline*, July 2005.

The importance measure criteria used to identify candidate safety significance are:

- Sum of F-V for all basic events modeling the SSC of interest, including common cause events > 0.005
- Maximum of component basic event RAW values > 2

22. (DV) In summary, an F-V value > 0.005 and a RAW value > 2 are well established indicators of PRA significance. This can be extended to apply to not just internal events core damage frequency ("CDF") and large early release frequency ("LERF"), but to external events CDF and LERF, and other integrated key output figures of merit. In the context of license renewal, the accepted key output figure of merit for decision making is "potential averted cost risk."

23. (DV) When averted cost risks are analyzed, the F-V importance measure would be highly dependent on the assumed reliability of the system once it is installed. This is illustrated in Figure 1 which shows an example of how the F-V value changes with assumed failure probability values given a case where a 50% reduction in the measured parameter is estimated assuming perfect reliability. In this example, a 0.005 F-V value would be obtained when the failure probability is ~0.005. This failure probability represents a system or component that is 99.5% reliable, which is fairly representative of many components modeled in typical PRA analyses.

24. (DV) On the other hand, as the reliability of the system increases (*i.e.*, as the likelihood of system failure decreases), the RAW importance measure would asymptotically approach a RAW of 2 if 50% of the measured parameter can be averted. This is illustrated in Figure 2, which shows an example of how the RAW changes with assumed failure probability values when a 50% reduction in the measured parameter is estimated

assuming perfect reliability. Therefore, a correlation to a RAW > 2 as the acceptance threshold for "significance" is established and a 50% reduction in the MACR is chosen for the "significance" threshold.

25. (DV) In other words, the threshold I have just described would be equivalent to a highly reliable system leading to doubling the cost risk when it is taken out of service for maintenance. This correlates to a well-established threshold for determining risk significance in the PRA applications discussed above.

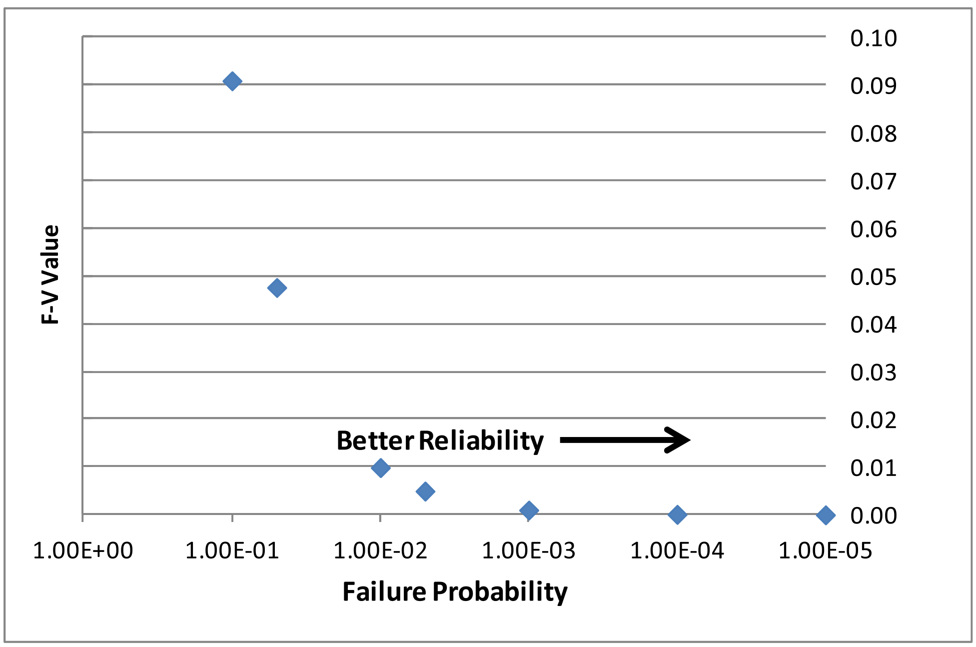

Figure 1

F-V AS A FUNCTION OF FAILURE PROBABILITY

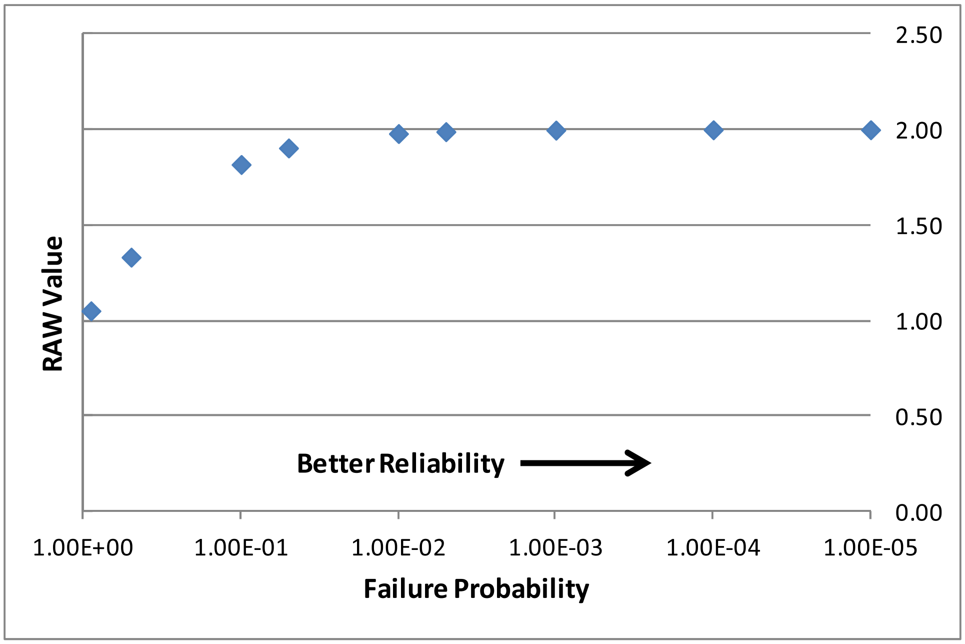

Figure 2

RAW AS A FUNCTION OF FAILURE PROBABILITY

26. (DV) In summary, a RAW value of 2 is selected as the key acceptance criterion for determining the significance of a potential plant enhancement in this context. This is consistent with a well-established threshold for determining risk significance in various PRA applications, and correlates well with a 50% reduction in the MACR for a SAMA that is implemented. Therefore, a 50% reduction in the MACR is chosen for the "significance" threshold.

27. (DM) Based on the definition the definition of "significance" presented above, implementation of a SAMA would have to result in at least a 50% reduction in a plant's MACR to be considered "significant." Yet each of the SAMAs, identified in Paragraph 11 of the Weaver Declaration that NRDC claims are relevant to the review of "new and significant" information in the Limerick Environmental Report ("ER"), falls into one of four categories:

1. Inapplicable to Limerick. For example, a SAMA in this category may apply only to containments or reactors of designs that are different than Limerick's BWR Mark II design (Table A accompanying this Counter Affidavit shows these SAMAs as yellow-shaded). (On a related note, NRDC argues on page 27 of the Waiver Petition that Exelon must consider an example of an accident that is caused by operating the plant with auxiliary feed pumps that are "closed for maintenance". This particular issue is not relevant to Limerick because the equipment identified in the example is specific to PWRs. Auxiliary feedwater pumps, which are part of a PWR's secondary side heat removal function, provide inventory makeup to the steam generators and are not used in BWR Mark II plants); or
2. Applicable to Limerick, but Exelon already has incorporated it at Limerick (these SAMAs are green-shaded on Table A); or
3. Applicable to Limerick and, although not incorporated at Limerick, Exelon has implemented a functional equivalent at Limerick (these SAMAs are orange-shaded on Table A); or
4. Applicable to Limerick and, although not incorporated at Limerick, the SAMA reduces the MACR in the plant of origin by less than 50% (these SAMAs are unshaded on Table A).

28. (DM) Given that none of the SAMAs are considered to be significant in the plants for which they were determined to be cost-beneficial, there is no evidence to suggest that the SAMAs would be significant for Limerick.

29. (EK) Paragraph 12 of the Weaver Declaration also argues that Exelon be required to consider, as a SAMA, a specific method of inspecting buried, safety-related piping to identify aging related degradation. However, Limerick already performs a functionally equivalent inspection process as part of its Aging Management Program implemented under NUREG-1801, Generic Aging Lessons Learned (GALL) Report (Rev. 2) (Dec. 2010).

30. (DM) While the proposed process may be possible, paragraph 12 of the Weaver Declaration does not suggest that replacing the existing program with the proposed process would result in a reduction in risk for Limerick. Rather, NRDC only suggests that use of the alternative process may be less costly than excavating safety-related pipes.

C. Contention 1-E, as previously admitted by the Board, would have required Exelon to analyze SAMA candidates that are not unique to Limerick. The SAMAs specifically identified for consideration by Exelon in Paragraphs 11 and 12 of the Weaver Declaration are, by definition, not unique to Limerick.

31. (JG) Page 15 of the Waiver Petition states that "NRDC Satisfies The Criteria For A Waiver Of 10 C.F.R. § 51.53(c)(3)(ii)(L) With Respect To Contention 1E As Admitted By The ASLB . . . ." But Contention 1-E, as previously admitted by the Board, would have required Exelon to analyze SAMA candidates that are not unique to Limerick. The SAMAs specifically identified for consideration by Exelon in Paragraph 11 of the Weaver Declaration are, by definition, not unique to Limerick because they all were originally developed for other sites, not for Limerick. In fact, many of NRDC's proffered SAMAs come directly from the generic industry BWR SAMA list included in Table 13 of NEI 05-01 (which I helped author), or are functional equivalents of SAMAs listed in NEI 05-01. The SAMAs in paragraph 12 of the Weaver Declaration address issues that

are common to many BWRs in the industry and are similarly not unique to Limerick. NEI-05-01 can be found at http://pbadupws.nrc.gov/docs/ML0605/ML060530203.pdf

D. MACCS2 is used for Level 3 PRA.

32. (DM) Page 21 of the Waiver Petition argues that Exelon should be required to use updated analytical tools to perform an analysis of SAMA candidates. The only such tool that NRDC identifies by name is the MELCOR Accident Consequence Code Systems 2 ("MACCS2"). This is the code used for BWRs and PWRs that takes the amount of radionuclide released from the plant in the case of a severe accident (as determined from the Level 2 PRA) and computes the dose to the public and any land contamination impacts. Accordingly, MACCS2 is used in Level 3 PRA, not Level 1 or 2.

33. (DV) Exelon has used PRAs to evaluate severe accidents since the 1989 SAMDA analysis performed for Limerick. The Limerick PRA model has been periodically updated to reflect as-built and as-operated condition of the plant. The PRA models include input from the Individual Plant Examination ("IPE") and individual plant examination for externally initiated events ("IPEEE") evaluations.

34. (JG) I assisted Exelon with preparing the ER to support Limerick's license renewal application to the NRC. I assisted Exelon with reviewing the current Limerick PRA model to identify any new information relative to the quantification of risk (measured in core damage events per year) in comparison to information provided in 1989 in the "Supplemental Final Environmental Statement Related to the Operation of Limerick Generating Station," Units 1 and 2 (NUREG-0974). The process included a review of the NRC's Supplement to NUREG-0974 itself, the June 1989 Limerick PRA Update, and the Limerick PRA model and updates subsequent to the publication of the Supplement to

NUREG-0974 in 1989. These are discussed in the ER at pages 5-4 to 5-6. We specifically discussed these PRAs in the Limerick ER because they informed our decision-making about what needed to be included in response to NRC requirements in 10 CFR Part 51.

I, Jeffrey R. Gabor, declare under penalty of perjury that the foregoing information attributed to me as indicated by my initials at the start of the paragraph is true and correct to the best of my knowledge, information, and belief.

Executed in Accord with 10 C.F.R. § 2.304(d)
Jeffrey R. Gabor
Vice President, Safety and Reliability
ERIN Engineering and Research, Inc.
158 West Gay Street
West Chester, PA 19380
(610) 431-8260
Executed on December 14, 2012

I, Donald E. MacLeod, declare under penalty of perjury that the foregoing information attributed to me as indicated by my initials at the start of the paragraph is true and correct, to the best of my knowledge, information, and belief.

Executed in Accord with 10 C.F.R. § 2.304(d)
Donald E. MacLeod
Consultant I, Probabilistic Safety Assessment and Reliability
ERIN Engineering and Research, Inc.
158 West Gay Street
West Chester, PA 19380
(610) 431-8260
Executed on December 14, 2012

I, Donald E. Vanover, declare under penalty of perjury that the foregoing information attributed to me as indicated by my initials at the start of the paragraph is true and correct to the best of my knowledge, information, and belief.

Executed in Accord with 10 C.F.R. § 2.304(d)
Donald E. Vanover
Vice President
ERIN Engineering and Research, Inc.
158 West Gay Street
West Chester, PA 19380
(610) 431-8260
Executed on December 14, 2012

I, Eugene Kelly, declare under penalty of perjury that the foregoing information attributed to me as indicated by my initials at the start of the paragraph is true and correct, to the best of my knowledge, information, and belief.

Executed in Accord with 10 C.F.R. § 2.304(d)
Eugene Kelley
Senior Project Manager, License Renewal
Exelon
200 Exelon Way
Kennett Square, PA PA 19348
(610) 765-5554
Executed on December 14, 2012

Table A to Exelon's Counter Affidavit Supporting Exelon's Response Opposing NRDC's Petition for Waiver of 10 C.F.R. § 51.53(C)(3)(ii)(L)

Nuclear Power Plant	Item #	List of Titles of SAMAs Found to be Cost-Beneficial or Potentially Cost-Beneficial from the Weaver Declaration (Paragraph 11)	Implemented at Limerick?		Base Case Maximum Averted Cost Risk [Note 1]	Base Case Averted Cost Risk [Note 2]	Percent Change	Comments	Major Modification?
			Unit 1? (Y/N)	Unit 2? (Y/N)					
	1	Portable DC generator	Y	Y				Limerick already has a portable AC generator and DC rectifier to open 3 SRVs without normal station DC power.	No. Portable equipment and procedure changes.
	2	Diverse EDG HVAC logic	N	N	$9,588,000	$267,916	2.8%		No. Installation of different instrumentation or an alternate set of instrumentation.
	3	Provide alternate feeds to panels supplied only by DC bus 2A-1	N	N	$9,588,000	$1,566,562	16.3%		No. Temporary cable alignments.
	4	Provide an alternate means of supplying the instrument air header	Y	Y				Limerick already has procedures to support this capability.	No. Portable equipment and procedure changes.
	5	Proceduralize battery charger high voltage shutdown circuit inhibit	N	N	$9,588,000	$463,930	4.8%		No. Procedure change.
	6	Portable EDG fuel oil transfer pump	Y	Y				Existing Limerick procedures provide the ability to cross-tie existing fuel oil transfer pumps to non-dedicated EDGs	No. Portable equipment and procedure changes.
Brunswick	7	Use fire water as a backup for containment spray	Y	Y				Limerick already has procedures to support this capability.	No. Procedure change and potentially the installation/modification of a pipe connection for some plants.
	1	Reduce CCFs between EDG-3 and EDG1/2	N	N	$1,886,578	$72,565	3.8%		No. Change in actuation instrumentation type or an alternate set of instrumentation, or a change in fuel vendor.
	2	Improve the fire resistance of cables to the containment vent valve	N	N	$1,886,578	$333,703	17.7%		No. Cables of a new type or installation of cable wrap.
Columbia	3	Improve the fire resistance of cables to transformer E-TR-S	N	N	$1,886,578	$75,446	4.0%		No. Cables of a new type or installation of cable wrap.
	1	Portable generator for DC power to supply the individual panels	Y	Y				See Brunswick #1	No. Portable equipment and procedure changes.
	2	Revise procedure to allow bypass of RCIC turbine exhaust pressure trip	Y	Y				Existing Limerick procedures provide this capability (defeat all RCIC isolation signals including RCIC turbine exhaust diaphragm high pressure at 10 psig).	No. Procedure change.
	3	Improve training on alternate injection via FPS	N	N	$1,053,957	$52,605	5.0%	LGS currently trains once every four years.	No. Training update.
	4	Revise procedures to allow manual alignment of the fire water system to RHR heat exchangers	N	N	$1,053,957	$199,969	19.0%		No. Procedure change.
	5	Proceduralize the ability to cross-connect the circulating water pumps and the service water going to the TEC heat exchangers	N	N	$1,053,957	$177,788	16.9%		No. Procedure change.
	6	Create ability for emergency connection of existing new water sources to feed water and condensate systems	N	N	$1,053,957	$431,725	41.0%	The Limerick PRA indicates this SAMA would have a low benefit for the site. The importance measures indicate the Feedwater/Condensate system contributes to less than 0.5% of the internal events CDF and are negligible contributors to Seismic and Fire risk; this SAMA would yield a very small averted cost-risk.	No. Procedure change and potentially the installation/modification of a pipe connection for some plants.
	7	Operator procedure revisions to provide additional space cooling to the EDG room via the use of portable equipment	N	N	$1,053,957	$33,160	3.1%		No. Portable equipment and procedure changes.

Table A to Exelon's Counter Affidavit Supporting Exelon's Response Opposing NRDC's Petition for Waiver of 10 C.F.R. § 51.53(C)(3)(ii)(L)

Nuclear Power Plant	Item #	List of Titles of SAMAs Found to be Cost-Beneficial or Potentially Cost-Beneficial from the Weaver Declaration (Paragraph 11)	Implemented at Limerick? Unit 1? (Y/N)	Unit 2? (Y/N)	Base Case Maximum Averted Cost Risk [Note 1]	Base Case Averted Cost Risk [Note 2]	Percent Change	Comments	Major Modification?
Cooper	8	Provide an alternate means of supplying the instrument air header	Y	Y				See Brunswick #4	No. Portable equipment and procedure changes.
	9	Proceduralize the use of a fire pumper truck to pressurize the fire water system	Y	Y				Existing Limerick procedures provide this capability (use of fire truck to supplement ring header).	No. Procedure change.
	10	Generation Risk Assessment implementation into plant activities	N	N	$1,053,957	$394,444	37.4%		No. Programmatic change.
	11	Modify procedures to allow use of the RHRSW system without a SWBP	N	N	$1,053,957	$110,566	10.5%		No. Procedure change.
Duane Arnold	1	Provide an alternate source of water for the RHRSW/ESW pit	Y	Y				Existing Limerick procedures provide this capability (cross-tie ESW / RHRSW)	No. Procedure change and potentially the installation/modification of a pipe connection for some plants.
	2	Increase the reliability of the low pressure ECCS RPV low pressure permissive circuitry. Install manual bypass of low pressure permissive	N	N	$2,261,022	$276,000	12.2%		No. Procedure change and update of the control panels to include a bypass switch.
Grand Gulf	1	Procedural change to cross-tie open cycle cooling system to enhance containment spray system	Y	Y				See Brunswick #7	No. Procedure change.
	2	Enhance procedures to refill CST from demineralized water or service water system	Y	Y				Existing Limerick procedures provide this capability (Fire Water supply to CST via hoses).	No. Procedure change.
	3	Increase operator training for alternating operation of the low pressure ECCS pumps (LPCI and LPCS) for loss of SSW scenarios	N	N	$821,403	$40,452	6.8%		No. Training update.
Monticello	1	Enhanced DC Power Availability (provide cables from DG-13, the security diesel, or another source to directly power division II 250V battery chargers or other required loads)	Y	Y				See Brunswick #1	No. Temporary cable alignments.
	2	Enhance Alternate Injection Reliability (include the RHRSW and FSW valves in the maintenance testing program)	N	N	$8,642,000	$687,044	8.0%	LGS uses hoses, hose connections, and manual valves. Maintenance is N/A	No. Programmatic change.
	3	Additional Diesel Fire Pump for FSW system (proceduralize the use of a fire truck to pressurize and provide flow to the fire main for RPV injection)	Y	Y				Existing Limerick procedures provide this capability (use of fire truck to supplement ring header). In addition, procedures exist for using a portable pump for Alternate RPV injection.	No. Procedure change.
	4	Refill CST (develop emergency procedures and ensure viability of refilling the CSTs with FSW)	Y	Y				See Grand Gulf #2	No. Procedure change.
	5	Divert Water from Turbine Building 931-foot elevation	N	N	$8,642,000	$1,899,615	22.0%		No. This SAMA involves changing the swing direction of a door and the inclusion of an interlock to open a door on high water level.
	6	Manual RCIC Operation	Y	Y				Existing Limerick procedures provide this capability.	No. Procedure change.
Oyster Creek	1	Allow 4160 VAC bus IC and ID cross-tie	Y	Y				Existing Limerick procedures provide this capability.	No. Procedure change with potential interlock/equipment modifications on existing busses.
	2	Provide an alternate method for IC shell level determination	N	N				Not applicable to the Limerick design. Limerick does not have an isolation condenser.	No. Modification to existing sensors.
	3	Portable DC battery charger to preserve IC and EMRV operability along with adequate instrumentation	N	N	$4,462,000	$674,000	15.1%		No. Portable equipment and procedure changes.
	4	Reduce fire impact in dominant fire areas	N	N	$4,462,000	$333,000	7.5%		No. Installation of cable wrap, new cables, or fire barriers.
	5	Operator Training	N	N	$4,462,000	NA			No. Training update.
	6	Protect Combustion Turbines	N	N	$4,462,000	$747,000	16.7%	Not applicable to the Limerick design. Limerick does not have combustion turbines, but the SAMA could potentially be extrapolated to address the EDG building.	No. Reinforcement of an existing structure.
	7	Upgrade Fire Pump House structural integrity	N	N	$4,462,000	$438,000	9.8%		No. Reinforcement of an existing structure.

Table A to Exelon's Counter Affidavit Supporting Exelon's Response Opposing NRDC's Petition for Waiver of 10 C.F.R. § 51.53(C)(3)(ii)(L)

Nuclear Power Plant	Item #	List of Titles of SAMAs Found to be Cost-Beneficial or Potentially Cost-Beneficial from the Weaver Declaration (Paragraph 11)	Implemented at Limerick? Unit 1? (Y/N)	Implemented at Limerick? Unit 2? (Y/N)	Base Case Maximum Averted Cost Risk [Note 1]	Base Case Averted Cost Risk [Note 2]	Percent Change	Comments	Major Modification?
Pilgrim	1	Enhance procedures to make use of AC bus cross-ties	Y	Y				See Oyster Creek #1	No. Procedure change.
	2	Enhance procedures to make use of DC bus cross-ties	N	N	$914,294	$19,761	2.2%	LGS cross-ties exist for 4 kV AC emergency buses only.	No. Procedure change.
	3	Provide redundant DC power supplies to DTV valves	N	N	$914,294	$36,773	4.0%		No. Additional fuses added to an existing electrical panel.
	4	Proceduralize use of the diesel fire pump hydro turbine in the event of EDG A failure or unavailability	N	N	$914,294	$29,213	3.2%		No. Procedure change.
	5	Proceduralize the operator action to feed B1 loads via B3 when A5 is unavailable post trip; similarly, feed B2 loads via B4 when A6 is unavailable post-trip	N	N	$914,294	$31,799	3.5%		No. Procedure change.
Susquehanna	1	Improve cross-tie capability between 4kV AC emergency buses (A-D, B-C)	Y	Y				See Oyster Creek #1	No. Procedure change with potential interlock/equipment modifications on existing busses.
	2	Procure spare 480V AC portable station generator	N	N	$538,000	$132,799	24.7%		No. Portable equipment and procedure changes.
Vermont Yankee	1	Shield injection system electrical equipment from potential water spray	N	N	$523,269	$26,000	5.0%		No. Barrier over or around existing equipment.
	2	Improve operator action: defeat low reactor pressure interlocks to open LPCI or core spray injection valves during transients with stuck open SRVs or LOCAs in which random failures prevent all low pressure valves from opening	N	N	$523,269	$142,000	27.1%		No. Procedure and/or training enhancements.
	3	Install a bypass switch to bypass the low reactor pressure interlocks of LPCI or core spray injection valve	N	N	$523,269	$142,000	27.1%		No. Procedure change and update of the control panels to include a bypass switch.

Note 1: This information was derived from originating site's Environmental Report. In some cases, it was necessary to calculate a MACR value based on the documented external events multiplier to ensure consistency with the averted cost-risk values provided in the Environmental Report.

Note 2: Obtained from the originating site's Environmental Report.

Not Applicable to the LGS Design

Implemented

Functionality addresses by other means at LGS.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:	)	
	)	
EXELON GENERATION COMPANY, LLC	)	**Docket No. 50-352-LR**
	)	**Docket No. 50-353-LR**
(Limerick Generating Station, Units 1 and 2)	)	
		December 21, 2012
(License Renewal Application)		

REPLY OF NATURAL RESOURCES DEFENSE COUNCIL IN SUPPORT OF PETITION, BY WAY OF MOTION, FOR WAIVER OF 10 C.F.R. § 51.53(c)(3)(ii)(L) AS APPLIED TO APPLICATION FOR RENEWAL OF LICENSES FOR LIMERICK UNITS 1 AND 2[1]

I. INTRODUCTION

In response to the Commission's remand of its November 22, 2011 Petition to Intervene and Request for Hearing, in which the Commission expressly directed the Board to consider a petition for "waiver of [10 C.F.R.] § 51.53(c)(3)(ii)(L) as it applies to the Limerick SAMDA analysis," CLI-12-19 (hereafter "Comm. Op.") at 15, the Natural Resource Defense Council ("NRDC") has filed a Waiver Petition. *See* NRDC Petition For Waiver of 10 C.F.R. § 51.53(c)(3)(ii)(L) As Applied To Application For Renewal of Licenses For Limerick Units 1 and 2 ("NRDC Waiver Pet."). As the Petition explains, while NRDC disputes a waiver is necessary, it nonetheless meets all the criteria for waiver of Section 51.53(c)(3)(ii)(L), because precluding

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[1] NRDC submits this Reply pursuant to the Board's November 27, 2012 Order expressly allowing NRDC to file a Reply in support of the Waiver Petition. ASLB No. 12-916-04-LR-BD) (Nov. 27, 2012).

NRDC from pursuing its Contentions – which concern new and significant information related to the SAMA analysis associated with the Limerick relicensing – would be contrary to the purpose for which the Commission adopted Section 51.53(c)(3)(ii)(L); the waiver request raises special circumstances that are unique to the Limerick relicensing; and the request concerns matters of significant environmental concern. *Id.* at 16-27.

NRC Staff ("Staff") and Exelon Generating Company, LLC ("Exelon") oppose the Waiver Petition. Staff Answer To NRDC Petition ("Staff Ans.") (Dec. 14, 2012); Exelon Response Opposing NRDC Petition ("Exelon Resp.") (Dec. 14, 2012). In their view, it is irrelevant whether there is new and significant information warranting further review of SAMAs for Limerick because, in promulgating its 1996 NEPA regulations for relicensing, the Commission intended that SAMAs would not need to be revisited during Limerick relicensing under *any* conceivable circumstances or timeframe. They further contend that the issues NRDC has raised do not qualify as "special circumstances," as "unique," or as raising a concern sufficiently "significant" to warrant a waiver.

As explained below, the Staff Answer and Exelon Response merely serve to further highlight why the Waiver Petition should be granted. Indeed, while one of their principal arguments is that NRDC's waiver petition is contrary to the "plain language" of Section 51.53(c)(3)(ii)(L), the sole purpose of a Waiver Petition is to obtain an exception from the plain terms of a regulation. Moreover, since the Staff and Exelon both acknowledge that NEPA requires that "new and significant information" *be considered in the relicensing process*, the narrow question here is whether an interested party is entitled to *challenge the adequacy* of that consideration when it relates to severe accident mitigation alternatives, as NRDC contends, or whether, as Staff and Exelon contend, the purpose of Section 51.53(c)(3)(ii)(L) was to *deny that opportunity and leave that aspect of the NEPA process beyond challenge*. Since neither Exelon nor Staff even assert – let alone demonstrate – that this was the purpose of Section 51.53(c)(3)(ii)(L), their arguments must fail.

Exelon and Staff also argue that NRDC's Contentions do not raise issues serious enough to warrant consideration. However, given that the Board had *already concluded* that NRDC's Contentions warrant consideration before the Commission remanded the matter for consideration through a waiver petition, *see* Atomic Safety and Licensing Board's ("ASLB") April 4, 2012 Memorandum and Order (ASLBP No. 12-916-04-LR-BD01) (hereafter "ASLB Op."), there can be no question that NRDC has made a "*prima facie*" case concerning these matters, warranting Commission referral. 10 C.F.R. § 2.335(d); *St. Mary's Honor Ctr. v. Hicks*, 509 U.S. 502, 527 (1993) (*prima facie* case burden may only "require[ ] production of enough evidence to raise an issue for the trier of fact"). As for the Commission, NRDC has submitted ample information to demonstrate that the waiver should be granted and its Contentions should be admitted, and, contrary to Staff and Exelon's arguments, NRDC is not required at this stage to demonstrate *either* that its Contentions will ultimately succeed, or that, if they do, they will necessarily lead Exelon to implement improved SAMAs for Limerick. *Cf. Lemon v. Geren*, 514 F.3d 1312, 1315 (D.C. Cir. 2008) (explaining that for "procedural injury" cases, such as those under NEPA, the "plaintiffs suffer harm from the agency's failure to follow [the] procedures, compliance with which *might have changed the agency's mind*") (emphasis added); *Lujan v. Defenders of Wildlife*, 504 U.S. 555, 573, n.7 (1992)).[2]

Exelon and Staff's arguments that the Waiver sought here is unnecessary because the Commission (and Exelon) have fully and fairly considered SAMAs in other contexts also must fail. While it is true that the Commission has discretion in determining how it will carry out its responsibilities under NEPA, that discretion simply does not extend to substituting *other* processes for NEPA, where Congress specifically directed that agencies take a "hard look" at all of the environmental impacts of their actions, along with appropriate alternatives, through a public participation process. *E.g., Limerick Ecology Action, Inc. v. U.S. Nuclear Regulatory Comm'n,* 869 F.2d 719, 729 (3d Cir. 1989) (rejecting argument that other processes can substitute for consideration of SAMAs in the NEPA process).

Accordingly, the Board should certify the Waiver Petition to the Commission, where the Petition should be granted.

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[2] Exelon also complains about the evidence reflecting new and significant information NRDC has submitted through expert Declarations in its original Request for Hearing and its Waiver Petition. As explained below, *see infra* at 12, n.7, however, Exelon's effort to exclude this information is baseless, as the Board and Commission may and should consider *both* Declarations, which were both submitted with the Waiver Petition and which amply demonstrate the new and significant information that warrants consideration during the Limerick relicensing NEPA review process.

II. ARGUMENT

At the outset, in light of Staff and Exelon's arguments it is critical to clarify that in order to grant a waiver here the Board and Commission do not need to consider the *merits* of NRDC's Contentions. The only question at this stage is whether NRDC meets the waiver standards. The Board *already determined* that two of the three Contentions at issue here should be admitted, and the Commission's remand specifically invited NRDC to raise the third. Thus, irrespective of what *future* proceeding could be appropriate to further consider the propriety of NRDC's Contentions, the criteria for contention admissibility is not at issue here, Staff and Exelon's arguments to the contrary notwithstanding. *E.g.* Staff Ans. at 22, 39 (claiming NRDC must, at this stage, show "plainly better" methodologies and a "substantial reduction in risk of severe accidents").

A. Neither Exelon Nor Staff Demonstrate That It Would Be Consistent With The Purposes Of Section 51.53(c)(3)(ii)(L) To Preclude Consideration Of New And Significant Information Concerning SAMAs For Limerick.

Staff and Exelon contend that denying NRDC a Waiver to permit consideration of its Request for Hearing concerning new and significant information related to SAMA's for Limerick would be consistent with the purposes of Section 51.53(c)(3)(ii)(L) because, (a) the plain language of the regulation precludes NRDC's request, and (b) the Commission considered this question in promulgating the regulation. Staff Ans. at 12-26; Exelon Resp. at 19-27. Neither of these arguments should succeed.

1. The Waiver Cannot Be Denied On The Grounds That It Is Inconsistent With The Plain Language Of The Regulation.

Both Staff and Exelon argue that NRDC cannot satisfy the first waiver criteria because allowing NRDC to raise new and significant information concerning SAMAs during the Limerick Relicensing would be contrary to the plain language of Section 51.53(c)(3)(ii)(L), which expressly states that further SAMA analysis need not be conducted if conducted in earlier NEPA review. *E.g.* Exelon Resp. at 20; NRC Staff Resp. at 16 (arguing the Commission may not interpret the regulation in "conflict[ ] with its 'plain language'"). This argument must fail.

If NRDC's Contentions were consistent with the plain language of Section 51.53(c)(3)(ii)(L), *no waiver would be required*. Indeed, that is what the Board originally ruled – *i.e.*, that it would not be inconsistent with the plain language of Section 51.53(c)(3)(ii)(L) to permit NRDC to pursue its Contentions. ASLB Op. at 21. However, it is precisely because the Commission has ruled that pursuit of the Contentions would be *contrary to the language of Section 51.53(c)(3)(ii)(L)* that NRDC has been directed to submit a Waiver Petition. Comm. Op. at 13-15.

Accordingly, it is – and must be – entirely irrelevant to NRDC's Waiver Petition that the waiver sought is not consistent with Section 51.53(c)(3)(ii)(L) as written. Indeed the Waiver regulations are designed to allow an interested person to demonstrate that "*application of* a specified Commission rule or regulation" should be waived, 10 C.F.R. § 2.335(b) (emphasis added), which necessarily means that applying the plain language of the regulation at issue would preclude relief. In short, NRDC here seeks a *waiver* of Section 51.53(c)(3)(ii)(L), and thus Staff and Exelon's reliance on the language of the regulation has no traction.

2. The Waiver Would Not Be Inconsistent With The Purposes For Which The Commission Enacted 51.53(c)(3)(ii)(L).

NRC Staff and Exelon argue that it would be inconsistent with the purposes of Section 51.53(c)(3)(ii)(L) to permit NRDC to pursue its Contentions concerning new and significant information related to SAMA for Limerick. NRC Staff Ans. at 15-26; Exelon Resp. at 19-27. These arguments also must fail.

First, with respect to NRDC's argument that the purpose of Section 51.53(c)(3)(ii)(L) was simply to exempt Limerick from reconsidering the SAMAs previously considered, Waiver Pet. at 16-19, Staff asserts that the Commission has already determined that under Section 51.53(c)(3)(ii)(L) "'a supplemental SAMA *analysis* need not be performed in' the Limerick proceeding." Staff Ans. at 17. However, the Staff's citation – and a similar one from Exelon – is to *the Commission decision remanding this matter for NRDC to submit a Waiver Petition. Id.* at 17, n.82; *see also* Exelon Resp. at 20-21 (similarly claiming that the Commission's remand for a waiver petition constitutes a "recent interpretation" by the Commission demonstrating that a waiver may not be granted).

It could hardly make sense to conclude that, in the very decision where it invited NRDC to submit a Waiver Petition, the Commission also concluded that the application of Section 51.53(c)(3)(ii)(L) in this instance serves the rule's purpose – in which case, a waiver *could not be granted*. To the contrary, since the Commission concluded that "NRDC *may challenge* the adequacy of the new information provided in the Limerick Environmental Report," Comm. Op. at 13 (emphasis added), and then explained that the "proper procedural avenue for NRDC to raise its concerns is to seek a waiver," *id.*, the Commission necessarily recognized that application of Section 51.53(c)(3)(ii)(L) in these circumstances would *not* necessarily serve the regulations' purposes. *Cf. Natural Res. Def. Council, Inc. v. EPA,* 25 F.3d 1063, 1070 (D.C. Cir. 1994) (regulations may not be implemented so as to "conflict with the governing statute").[3]

Second, while Staff and Exelon claim language in the 1996 Statement of Consideration ("SOC") supports their view that the regulation was intended to foreclose further consideration of *any* SAMAs, not just those previously considered, *e.g.* Staff Ans. at 18-19, neither can explain how this could have been the Rule's purpose given the language in the SOC affirming the Commission's commitment to consider new and significant information during relicensing, as mandated by NEPA. *See, e.g.* 61 Fed. Reg. 28,467, 28,468 (1996) ("The NRC will also review and consider any new and significant information presented during the review of individual license renewal applications"). Indeed, neither even attempts to reconcile Section 51.53(c)(3)(ii)(L) and Section 51.53(c)(iv) (requiring consideration of "new and significant information" during relicensing) *at all*. 10 C.F.R. § 51.53(c)(iv). While the Board initially

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[3] It is thus also irrelevant that the GEIS and Section 51 regulations concluded that the likelihood of severe accidents is "of SMALL significance for all plants," Exelon Resp. at 17, as, once again, if this was a bar to a waiver there would have been no reason for the Commission's remand. Indeed, Staff's overarching premise that granting the waiver would render "the exception in 51.53(c)(3)(ii)(L) meaningless," Staff Ans. at 27, is plainly mistaken. The waiver could not be denied on that basis because that would mean the Commission's remand was a futile exercise. *Cf. In re Butcher*, 125 F.3d 238, 242 (4th Cir. 1997) (reiterating general rule of interpretation whereby a legislature is "presumed not to have enacted futile laws or laws which generate such absurd results"). In NRDC's view, having reached its construction of the regulations, the Commission naturally remanded in recognition that applying the regulation here as written would be contrary to the Commission's commitment, as reflected in the SOC, to comply with NEPA, and that the regulation may have a more narrow purpose – to avoid duplicative SAMA analysis – than reflected by the language itself.

resolved the tension between these regulations by concluding that Section 51.53(c)(3)(ii)(L) did not preclude NRDC's Contentions, the Commission resolved what it characterized as "ambiguity" in the regulations, Comm. Op. at 11, by inviting NRDC to submit this Waiver Petition. Accordingly, the language cited by Staff and Exelon does not demonstrate that the purpose of Section 51.53(c)(3)(ii)(L) was to exempt Exelon from any requirement to consider new and significant information related to individual SAMAs during the Limerick relicensing. Rather, as NRDC has explained, the purpose of the regulation was to insure NEPA compliance while avoiding duplication of effort, by exempting Limerick from reconsidering specific SAMAs during relicensing.

Indeed, it bears emphasizing that both Staff and Exelon agree that "'NEPA *does impose* a requirement that the NRC consider any new and significant information regarding environmental impacts before renewing a nuclear power plant's operating license.'" NRC Ans. at 9 (quoting *Massachusetts v. United States*, 522 F.3d 115, 127 (1st Cir. 2008) (emphasis added)). Thus, as Exelon explained, "[b]oth the applicant and the NRC Staff have obligations to address new and significant information related to SAMAs in their NEPA analyses." Exelon Resp. at 16. NRC Staff and Exelon further assert that the only way an interested party may pursue an argument that these obligations have not been fulfilled is to submit a Waiver Petition. *Id.* at 17; Staff Ans. at 34. *That is precisely what NRDC is doing here*, and thus far from undermining the Waiver Petition these arguments serve to further highlight why it should be granted.

Moreover, if Staff and Exelon were correct that, despite the fact that a waiver is the *only* procedural vehicle for NRDC to challenge the adequacy of the consideration of SAMA's in the Limerick relicensing ER, a waiver cannot be granted because an adequate analysis was previously conducted – *irrespective of new and significant information bearing on the validity of SAMAs never previously considered* – then the end result would be that a waiver could never be granted and that while the Commission, in carrying out its NEPA responsibilities, *is* required to consider new and significant information, an interested party has no procedural vehicle to challenge the adequacy of that analysis. Exelon Resp. at 17 ("NEPA requires the NRC to fully consider environmental issues, but does not automatically require the NRC to do so in an adjudicatory process."). There is simply nothing in the 1996 regulations suggesting that the Commission's purpose was to foreclose such public participation, in appropriate cases, which, again, would flatly contradict both NEPA's dictates and the good faith presumption that the Commission did not intend this remand to have a preordained result. *See also, e.g. Calvert Cliff's Coord. Comm. v. AEC*, 449 F.2d 1109, 1117 (D.C. Cir. 1971) (rejecting proposal to conduct the NEPA analysis outside the hearing process as a "crabbed interpretation of NEPA).[4]

Third, Staff and Exelon claim that in enacting Section 51.53(c)(3)(ii)(L) the Commission recognized that there would be other, *non-NEPA* methods through which applicants and the NRC would continue to consider SAMAs in the future. NRC Staff Ans. at 13; Exelon Resp. at 40-41.

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[4] Staff emphasizes that in *Mass. v. U.S.*, 522 F.3d at 127, the First Circuit explained that NRC has broad discretion to structure its NEPA compliance procedures. Staff Ans. at 10. NRDC does not disagree with that proposition, but those procedures *must still comport with NEPA*, including by providing an avenue for an interested party to contest whether adequate consideration has been given to new and significant information. While NRC Staff claims the waiver process provides that avenue, that path is only meaningful *if the Waiver is granted*, as NRDC urges.

But this merely serves to highlight once again that the Commission's purpose in enacting Section 51.53(c)(3)(ii)(L) was not to foreclose consideration of additional SAMAs during relicensing, in the event that new and significant information exists. In short, since these alternative avenues for considering SAMAs certainly are not the functional equivalent of NEPA review – with, *inter alia*, appropriate public participation and consideration of alternatives – they are no substitute for considering SAMAs in the NEPA review during relicensing. *See, e.g. United States v. Coal. for Buzzards Bay*, 644 F.3d 26, 38 (1st Cir. 2011) (rejecting argument that alternative process can substitute for NEPA).[5]

Indeed, Staff and Exelon's rejoinder regarding the 1999 Nuclear Energy Institute ("NEI") Rulemaking Petition further demonstrates this point. Staff Ans. at 20-21; Exelon Resp. at 41-42. As NRDC explained in the Waiver Petition, when NEI sought to make SAMA analysis a Category 1 issue on the grounds that the issue was being considered through other methods (*e.g.*, through Individual Plant Examinations of External Events ("IPEEE")), the Commission *rejected the Petition*, explaining that "it should continue to consider SAMAs for individual license renewal applications to continue to meet its responsibilities under NEPA," 66 Fed. Reg. 10,834, 10,836 (2001). NRDC Pet. at 18, n.10. While Staff claims that in resolving this Petition the Commission rejected an argument that SAMAs need not be considered during license renewal "because severe accidents are remote and speculative," Staff Ans. at 20, in fact the Commission expressly concluded that "insufficient information is available to conclude generically that a

[5] Exelon also conclusorily states that updated SAMAs were considered in a more recent update of the GEIS. Exelon Resp. at 23, n.95. This overstates the status of the GEIS update, which has not been completed. *See* Staff Ans. at 18, n.88 (citing *proposed rule*).

SAMA analysis is not warranted for individual plant license renewal reviews." 66 Fed. Reg. at 10,838. Since the Commission has affirmatively decided, contrary to Staff and Exelon's claim, that its other analyses of SAMAs are insufficient to support a generic SAMA finding, there is no basis in the Commission's prior actions for concluding that this alternative could substitute for adequate NEPA review.[6]

Staff and Exelon's responses regarding NRDC's specific Contentions are also unavailing.[7] *First*, with respect to the additional specific SAMAs that Exelon has thus far

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[6] Thus, although Staff *claims* that the Commission "explicitly determined that . . . if a consideration of SAMA was completed, another need not be completed at license renewal, despite the fact that future SAMA analyses may uncover additional, cost-beneficial SAMAs," Staff Ans. at 24, they provide no citation for this unvarnished assertion, which is not only antithetical to NEPA – as it would mean that even though the Commission recognizes that a relicensing is a *new* decision involving "the consideration of environmental impacts caused by 20 additional years of operation," 66 Fed. Reg. at 10,836, a new SAMA with extremely high benefits for very low costs neither need be considered nor implemented – but, also, to the Commission's own regulation governing consideration of "new and significant information" during relicensing. 10 C.F.R. § 51.53(c)(iv).

[7] Exelon's extended attack on NRDC's supporting Declarations, Exelon Resp. at 24, 43-45, is spurious. The Waiver Petition was supported both by the Declaration of Dr. Weaver (and Mr. Fettus), *as well as* by NRDC's original Request for Hearing and Contentions, which was supported by a more extensive Declaration of Dr. Weaver and two of his colleagues – *all of which was submitted in support of the Waiver Petition*. *See* ADAMS Doc. ID 11648 (Nov. 21, 2012). NRDC pared down the Hearing Request Declaration to focus on the issues most relevant to the Waiver Petition, and most importantly, to remove discussion related to Contentions that are no longer at issue, such as population numbers. The Board and Commission should thus not be distracted by Exelon's effort to waste the parties, Board, and Commission's time arguing that submitting the Dr. Weaver declaration with the Waiver Petition somehow calls into question the earlier Declaration, or otherwise precludes the Board and Commission from considering the earlier Declaration should that prove necessary. Such diversionary tactics have no place in this or any other proceeding. *E.g. AT&T. v. FCC*, 978 F.2d 727, 731-32 (D.C. Cir.

refused to consider, as noted, Staff asserts that, in promulgating Section 51.53(c)(3)(ii)(L), the Commission recognized that "future SAMA analyses may uncover additional, cost-beneficial SAMAs," but determined that if a prior SAMA had been completed during licensing a further consideration of SAMAs during relicensing was not required. NRC Staff Ans. at 24.

However, NRC Staff can point to no specific language in the SOC that makes this point. To the contrary, the SOC repeatedly emphasizes that "new and significant information" *will be considered* during relicensing. 61 Fed. Reg. at 28,468. Again, since such consideration is both consistent with NEPA, and with NRC's own concession in its (and Exelon's brief) that "new and significant information" must be considered during the relicensing process, application of the regulation to preclude NRDC from pursuing this issue would be contrary to the purpose of the regulation.[8]

1992) (parties should not be subjected to an "administrative law shell game").

[8] Seeking to put NRDC to an untenable and inappropriate burden, Staff also asserts the waiver should be denied because NRDC has not demonstrated that the SAMAs it has identified are different from those the Commission recognized "could be identified" in promulgating Section 51.53(c)(3)(ii)(L), or have not "already been considered at Limerick." Staff Ans. at 24-25. Of course, if the Commission or Exelon had already considered these specific SAMAs, Staff would point to that consideration, rather than suggesting the NRDC's has an obligation to prove a negative. In any event, the salient point is that these SAMAs have not yet been considered *in the NEPA process*, and since the SOC makes plain that the Commission was not disavowing its fundamental NEPA obligation to consider new and significant information during the relicensing *NEPA* process, application of Section 51.53(c)(3)(ii)(L) to preclude NRDC's contentions would be contrary to its purposes.

Second, as regards economic analysis and modeling techniques, Staff claims that these issues concern how a SAMA analysis is conducted, and that since "the rule does not provide particular requirements for a SAMA analysis," there is no basis for these Contentions. Staff at 25-26. Similarly, Exelon argues that the Commission anticipated that any SAMA improvements would be "minor in nature and few in number." Exelon Resp. at 22; *see also id.* at 24 (asserting that waiver can only be granted if NRDC identifies "*major* design changes or *major* plant modifications that would be cost effective"); *id.* at 26 (arguing NRDC has failed to demonstrate "major, cost-beneficial plant improvements"); *id.* at 31 ("NRDC fails to demonstrate" that its Contentions "would lead to cost-effective, major design or hardware changes for Limerick").[9]

These arguments are premature. As NRC Staff explains, Exelon's ER "*omit[ted] a discussion of severe accident mitigation alternatives*, which are typically analyzed in license renewal ERs." Staff Ans. at 2 (emphasis added). Once Exelon evaluates the impact of new and significant information in its analysis of the required reasonable range of severe accident mitigation alternatives for Limerick, NRDC will be able to assess whether the economic analysis and modeling approaches employed are adequate. *See, e.g., Lands Council v. Vaught,* 198 F. Supp. 2d 1211, 1238 (E.D.Wash. 2002) (reiterating the principal that "[a]n environmental impact statement must contain high quality information and accurate scientific analysis"); *see*

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[9] Exelon's "expert" conclusorily asserts that a "50% reduction in the maximum averted cost-risk" is necessary for a SAMA to be significant. Decl. ¶ 21. However, the Commission has no such threshold, and, in any event, as noted, NRDC need not demonstrate the significance of these matters in order to obtain a Waiver; rather those are matters for another day, once the Waiver has been granted.

also 40 C.F.R. § 1502.22(a) (Council on Environmental Quality NEPA regulations providing that where information "is essential to a reasoned choice among alternatives and the overall costs of obtaining it are not exorbitant, the agency shall include the information in the environmental impact statement"). However, at this stage the issue is whether the purpose of Section 51.53(c)(3)(ii)(L) is served by precluding NRDC from challenging the fact that Exelon inappropriately relied on data from Three Mile Island ("TMI") in considering the significance of information concerning economic cost risks, and has not used the most updated probabilistic safety assessment severe accident consequences code system. NRDC Cont. at 18 (¶ 15), 22 (¶¶ 1,3). Again, given the Commission's assurances that new and significant information *would be considered during relicensing*, it would be wholly inconsistent with the purpose of this regulation to foreclose consideration of these matters unless NRDC can demonstrate – *before such NEPA analysis is performed* – that such consideration will lead to major changes at Limerick.

Indeed, it once again bears emphasizing in this regard that the Board *already determined that two of NRDC's Contention bases should be admitted*, simply not through the waiver process. ASLB Op. at 20-21 ("NRDC has shown there are numerous new SAMA candidates which should be evaluated for their significance"); *id.* at 23-25 (admitting "whether Exelon's use of data from TMI in its analysis provides an adequate consideration of new and significant information regarding economic cost risk"). And the Commission invited NRDC to add the third. Comm. Op. at 15. Therefore, the admissibility of NRDC's Contentions is simply not at issue in this Waiver Petition.[10]

B. Neither Exelon Nor NRC Staff Demonstrate That The Petition Raises No Special Circumstances Unique To Limerick.

Staff's and Exelon's threshold argument as to special circumstances repackages the argument that, in promulgating 51.53(c)(3)(ii)(L), the Commission anticipated that SAMAs would be considered in the future *outside* the NEPA process. Staff Ans. at 28-29; Exelon Resp. at 28-30. However, as NRDC has explained, *see supra* at 10-11, this is not consistent with the Commission's commitment in the SOC to consider new and significant information through NEPA.

Staff next argues that the waiver cannot be predicated on an issue "the Commission *did not consider*" in promulgating the regulation. Staff Ans. at 31 (emphasis added) (arguing that waiver concerning economic analysis "cannot be proper merely when the Commission did not consider how a licensee might later address . . . an issue in the first place").[11] Once again, Staff offers a heads they win, tails we lose approach: waiver cannot be inappropriate *both* because the Commission considered these issues and because it did *not* consider them. To the contrary, the

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[10] Moreover, neither Staff nor Exelon have met the strict standards for reconsideration of the Board's determination to admit NRDC's contentions, and thus at least with respect to the previously admitted Contentions, their admissibility once the Waiver is granted should not be reconsidered here. *E.g.*, 10 C.F.R. § 2.323(e) (reconsideration standards).

[11] For its part, Exelon claims that "[t]he Commission was aware of the specific concern" regarding economic analysis when the regulations was issued. Exelon Resp. at 31.

salient question is whether it would be consistent with the purposes of the regulation – which expressly made SAMA analysis a Category 2 issue, and included a narrow exception for Limerick – to conclude that an interested party has no recourse concerning whether new and significant information regarding SAMAs is properly included in the Limerick relicensing NEPA process. Since the answer to that question is no, it is irrelevant whether the Commission did or did not generally anticipate NRDC's Contentions in promulgating 51.53(c)(3)(ii)(L), particularly given that the Commission has already recognized the tension between this regulation and 51.53(c)(iv) requiring consideration of new and significant information during relicensing.[12]

As regards NRDC's third Contention basis, Exelon claims that even if "every other BWR nuclear power plant" relicensing has utilized the improved methodologies NRDC has identified, in promulgating the Rule the Commission intended to exempt Limerick from doing so. Exelon Resp. at 31-32. Since NRDC does not argue that these improved analytical techniques should be used to reexamine the SAMAs already evaluated by Exelon, the point is irrelevant. In addition, once again, Exelon's argument is flatly inconsistent with the Commission's commitment to

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[12] In further circular reasoning, Staff argues that Exelon's obligation to consider new and significant information, and NRDC's opportunity to challenge that consideration, are tied to 51.53(c)(3)(ii)(L) and whether the exemption it provides Limerick should be waived. Staff Ans. at 33-34 ("Exelon is required under § 51.53(c)(3)(iv) to determine whether any new and significant information might impact the Commission's § 53.53(c)(3)(ii)(L) finding" and "NRDC's right to challenge Exelon's analysis is via waiver petition"). If so, then the new and significant information NRDC has presented warrants a Waiver.

consider new and significant information during relicensing, and its commitment in the rulemaking to comply with NEPA.[13]

Staff and Exelon's efforts to demonstrate the Waiver Petition is not unique to Limerick is also unavailing. Staff Ans. at 34-36; Exelon Resp. at 32-35. Staff suggests the rule "could" apply to other license renewals, Staff Ans. at 35, but, once again, if there were such other plants Staff would have identified them, and NRDC is aware of none. As for "second license renewals," *see* Staff Ans. at 35, Exelon Resp. at 33, the notion that Section 51.53(c)(3)(ii)(L) will exempt further SAMA analysis when plants are renewed again in the mid-twenty-first century is flatly contradictory to the Generic Environmental Impact Statement ("GEIS") on which the regulations are predicated, which was prepared only to address "the potential environmental consequences *of renewing the licenses of and operating individual nuclear power plants for an additional 20 years,*" not of second – and third, and fourth – generation renewals. *See* GEIS Executive Summary; *see also id.* at § 1.1 ("This Generic Environmental Impact Statement (GEIS) for license renewal of nuclear plants was undertaken to assess what is known about the

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[13] Exelon also claims that NRDC is expressly forbidden from suggesting the use of modern SAMA analysis methodologies, such as Level 3 PRAs and MACCS2, as part of any updated NEPA analysis. Exelon Resp. at 43. What Exelon ignores is that the Commission did not want to specify the particular way in which an applicant would supplement the results of the Level 1 and Level 2 PRAs. Contention 3E does not seek to require Exelon to use MACCS2 or any other PRA Level 3 analysis. Rather, NRDC seeks no more, at this time, than that any further analysis of SAMAs follow the guidance provided by NEI and NRC Staff in ascertaining severe accident impacts and mitigation measure benefits.

environmental impacts that could be associated with license renewal *and an additional 20 years of operation of individual plants*. That assessment is summarized in this GEIS") (emphasis added). In short, Staff and Exelon may not use the prospect of second-generation renewals to demonstrate that allowing NRDC to obtain a waiver of the regulation as it applies to Limerick would open the door for waiver of the regulation as applied to hypothetical license re-renewal proceedings in the future since it is clear the GEIS does not apply to re-relicensing applications. Rather, the waiver sought here is limited to only a *single* BWR, Limerick, for which Exelon has asserted, with allegedly supporting evidence and reasoning, in its ER that it need not do an economic analysis of severe accidents and mitigation alternatives and that it need not consider mitigation alternatives not previously considered.

NRDC also need not demonstrate that the SAMAs and measures it has identified are only relevant to Limerick in order to obtain a waiver. Exelon Resp. at 34. As NRDC has explained, because Limerick is the only BWR to which the exemption in Section 51.53(c)(3)(ii)(L) applies, this issue here is necessarily unique to that "facility rather than 'common to a large class of facilities.'" *In the Matter of Dominion Nuclear Connecticut (Millstone)*, 62 N.R.C. 551, 560 (Oct. 26, 2005). Put another way since the other BWRs are not subject to the Section 51.53(c)(3)(ii)(L) exemption, the fact that other BWRs have considered these SAMAs serves to highlight, rather than undermines, the uniqueness of the circumstances here.

C. Neither Exelon Nor NRC Staff Demonstrate That The Petition Raises No Significant Environmental Concerns.

Staff and Exelon assert that the Petition does not raise any significant environmental concerns warranting waiver. Staff Ans. at 37-42; Exelon Resp. at 36-42. They are mistaken.[14]

At the outset, it is critical to note that, as the Staff acknowledges, the fact that the risk of a severe accident may be small does not mean that measures to mitigate against that risk cannot be significant. Staff Ans. at 39, n.189. Rather, as NRDC has explained, particularly because of the severe consequences associated with such an accident, even a small reduction in that risk may be significant. NRDC Pet. at 26. Moreover, given that alternatives analysis is "the heart" of the NEPA process, App. A to 10 C.F.R. 51 at Section 5, the consideration of alternatives to mitigate severe accidents is central to fulfilling the Commission's NEPA obligations.

NRC Staff's assertion that significance must be evaluated in terms of the environmental impacts *alone* rather than in relation to reasonable alternatives that may reduce that impact is also mistaken. Staff Ans. at 38. NEPA – and NRC's regulations – rightly also focus on reasonable *alternatives*, and thus when viewing NRDC's Contentions bases through the lens of alternatives analysis, reasonable alternatives must be appropriately considered even if they have similar impacts. *See, e.g.¸ Ala. Wilderness Recreation & Tourism Ass'n v. Morrison*, 67 F.3d 723, 730 (9th Cir. 1995) (stating that alternatives are "the heart of the environmental impact statement," and when new reasonable alternatives arise they must be independently considered in

[14] Both Staff and Exelon acknowledge that this factor encompasses environmental as well as safety concerns. Staff Ans. at 6, n.26 and 37-38; Exelon Resp. at 36, n.144.

the NEPA process); *see also* 10 C.F.R. § 51.103(a)(4) (explaining that an NRC Record of Decision must "[s]tate whether the Commission has taken all practicable measures within its jurisdiction to avoid or minimize environmental harm from the alternative selected, and if not, to explain why those measures were not adopted. Summarize any license conditions and monitoring programs adopted in connection with mitigation measures"). Moreover, since the entire purpose of SAMAs and the other related bases for NRDC's contentions is to lessen the environmental impacts that would be associated with severe accidents, significant environmental impact issues have been raised as well. *E.g.*, *LEA*, 869 F.2d at 738-39 (rejecting NRC's argument that SAMA alternatives need not be considered in individual licensing proceedings).

As for whether NRDC has met this factor, NRC Staff argues that it is not met because NRDC has not shown that the analysis it seeks "*will* result in a serious reduction in the risk of severe accidents posed by the Limerick facility." Staff Ans. at 39 (emphasis added); *id.* at 40 (arguing factor not met due to failure to show waiver will "necessarily lead to a substantial reduction in risk of severe accidents"). However, as the Staff elsewhere recognized, NRDC need not "*prove the merits of its underlying contention at this stage* . . . ." Staff Ans. at 38, n.182 (emphasis added).

As discussed above, the Board already determined that NRDC had met its threshold burden to assert "not only new, but significant" information warranting consideration of certain of NRDC's Contentions. ASLB Op. at 21. As Exelon recognizes, "new and significant information" is an appropriate basis on which to find that NRDC has "satisf[ied] the fourth prong" of the *Millstone* test. Exelon Resp. at 36, n.146. Accordingly, this issue has already been resolved. *See supra* at 5.

Exelon further argues that because the 1996 SOC contemplated that that Exelon would continue to consider SAMAs outside the NEPA context, the issues NRDC raises are not significant for NEPA purposes. Exelon Resp. at 41. However, once again, this circular logic merely reinforces the basis for NRDC's Contentions. Exelon claims that "*though not conducted to satisfy NEPA*, these PRAs inform the analysis in the ER – which is a document required under Part 51 – and can be used to inform the environmental analysis performed by the NRC staff." *Id.* (emphasis added). Once again, since Exelon acknowledges its obligation to consider new and significant information concerning its SAMA analysis, it plainly must do so in a way that satisfies NEPA, and thus the Waiver Petition – by insuring review of the adequacy of Exelon's SAMA analysis – raises significant environmental concerns satisfying this factor. [15]

Finally, Exelon's reliance on *Mass. v. NRC*, 522 F.3d at 120-121, and the underlying Commission proceeding there, to argue that the significance of new and significant information is insufficient to allow NRDC's Contentions to be admitted, Exelon Resp. at 46-47, is misplaced. In *Mass.*, Petitioners claimed that they were entitled to pursue their contentions *without* seeking a waiver. 522 F.3d at 121-24. Here, by contrast, NRDC contends that if, as the Commission has determined, a waiver is required, then NRDC satisfies the criteria, including this final factor, in light of the new and significant information it has presented concerning the consideration of SAMAs at Limerick. Nothing in *Mass.* suggests that the waiver may not be granted. To the

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[15] Indeed, if Exelon has conducted the requisite analysis in its ER, it should be able to defend the analysis rather than expending its efforts trying to foreclose any challenge to its adequacy. Moreover, if the analysis has been conducted elsewhere, there is simply no logical reason not to include it in the NEPA review, where it squarely belongs.

contrary, the First Circuit's admonition that "NEPA *does* impose a requirement that NRC consider new and significant information regarding environmental impacts before renewing a nuclear power plant's operating license," 522 F3d at 127 (emphasis added), merely serves to further highlight that, in this case, a waiver is appropriate to consider NRDC's Contentions regarding whether Staff and Exelon have adequately fulfilled this fundamental NEPA responsibility.

III. CONCLUSION

For the foregoing reasons the Waiver Petition should be granted.

Respectfully Submitted,

s/ (electronically signed)
Howard M. Crystal
Meyer Glitzenstein & Crystal
1601 Connecticut Ave., N.W., Suite 700
Washington, D.C. 20009
(202) 588-5206
hcrystal@meyerglitz.com

s/ (electronically signed)
Anthony Z. Roisman
National Legal Scholars Law Firm, P.C.
241 Poverty Lane, Unit 1
Lebanon, NH 03766
603-443-4162
aroisman@nationallegalscholars.com

s/(electronically signed)
Geoffrey H. Fettus
Natural Resources Defense Council
1152 15th Street, NW, Suite 300
Washington, D.C. 20005
202-289-2371
gfettus@nrdc.org

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LBP-13-1

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD

Before Administrative Judges:

William J. Froehlich, Chairman
Dr. Michael F. Kennedy
Dr. William E. Kastenberg

In the Matter of	Docket Nos. 50-352-LR, 50-353-LR
EXELON GENERATION COMPANY, LLC	ASLBP No. 12-916-04-LR-BD01
(Limerick Generating Station, Units 1 and 2)	February 6, 2013

ORDER
(Denying Petition for Waiver of 10 C.F.R. § 51.53(c)(3)(ii)(L) and
Referring this Decision to the Commission)

Before the Board is a November 21, 2012 petition for waiver of 10 C.F.R. § 51.53(c)(3)(ii)(L) filed by the Natural Resources Defense Council (NRDC).[1] For the reasons discussed herein, and in accordance with 10 C.F.R. § 2.335(b), the Board denies NRDC's petition. However, because the legal issue presented by NRDC's petition is novel and worthy of the Commission's immediate attention, we refer this decision to the Commission pursuant to 10 C.F.R. § 2.323(f)(1).

I. BACKGROUND

On August 8, 1985, the Commission issued a full-power operating license for Limerick Generating Station, Unit 1, to the Philadelphia Electric Company (PECO), now a subsidiary of

[1] Natural Resources Defense Council's Petition, by Way of Motion for Waiver of 10 C.F.R. § 51.53(c)(3)(ii)(L) as Applied to Application for Renewal of Licenses for Limerick Units 1 and 2 (Nov. 21, 2012) [hereinafter Waiver Petition].

Exelon Generation Company, LLC (Exelon).[2] A group, Limerick Ecology Action, Inc. (LEA), challenged the granting of this full-power license in part on the ground that the NRC did not consider Severe Accident Mitigation Alternatives (SAMAs) during its review of PECO's operating license application.[3] At the time, NRC regulations did not require applicants to consider SAMAs.[4] In 1989, the United States Court of Appeals for the Third Circuit ruled on LEA's challenge, holding that the National Environmental Policy Act (NEPA) requires the NRC to consider SAMAs.[5] In response to this decision, the NRC Staff considered SAMAs "in the Final Environmental Impact Statement for the Limerick 1 and 2 and Comanche Peak 1 and 2 operating license reviews, and in the Watts Bar Supplemental Final Environmental Statement for an operating license."[6]

In 1996, the NRC amended its regulations regarding environmental reviews for operating license renewals.[7] One of the regulations derived from this amendment process was 10 C.F.R. § 51.53(c)(3)(ii)(L), which reads as follows:

> If the staff has not previously considered severe accident mitigation alternatives for the applicant's plant in an environmental impact statement or related supplement or in an environmental assessment, a consideration of alternatives to

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[2] See Philadelphia Electric Company, Docket No. 50-352, Limerick Generating Station, Unit 1, Facility Operating License, License No. NPF-39 (Aug. 8, 1985) (ADAMS Accession No. ML011520196).

[3] See Limerick Ecology Action v. NRC, 869 F.2d 719, 722-23 (3d Cir. 1989).

[4] Indeed, the Commission issued a policy statement in 1985 declaring that individual licensing proceedings were not the appropriate forum for evaluating SAMAs. Id. at 727.

[5] Id. at 739.

[6] Environmental Review for Renewal of Nuclear Power Plant Operating Licenses, 61 Fed. Reg. 28,467, 28,481 (June 5, 1996).

[7] See generally id.

mitigate severe accidents must be provided.[8]

In promulgating that regulation the Commission noted that because SAMAs had already been considered for Limerick, Comanche Peak, and Watts Bar, "[SAMAs] need not be reconsidered for these plants for license renewal."[9]

On June 22, 2011, Exelon submitted an application for renewal of the operating licenses for the Limerick Generating Station, Units 1 and 2 (Limerick) for an additional 20 years.[10] On November 22, 2011, NRDC submitted a petition to intervene, proffering four contentions.[11] One of the central issues presented by NRDC's petition was the interplay between two seemingly contradictory NRC regulations: 10 C.F.R. § 51.53(c)(3)(ii)(L) [sub-section (L)] and 10 C.F.R. § 51.53(c)(3)(iv) [sub-section (iv)]. Whereas the former states that an applicant for license renewal need not consider SAMAs if the NRC Staff has already considered SAMAs for that plant, the latter states, "The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware." The question then facing the Board was what effect, if any, the sub-section (L) exemption had on an applicant's duty under sub-section (iv) to consider new and significant information related to SAMAs and, concomitantly, a petitioner's ability to challenge that consideration (or lack thereof).

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[8] 10 C.F.R. § 51.53(c)(3)(ii)(L).

[9] 61 Fed. Reg. at 28,481.

[10] See Notice of Acceptance for Docketing of the Application and Notice of Opportunity for Hearing Regarding Renewal of Facility Operating License Nos. NPF-39 and NPF-85 for an Additional 20-Year Period; Exelon Generation Co., LLC, Limerick Generating Station, 76 Fed. Reg. 52,992, 52,992 (Aug. 24, 2011).

[11] Natural Resources Defense Council Petition to Intervene and Notice of Intention to Participate (Nov. 22, 2011).

In LBP-12-08, we granted NRDC's petition to intervene, admitting portions of one contention.[12] We also noted there that the parties did not dispute that Exelon must consider new and significant information regarding SAMAs pursuant to sub-section (iv).[13] The dispute between the parties thus centered on whether the exemption provided in sub-section (L) converted the issue of SAMAs from a so-called "Category 2" issue to a so-called "Category 1" issue for Limerick.[14]

The effect of this categorization would have significant implications for the environmental review of this (and other) license renewal applications in that Category 1 issues are those issues that the Commission has dealt with generically and that may not be challenged during license renewal absent a waiver.[15] On the other hand, Category 2 issues are plant-specific and may be challenged during license renewal without a waiver.[16] In LBP-12-08 we held that the issue of SAMAs was a Category 2 issue for Limerick, because NRC regulations explicitly list SAMAs as a Category 2 issue,[17] and because we could find no regulatory basis for the notion that a Category 2 issue could be converted into a Category 1 issue without evidence of the Commission's express intent to do so.[18] As such, we held that NRDC was free to challenge Exelon's consideration of new and significant information regarding SAMAs in this license

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[12] LBP-12-08, 75 NRC __, __ (slip op. at 40) (Apr. 4, 2012).

[13] Id. at 10-11.

[14] See Tr. at 43-52, 59-68, 80-85, 108-09, 118-25, 132-34, 172-76, 266.

[15] See 61 Fed. Reg. at 28,474.

[16] See id.

[17] See 10 C.F.R. Part 51, Subpt. A, App. B, Tbl. B-1.

[18] LBP-12-08, 75 NRC at __ (slip op. at 14).

renewal proceeding.[19]

Exelon and the NRC Staff appealed this ruling to the Commission, which reversed our decision, holding that "the exception in [sub-section (L)] operates as the functional equivalent of a Category 1 issue, removing SAMAs from litigation in this, as well as certain other, case-by-case license renewal adjudications."[20] Therefore, the Commission held that "the proper procedural avenue for NRDC to raise its concerns [regarding Exelon's consideration of new and significant information] is to seek a waiver of the relevant provision in [sub-section (L)]."[21] The Commission then remanded this proceeding to us, instructing NRDC to submit a waiver petition for Board consideration by November 27, 2012.[22]

NRDC submitted the instant waiver petition on November 21, 2012,[23] and Exelon and the NRC Staff submitted their responses opposing the waiver petition on December 14, 2012.[24] NRDC submitted a reply brief on December 21, 2012.[25]

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[19] Id. at 16.

[20] CLI-12-19, 76 NRC __, __ (slip op. at 13) (Oct. 23, 2012).

[21] Id.

[22] Id. at 17.

[23] See Waiver Petition.

[24] See Exelon's Response Opposing NRDC's Petition for Waiver of 10 C.F.R. § 51.53(c)(3)(ii)(L) (Dec. 14, 2012) [hereinafter "Exelon Response"]; NRC Staff Answer to [NRDC] Petition for Waiver of 10 C.F.R. § 51.53(c)(3)(ii)(L) (Dec. 14, 2012) [hereinafter "NRC Response"].

[25] See Reply of [NRDC] in Support of Petition, by Way of Motion, for Waiver of 10 C.F.R. § 51.53(c)(3)(ii)(L) as Applied to Application for Renewal of Licenses for Limerick Units 1 and 2 (Dec. 21, 2012).

II. LEGAL STANDARDS

Generally, NRC regulations may not be challenged in any NRC adjudicatory proceeding.[26] However, a petitioner that believes a regulation should not be applied in a particular proceeding may seek a waiver of that regulation pursuant to 10 C.F.R. § 2.335(b). Section 2.335(b) states:

> The sole ground for petition of waiver or exception is that special circumstances with respect to the subject matter of the particular proceeding are such that the application of the rule or regulation (or a provision of it) would not serve the purposes for which the rule or regulation was adopted.[27]

The Commission has elaborated on this standard in its case law, establishing a more arduous four-part test for waiver petitions.[28] The Commission stated in its Millstone decision that for a waiver to be granted, a petitioner must demonstrate the following:

> (i) the rule's strict application would not serve the purposes for which it was adopted; (ii) the movant has alleged special circumstances that were not considered, either explicitly or by necessary implication, in the rulemaking proceeding leading to the rule sought to be waived; (iii) those circumstances are unique to the facility rather than common to a large class of facilities; and (iv) a waiver of the regulation is necessary to reach a significant safety problem.[29]

The Commission made clear that "all four factors must be met" for a waiver to be granted.[30]

The role of the Board when a request for a waiver is filed is limited to determining whether the petitioner has made a prima facie showing that it has satisfied 10 C.F.R. § 2.335(b).

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[26] 10 C.F.R. § 2.335(a).

[27] Id. § 2.335(b).

[28] See Dominion Nuclear Connecticut, Inc. (Millstone Nuclear Power Station, Units 2 and 3), CLI-05-24, 62 NRC 551, 559-60 (2005).

[29] Id. (quotations and citations omitted). Hereinafter, we will refer to this four-part test as "the Millstone test."

[30] Id. (emphasis in original).

If not, the Board "may not further consider the matter."[31] However, where the petitioner has successfully made such a prima facie showing, the Board "shall, before ruling on the petition, certify the matter directly to the Commission," and the Commission shall determine whether to grant or deny the waiver request.[32]

III. ANALYSIS AND RULING

It is clear to us that the Millstone test establishes an appreciably higher burden for would-be waiver seekers than does 10 C.F.R. § 2.335(b). Indeed, on its face, Section 2.335(b) appears to only require a petitioner to satisfy the first two prongs of the Millstone test. In other words, Section 2.335(b) does not require petitioners to demonstrate that their complaint is "unique" to the facility in question or that their complaint reflects a "significant safety issue." Because, as we will explain, we believe that NRDC has not satisfied the lower threshold of 10 C.F.R. § 2.335(b), we will apply that Section of the Commission's regulations, rather than the more stringent Millstone test.

A. The purpose of 10 C.F.R. § 51.53(c)(3)(ii)(L)

To determine whether NRDC has demonstrated that application of 10 C.F.R. § 51.53(c)(3)(ii)(L) "would not serve the purposes for which [it] was adopted,"[33] we must first determine the purpose of sub-section (L). In its Waiver Petition, NRDC argues that the purpose of sub-section (L) "was simply to limit the analysis during relicensing to exclude 'consideration of such alternatives regarding plant operation' that were previously considered."[34] In other words,

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[31] 10 C.F.R. § 2.335(c).

[32] Id. § 2.335(d). We were unable to find any reported instances in which the Commission has granted a waiver request pursuant to Section 2.335(d) submitted by an intervenor/petitioner.

[33] Id. § 2.335(b).

[34] Waiver Petition at 17 (quoting 61 Fed. Reg. at 28,480) (emphasis in original).

NRDC argues, sub-section (L) was intended to excuse license renewal applicants that have already performed a SAMA analysis "from being forced to reconsider specific alternatives previously considered, from which it necessarily follows that any new alternatives that would mitigate severe accidents should be subject to the standard for 'new and significant information.'"[35]

Exelon and the NRC Staff, however, contend that the purpose of sub-section (L) was to exempt license renewal applicants that have already performed a SAMA analysis from performing another SAMA analysis, even if new mitigation alternatives have emerged since the performance of the original SAMA analysis.[36]

This distinction is subtle, but important in license renewal proceedings. A "mitigation alternative," or a "SAMA candidate," is, as the name suggests, an alternative that may mitigate the impacts of a severe accident. A "SAMA analysis," on the other hand, is an analysis of a class of SAMA candidates using probabilistic risk assessment techniques to determine whether any of the SAMA candidates would be cost-beneficial.[37] So, to contrast the parties' positions, NRDC maintains that the purpose of sub-section (L) is to excuse applicants from considering specific SAMA candidates that they have already considered, while Exelon and the NRC Staff argue that its purpose is to excuse applicants from performing another SAMA analysis altogether, meaning such applicants need not consider any additional SAMA candidates.

We do not find NRDC's argument compelling for several reasons. First, we believe the

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[35] Id. (emphasis in original).

[36] See Exelon Response at 20-21; NRC Staff Response at 13-15.

[37] For a more detailed discussion of how SAMA analyses are conducted, see FirstEnergy Nuclear Operating Co. (Davis-Besse Nuclear Power Station, Unit 1), LBP-12-27, 76 NRC __, __ (slip op. at 9-11) (Dec. 28, 2012).

language of sub-section (L) makes its purpose quite clear. It states, "If the staff has not previously considered severe accident mitigation alternatives for the applicant's plant . . ., a consideration of alternatives to mitigate severe accidents must be provided."[38] The clear implication of this language is that, once the staff has considered severe accident mitigation alternatives for the applicant's plant, no further consideration of alternatives to mitigate severe accidents is needed. NRDC's interpretation seems to be that if the staff has previously considered certain severe accident mitigation alternatives, a consideration of those specific alternatives need not be provided, but a consideration of other alternatives must be provided. This is a strained and inappropriate reading of sub-section (L). Rather, the purpose of sub-section (L) seems quite clear: it evidences a Commission determination that, in effect, one SAMA analysis is enough. Once an applicant has performed a SAMA analysis, even if it was performed almost 25 years ago, the applicant does not need to perform another, regardless of whether new SAMA candidates have been discovered in the interim.

This plain-meaning reading of sub-section (L) is bolstered by looking to the Statement of Considerations accompanying the Commission's final rule adopting sub-section (L). The Commission stated, "NRC staff considerations of severe accident mitigation alternatives have already been completed and included in an EIS or supplemental EIS for Limerick, Comanche Peak, and Watts Bar. Therefore, severe accident mitigation alternatives need not be reconsidered for these plants for license renewal."[39] It is noteworthy that the Commission did not say that those severe accident mitigation alternatives considered in the previous analysis need not be reconsidered. Rather, the Commission made a general statement that mitigation

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[38] 10 C.F.R. § 51.53(c)(3)(ii)(L).

[39] 61 Fed. Reg. at 28,481.

alternatives, as a class of items, need not be reconsidered at license renewal. As such, we find that the purpose of sub-section (L) is to exempt those plants that have already performed SAMA analyses from considering severe accident mitigation alternatives at license renewal.

As noted above, in order to obtain a waiver of a regulation, a petitioner must demonstrate that application of the regulation "would not serve the purposes for which [it] was adopted."[40] Considering this requirement, it becomes abundantly clear why NRDC provided such a strained reading of the purpose of sub-section (L). After all, if the purpose of sub-section (L) is simply to grant to a set of plants an exemption from the otherwise applicable requirement to consider severe accident mitigation alternatives at license renewal, then that purpose will always be met if no further analysis is required or submitted by the applicant. Accordingly, it is unclear how any petitioner could ever demonstrate that the purpose of sub-section (L) is frustrated by the application of sub-section (L). Even if a petitioner could demonstrate that there exists a group of cost-effective SAMA candidates that would greatly reduce the impacts of severe accidents and that have not been considered in the previous analysis, that petitioner could not successfully seek a waiver of sub-section (L), because the purpose of sub-section (L) – to grant the plant an exemption from considering any SAMA candidates at license renewal – is not frustrated. Given its clear purpose, sub-section (L) becomes, in effect, unwaivable.

B. The application of 10 C.F.R. § 51.53(c)(3)(ii)(L)

The Commission stated in CLI-12-19 that sub-section (L) "operates as the functional equivalent of a Category 1 issue, removing SAMAs from litigation in this, as well as certain other, case-by-case license renewal adjudications."[41] This is certainly true as to the preclusive

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[40] 10 C.F.R. § 2.335(b).

[41] CLI-12-19, 76 NRC at __ (slip op. at 13).

effect of sub-section (L), but is not necessarily the case relative to the "waivability" of sub-section (L). Indeed, in this regard sub-section (L) seemingly functions very differently than Table B-1 of 10 C.F.R. Part 51, Subpart A, Appendix B, which lists certain issues and then categorizes them as Category 1 or Category 2.

To illustrate the difference, let us consider, as an example, bird collisions with cooling towers. Table B-1 lists this issue as Category 1, stating that "[t]hese collisions have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term."[42] The finding that an issue like this is a Category 1 issue seems to be based on then-current factual information, as subjected to appropriate scientific analysis. But there is nothing in this designation that precludes a later finding associated with a waiver petition that bird collisions with cooling towers would have to be considered at license renewal for a certain plant should matters change. And indeed, one can readily imagine a set of circumstances where a petitioner could successfully seek a waiver of this Category 1 finding. For instance, if changes in the migratory habits of a certain bird during the initial operating term led to a large number of collisions with the cooling towers at a specific plant, a petitioner might well be able to satisfy 10 C.F.R. § 2.335(b) and the Millstone test and, therefore, challenge the applicant's lack of consideration of bird collisions with cooling towers in an adjudicatory license renewal proceeding. This possibility is based on the understanding that factual circumstances and scientific analysis can change over time. That is, while bird collisions may not have posed a problem for plants generally at the time the generic determination was made, they may pose a problem now, at a specific facility seeking license renewal. The waiver process provides, then, a mechanism through which such new information and analysis may be brought to the

[42] 10 C.F.R. Pt. 51, Subpt. A, App. B, Tbl. B-1.

Commission's attention.

However, the same argument simply does not apply to sub-section (L). When it enacted sub-section (L) the Commission understood that technology would change, and that new SAMA candidates could emerge over time.[43] The emergence of new SAMA candidates is, it seems, the equivalent of the new data regarding bird collisions in our example above. However, in the case of bird collisions, the possibility that new data could become available also provides the basis for a potential successful waiver petition. Here, the possibility that new SAMA candidates may become available cannot be the basis for a successful waiver petition, because the Commission knew that SAMA technology would change, but was confident that processes, other than the SAMA analysis process, would adequately address any such developments.[44] To put it another way, for most Category 1 issues, there is an implicit understanding that information and analysis may change, and such new information may be presented in a waiver petition. However for sub-section (L), for this "functional equivalent" of a Category 1 issue, there can be no such understanding. Indeed, the Commission certainly enacted sub-section (L) knowing that new SAMA candidates likely could and would emerge during the time between the initial SAMA analysis and license renewal.

C. Conclusions regarding 10 C.F.R. § 51.53(c)(3)(ii)(L)

So, this leaves us in a difficult and ambiguous situation. Has NRDC demonstrated that

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[43] In the Statement of Considerations accompanying the final rule adopting sub-section (L), the Commission stressed that it had three other ongoing processes whereby the NRC Staff would be evaluating alternatives to mitigate severe accidents: the Containment Performance Improvement (CPI) program, the Individual Plant Examination (IPE) program, and the Individual Plant Examination for External Events (IPEEE) program. 61 Fed. Reg. at 28,481. The Commission noted that the IPE and IPEEE programs "have resulted in a number of plant procedural or programmatic improvements and some plant modifications that will further reduce the risk of severe accidents." Id.

[44] See id.

the purpose of sub-section (L) will be frustrated by applying sub-section (L) to Limerick? No, but through no fault of their representatives, who seem to have done the most they could in a confusing situation. Ultimately, given the purpose of sub-section (L), NRDC was faced with the seemingly impossible task of demonstrating that the purpose of sub-section (L) (i.e., to grant Limerick an exemption from the SAMA requirement) would be frustrated by granting Limerick an exemption from the SAMA requirement. In CLI-12-19, the Commission remanded to the Board review of a waiver petition to be filed by NRDC. This implies to the Board that, on some level, the Commission believed that a petitioner or party could be granted a waiver of 10 C.F.R. § 51.53(c)(3)(ii)(L) under Section 2.335(b). Our review of the regulations leads us to conclude that this is an impossibility.

For the foregoing reasons, we are compelled to find that NRDC has not presented a prima facie case that it has satisfied 10 C.F.R. § 2.335(b), and therefore we must deny its waiver petition. However, NRDC's petition has presented us with such a "catch-22" situation[45] that we also feel compelled to refer this decision to the Commission, not under 10 C.F.R. § 2.335(d), but under 10 C.F.R. § 2.323(f)(1). We trust the Commission, in its review of our decision, will shed light on the interplay of 10 C.F.R. § 51.53(c)(3)(ii)(L) and 10 C.F.R. § 2.335(b).

IV. CONCLUSION

For the foregoing reasons, NRDC's petition for a waiver of 10 C.F.R. § 51.53(c)(3)(ii)(L)

[45] A catch-22 is a paradoxical situation in which an individual cannot or is incapable of avoiding a problem because of contradictory constraints or rules. Random House Dictionary (2012).

is DENIED, and this decision of the Board is hereby REFERRED to the Commission pursuant to 10 C.F.R. § 2.323(f)(1).[46]

It is so ORDERED.

THE ATOMIC SAFETY
AND LICENSING BOARD
/RA/

William J. Froehlich, Chairman
ADMINISTRATIVE JUDGE
/RA/

Dr. Michael F. Kennedy
ADMINISTRATIVE JUDGE
/RA/

Dr. William E. Kastenberg
ADMINISTRATIVE JUDGE

Rockville, Maryland
February 6, 2013

[46] We note that our denial of NRDC's waiver petition does not terminate this proceeding. On July 9, 2012, NRDC filed with the Board a motion to admit a new environmental contention that challenges the failure of Exelon's Environmental Report to address the environmental impacts of spent fuel pool leakage and fires, as well as the environmental impacts that may occur if a spent fuel repository does not become available. See NRDC's Motion for Leave to File a New Contention Concerning Temporary Storage and Ultimate Disposal of Nuclear Waste at Limerick (July 9, 2012) [hereinafter New Contention Motion]. The New Contention Motion is based on the United States Court of Appeals for the District of Columbia Circuit's decision in State of New York v. NRC, 681 F.3d 471 (D.C. Cir. 2012) which invalidated the NRC's Waste Confidence Decision Update (75 Fed. Reg. 81,037 (Dec. 23, 2010)) and the NRC's final rule regarding Consideration of Environmental Impacts of Spent Fuel After Cessation of Reactor Operation (75 Fed. Reg. 81,032 (Dec. 23, 2010)).

On August 7, 2012, the Commission issued CLI-12-16, wherein it found, "[I]n view of the special circumstances of this case, as an exercise of our inherent supervisory authority over adjudications, we direct that these [Waste Confidence] contentions—and any related contentions that may be filed in the near term—be held in abeyance pending our further order." CLI-12-16, 76 NRC __, __ (slip op. at 6) (Aug. 7, 2012). The Commission noted that "should we determine at a future time that case-specific challenges are appropriate for consideration, our normal procedural rules will apply." Id. at 6 n.11. In an August 8, 2012 Order we held any participant or Board activity concerning this new contention in abeyance pending further Commission directive. See Order (Suspending Procedural Date Related to Proposed Waste Confidence Contention) (Aug. 8, 2012) (unpublished).

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE COMMISSION

In the Matter of:	)	
	)	
EXELON GENERATION COMPANY, LLC	)	Docket No. 50-352-LR
	)	Docket No. 50-353-LR
(Limerick Generating Station, Units 1 and 2)	)	
		March 13, 2013
(License Renewal Application)		

NATURAL RESOURCES DEFENSE COUNCIL'S BRIEF IN SUPPORT OF WAIVER OF 10 C.F.R. § 51.53(c)(3)(ii)(L) AS APPLIED TO APPLICATION FOR RENEWAL OF LICENSES FOR LIMERICK UNITS 1 AND 2

Howard M. Crystal
Meyer Glitzenstein & Crystal
1601 Connecticut Ave., N.W., Suite 700
Washington, D.C. 20009
(202) 588-5206
hcrystal@meyerglitz.com

Anthony Z. Roisman
National Legal Scholars Law Firm, P.C.
241 Poverty Lane, Unit 1
Lebanon, NH 03766
603-443-4162
aroisman@nationallegalscholars.com

Geoffrey H. Fettus
Natural Resources Defense Council
1152 15th Street, NW, Suite 300
Washington, D.C. 20005
202-289-2371
gfettus@nrdc.org

TABLE OF CONTENTS

TABLE OF AUTHORITIES

CASES **PAGE**

STATUTES

FEDERAL REGULATIONS

GLOSSARY

AEA	Atomic Energy Act of 1954
ASLB or Board	Atomic Safety and Licensing Board Panel
BWR	Boiling Water Reactor
CEQ	Council on Environmental Quality
EIS	Environmental Impact Statement
ER	Environmental Report
Exelon	Exelon Generation Company, LLC
FES	Final Environmental Statement
IPE	Individual Plant Examination
IPEEE	Individual Plant Examination for External Event Programs
Limerick	Limerick Generating Station, Units 1 and 2
NEPA	National Environmental Policy Act
NRDC	Natural Resources Defense Council
NRDC Contentions	NRDC Petition to Intervene and Notice of Intention to Participate
NRDC Cont. Decl.	NRDC Contention Declaration
PWR	Pressurized Water Reactor
SAMAs	Severe Accident Mitigation Alternatives
TMI	Three Mile Island

INTRODUCTION

In June, 2011, Exelon Generation Company, LLC ("Exelon") filed its license renewal application for the Limerick Generating Station, Units 1 and 2 ("Limerick"), including a discussion of what it considered to be the new information related to its previously conducted analysis of Severe Accident Mitigation Alternatives ("SAMA"), and concluding that none of the information was significant.[1] Natural Resources Defense Council ("NRDC") submitted several straightforward Environmental Contentions that challenged the portion of the ER that discussed SAMAs.[2] The basic thrust of the Contentions is that, in relicensing the nuclear power facility, Exelon – and ultimately the Commission – must fully and fairly consider new and significant information concerning SAMAs for the plant, as dictated by the National Environmental Policy Act ("NEPA"), 42 U.S.C. § 4321, *et seq*. *Id*.[3]

The Atomic Safety and Licensing Board Panel ("ASLB" or "Board") initially *admitted* NRDC's contention that focused on the existence of new and significant information, reasoning that the Commission's SAMA requirement regulation could not reasonably be interpreted to bar consideration of new and significant information under NEPA.[4] The Commission reversed on

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[1] Applicant's Environmental Report (June 2011) (ADAMS Accession No. ML11179A104 (hereafter "ER") at 5-1 to 5-9.

[2] NRDC Petition to Intervene and Notice of Intention to Participate (Nov. 22, 2001) (hereafter "NRDC Contentions") (attached as Exhibit A, along with NRDC's Contention Declaration ("NRDC Cont. Decl.")).

[3] A SAMA – previously referred to in a more restrictive sense as a "SAMDA" – "is a cost-benefit analysis that addresses whether the expense of implementing a mitigation measure not mandated by the NRC is outweighed by the expected reduction in environmental cost it would provide in a core damage event." *Massachusetts v. NRC*, 2013 WL 668468, *2 (1st Cir. Feb. 25, 2013).

[4] *In re Exelon Generation Co.*, LBP-12-8, slip op. (ASLB Apr. 4, 2012) (hereafter

the ground that the Contentions are barred by 10 C.F.R. § 51.53(c)(3)(ii)(L).[5] Then, when NRDC accepted the Commission's invitation to seek a *waiver* of that regulation pursuant to 10 C.F.R. § 2.335(b), the Board *denied* the waiver, explaining that while NRDC is entitled to have its Contentions aired, it has been put into "a catch-22 situation" because, in the Board's view, it cannot meet the strict criteria necessary for a waiver.[6] However, recognizing that the Commission had specifically invited NRDC to submit the waiver request, this anomalous situation caused the Board to refer the matter to the Commission under 10 C.F.R. § 2.323(f)(1), in light of the novel issue raised, seeking guidance from the Commission on the "interplay of 10 C.F.R. § 51.53(c)(3)(ii)(L) and 10 C.F.R. § 2.335(b)." Second ALSB Op. at 14.

NRDC's Contentions should be admitted at this time. Pursuant to NEPA, NRDC has a right to challenge the adequacy of Exelon's environmental analysis based on the existence of new and significant information, a right that is reinforced by the fact that NRDC's challenge is based on Exelon's *own* efforts to analyze new and significant information in its ER and the inadequacy of that analysis. Since Exelon does not dispute that it must consider new and significant information relevant to its previously concluded SAMA analysis, the fundamental question here is whether Commission regulations can legally be interpreted to prohibit NRDC from challenging Exelon's analysis. They cannot.

"First ASLB Op.")

[5] *In re Exelon Generation Co.*, CLI -12-19, 2012 WL 5266118 (N.R.C. Oct. 23, 2012) (hereafter "Comm. Op.")

[6] *In re Exelon Generation Co.* LBP-13-1, slip op. at 13 (ASLB Feb. 6, 2013) (hereafter "Second ASLB Op.").

In particular, as detailed below, NRDC is entitled to the admission of the two bases of Contention 1E originally admitted by the ASLB: (a) that Exelon has omitted from its ER a required analysis of new and significant information regarding potential new SAMA alternatives previously considered for other Boiling Water Reactor ("BWR") Mark II Containment reactors (Contention 1E-1); and (b) that Exelon's reliance on data from Three Mile Island ("TMI") in its analysis of the significance of new information regarding economic cost risk constitutes an inadequate analysis of new and significant information (Contention 1E-2). NRDC is also entitled to the admission of Contention 3E, that seeks to require Exelon to utilize modern techniques for assessing whether new information, including consideration of newly identified severe accident mitigation alternatives for BWR Mark II Containment reactors, are cost-beneficial. *See* NRDC Contentions at 22 (¶¶ 1, 3). Any other result would be contrary to NEPA's dictates. *E.g., Limerick Ecology Action, Inc. v. NRC*, 869 F.2d 719, 741 (3d Cir. 1989).

BACKGROUND

A. STATUTORY AND REGULATORY FRAMEWORK

1. The National Environmental Policy Act

NEPA's "twin aims" are to force every agency "to consider every significant aspect of the environmental impact of a proposed action," and to "inform the public that it has indeed considered environmental concerns in its decision-making process." *Baltimore Gas & Elec. Co. v. NRDC*, 462 U.S. 87, 97 (1983). Under NEPA, federal agencies are required to prepare an Environmental Impact Statement ("EIS") for all "major Federal actions significantly affecting the quality of the human environment." 42 U.S.C. § 4332(C). Among other issues, an EIS must analyze the "environmental impact of the proposed action" and reasonable alternatives. *Id.* § 4332(C).

The completion of an EIS for a proposed action does not end an agency's responsibility to weigh the environmental impacts of a proposed action. *Marsh v. Or. Natural Res. Council*, 490 U.S. 360, 371-72 (1989). As the Supreme Court has recognized, it would be incongruous with NEPA's "action-forcing" purpose to allow an agency to put on "blinders to adverse environmental effects," just because an EIS has been completed. *Id*. at 371. Accordingly, an agency must *supplement* its EIS if there is new information showing that the remaining federal action will affect the quality of the human environment "in a significant manner or to a significant extent not already considered." *Id.* at 374; *see also Warm Springs Dam Task Force v. Gribble*, 621 F.2d 1017, 1024 (9th Cir. 1980) ("When new information comes to light the agency must consider it, evaluate it, and make a reasoned determination whether it is of such significance as to require implementation of formal NEPA filing procedures"); *Friends of the Clearwater v. Dombeck*, 222 F.3d 552, 558 (9th Cir. 2000).

The Council on Environmental Quality's ("CEQ") implementing NEPA regulations similarly require that even after a NEPA process is completed, where an agency learns of "significant new circumstances," or new "information relevant to environmental concerns and bearing on the proposed action or its impacts," 40 C.F.R. § 1502.9(c), it must supplement its NEPA review. This is a continuing obligation, and a NEPA process may require *more than one supplement*. *E.g., Marsh*, 490 U.S. at 368 ("if all of the information contained in the [two documents] was both new and accurate, the Corps would have been required to prepare a *second supplemental* EIS") (emphasis added); *Deukmejian v. NRC*, 751 F.2d 1287, 1298 (D.C. Cir.

1984) (explaining that "the [NRC's] obligations under NEPA [include] a continuing duty to supplement EISs which have already become final whenever the discovery of significant new information renders the original EIS inadequate").

2. The Commission's NEPA Framework For Relicensing Nuclear Power Plants

The scope of the NEPA review for the relicensing of nuclear power plants by the NRC is set out in 10 C.F.R. Pt. 51, and the NRC's "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" ("GEIS") (NUREG-1437) (May 1996). NRC's NEPA regulations require an EIS for any major licensing action significantly affecting the quality of the human environment. 10 C.F.R. §§ 51.71, 51.91. Before the EIS is prepared, however, NRC's regulations require that the license applicant must prepare what amounts to a first draft of the EIS, *i.e.*, the ER, 10 C.F.R. § 51.53(c)(1), *Duke Power Co.* (Catawba Nuclear Station, Units 1 and 2), CLI-83-19, 17 NRC 1041, 1049 (1983), which generally must address all the same impacts, alternatives, and other environmental issues that will be addressed later in the NRC's EIS. *Compare* 10 C.F.R. § 51.53(c)(2) *with* 10 C.F.R. § 51.71.

Some environmental issues that might otherwise be germane in a license renewal proceeding have been resolved generically for all plants in the GEIS. These "Category 1" issues are "beyond the scope of a license renewal hearing." *In re Fla. Power and Light Co.*, 54 N.R.C. 3, 11 (2001); *see* 10 C.F.R. § 51.53(c)(3)(i). For other issues, referred to as "Category 2" issues, an ER "must contain analysis of the[ir] environmental impacts." *Id.* § 51.53(c)(3)(ii). This includes the consideration of "alternatives to mitigate severe accidents" – SAMAs, including the "consequences of atmospheric releases, fallout onto open bodies of water, releases to ground water, and societal and economic impacts from severe accidents." *Id.* at Table B-1, Postulated

Accidents; *see also, e.g. Limerick Ecology*, 869 F.2d at 741 (holding that SAMAs "must be given careful consideration" in the NEPA process). Thus, as a threshold matter, SAMAs must be considered in individual relicensing proceedings.

Central to the current dispute, the Category 2 obligation for an applicant and NRC Staff to consider SAMAs during relicensing appears to contain a carve-out for plants seeking a renewed license for severe accident mitigation alternatives that have been previously considered for that plant. 10 C.F.R. § 51.53(c)(3)(ii)(L). There are only three plants that arguably fall into this exception – Limerick, Comanche Peak, and Watts Barr.

Nonetheless, consistent with the CEQ regulations, the Commission's own NEPA regulations also provide that supplements to either a Draft EIS, or a Final EIS, will address, *inter alia*, "significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts." 10 C.F.R. §§ 51.72(a); 51.92(a). In the relicensing context, this obligation is codified at 10 C.F.R. § 51.53(c)(3)(iv), which provides that the EIS for a license renewal "must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware." *See also, e.g., In re Union Elec. Co.*, CLI-11-05, 2011 WL 4027741, at 12 (N.R.C. Sept. 9, 2011) (holding further NEPA review required where new information presents "a seriously different picture of the environmental impact of the proposed project from what was previously envisioned").

Exelon recognizes the paramount role of the "new and significant information" supplementation requirement in its ER, where a discussion of new and significant information related to its previous SAMDA analysis is included. Although Exelon concludes that none of the new information is significant, it clearly implies that if it had found the information was both new and significant it would have had to supplement its previous SAMDA analysis. *See* ER at 5-4 to 5-9.[7]

B. PROCEDURAL BACKGROUND

1. The Commission's Prior Consideration of SAMAs for Limerick

In 1980, in the wake of the TMI accident, the Commission issued a policy requiring the consideration of "severe accidents in future NEPA reviews." *Limerick Ecology*, 869 F.2d at 726. Five years later, the agency issued a Final Policy Statement that "excluded consideration of severe accident mitigation design alternatives from individual licensing proceedings." *Id.* at 727.

In the meantime, in 1981 Limerick Ecology and others intervened in the licensing proceeding, challenging, *inter alia*, whether the NRC had adequately considered SAMAs. In the Final Environmental Statement ("FES") the staff rejected these arguments, and, as to SAMDAs in particular, "'concluded that there are *no special or unique circumstances* about the Limerick site and environs that would warrant consideration of'" such alternatives. *Id.* at 732 (quoting FES at 5-126) (emphasis added). On appeal, the Board also relied on the conclusion that there were "*no special or unique circumstances* about the Limerick site" that warranted further review. *Id.* (emphasis added).

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[7] In order to challenge a relicensing application, a party generally must file Contentions setting forth, *inter alia*, the specific issues to be raised, a brief explanation of the bases for those issues, and sufficient evidence supporting those bases to demonstrate that the issue is material to the matters to be decided in a relicensing proceeding and is within the scope of the proceeding. 10 C.F.R. § 2.309(f). Among the issues that may *not* be raised in such a proceeding is a challenge to any "rule or regulation of the Commission, or any provision thereof." 10 C.F.R. § 2.335(a). Rather, if a party seeks to challenge a rule or regulation, then it must file a separate "waiver petition" requesting that the rule or regulations be "waived or an exception made for the particular proceeding," based upon "special circumstances with respect to the subject matter of the particular proceeding." *Id.* § 2.335(b).

Limerick Ecology filed a Petition for Review in the Third Circuit. *Id.* at 719. The Court of Appeals first concluded that the Final Policy Statement did not preclude consideration of the issue, *see id.* at 733-36, and then also rejected the argument that no special or unique circumstances at Limerick warranted consideration of SAMAs there. *Id.* at 738-39. In particular, the Court found that: (a) "the Commission itself has noted [that] the impact of SAMDAs on the environment will differ with the particular plant's design, construction and location," and (b) "the risk will vary with the potential consequences," which "will vary *tremendously* across all plants." *Id.* (emphasis added).

The NRC subsequently issued a 1989 document entitled a "Supplement" to the FES for Limerick to address SAMA issues, but the Supplement "discovered no substantial changes in the proposed action as previously evaluated . . . that are relevant to environmental concerns nor significant new circumstances or information relevant to environmental concerns." NUREG-0974 at iii. Thus, the Commission found "no new information that would call into question the FES conclusion" that there is no basis to further consider" SAMAs at Limerick. *Id.* at 1.

2. The Present Proceeding

On November 22, 2011, NRDC submitted a petition to intervene and notice of intent to participate in the Limerick relicensing proceeding, submitting four contentions. *See* NRDC Contentions (Att. A). Contention 1E asserts that, in its ER for the relicensing, Exelon's analysis of new and significant information related to the 1989 SAMDA was inadequate because it failed to properly analyze the significance of *new* information that Exelon conceded existed, and because it failed to acknowledge other new information that was also significant. *Id.* at 16-19. As detailed in NRDC's expert declarations, other BWR plants have identified numerous cost-beneficial or potentially cost-beneficial SAMAs such as, for example, portable generators for emergency power supply; providing alternative sources of water to address emergencies; and improvements to the connections between electric power systems to allow more flexible supply of critical power needs during an emergency. NRDC Cont. Decl. ¶¶ 12-14. Indeed, as the ASLB recognized, "NRDC has shown there are numerous new SAMA candidates which should be evaluated for their significance." First ASLB Op. at 21.[8]

In Contention 1E, NRDC also argued that Exelon has improperly relied on data from an analysis done at TMI concerning the economic impacts of a severe accident. NRDC Cont. at 18. NRDC explained that use of that analysis was not appropriate since TMI is a markedly different and less economically developed site than Limerick, which includes densely populated areas including Philadelphia, PA. *Id.* NRDC also explained that the comparison is inappropriate because TMI is a Pressurized Water Reactor ("PWR"), with correspondingly different accident scenario source terms than the BWR at Limerick. *Id.*; *see also* NRDC Decl. ¶¶ 17-24.

In addition, in Contention 3E NRDC argued, *inter alia*, that the ER is inadequate in relying on the methodology used in the 1989 SAMDA analysis, both for that analysis and for consideration of any newly identified mitigation alternatives, in light of techniques that have been developed since that SAMDA was conducted to assess whether alternatives are cost-beneficial. NRDC Cont. at 21-23. In particular, Contention 3E asserted, *inter alia*, that the 1989 SAMDA was legally deficient because it failed to use a probabilistic safety assessment severe

[8] NRDC is not seeking a full new SAMA analysis or the redoing of the previous SAMDA analysis. It is seeking consideration of additional potential mitigation measures, using up-to-date methodologies and including full consideration of off-site economic impacts. Thus, what is sought is a supplementation of the prior SAMDA analysis, not a replacement of that analysis with a new SAMA analysis.

accident consequences code system comparable to the MELCOR Accident Consequence Codes Systems ("MACCS") 2. *Id.* Contention 3E was based, in part, on the continuing obligation imposed by NEPA on federal agencies, to update and correct previous information when the agency becomes aware of new information that demonstrates the inadequacy of a prior analysis. *See, e.g., Deukmejian*, 751 F.2d at 1298. Thus, this aspect of Contention 3E sought, *inter alia*, to require Exelon and NRC Staff to use the more accurate and reliable methods available today for assessing the consequences of a severe accident, including economic consequences, and assessing the costs and benefits of the additional mitigation alternatives that are appropriate for BWRs – which has never been done for Limerick.[9]

The applicant and NRC staff opposed intervention, arguing, *inter alia*, that issues related to severe accident mitigation alternatives were precluded by 10 C.F.R. § 51.53(c)(3)(ii)(L).

On April 4, 2012, the Board rejected many of the applicant's and NRC's arguments and admitted a modified version of Contention 1E. First ASLB Op at 40-41. With respect to the threshold argument that any contention concerning SAMAs is precluded by 10 C.F.R. § 51.53(c)(3)(ii)(L), the Board concluded, correctly, that the "regulation[ ] cannot trump statutory mandates," *id.* at 15, and that NEPA mandates an analysis based on "the best information available today." *Id.* The Board further recognized that Exelon had, in fact,

[9] This brief only concerns the Contentions originally admitted by the ASLB, *i.e.*, two aspects of Contention 1E concerning (a) the failure to consider the wider range of mitigation alternatives now identified for BWRs, and (b) the failure to conduct a reliable off-site economic consequences analysis, as well as one aspect of Contention 3E, *i.e.*, the need to use a modern methodology to assess the cost-benefit of new mitigation alternatives for Limerick. NRDC will pursue the other issues raised in its Contentions that were rejected by the ASLB and thus are not presently before the Commission, at the appropriate time.

"identified new information relating to severe accident mitigation," and had included such information in its ER. *Id.* at 30.

Thus, the Board concluded that in the relicensing proceeding Exelon must abide by the regulatory requirement to consider "any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware." 10 C.F.R. § 51.53(c)(3)(iv). On that basis the Board admitted a modified Contention 1E focused on the consideration of two of the bases presented by NRDC. *First*, it found that NRDC had raised an admissible contention regarding the extent to which Exelon should have addressed in its ER the "new severe accident mitigation alternatives previously considered for other BWR Mark II Containment reactors." First ASLB Op. at 27. *Second*, the Board found admissible the issue of "whether Exelon's use of data from TMI in its analysis provides an adequate consideration of new and significant information regarding economic cost risk." *Id.* at 25, 27.

The Commission reversed. Comm. Op. As an initial matter, the Commission recognized what it considered to be "ambiguity in our regulations." *Id.* at 11. While the Commission characterized 10 C.F.R. § 51.53(c)(3)(ii)(L) as exempting Exelon from site-specific supplemental SAMA analysis in the relicensing proceeding, it also recognized that the regulations mandate that "the license renewal application must contain any significant new information relevant to environmental impacts," which "may be challenged in individual adjudications." Comm. Op. at 11-12. The Commission also noted that "*Exelon has put forward in its license renewal application new information regarding its [SAMA] analysis*." *Id.* at 13 (emphasis added). Particularly in light of that fact, and NRDC's claim that "the information provided by Exelon" is insufficient, the Commission ruled that "*NRDC may challenge the adequacy of the new information provided in the Limerick Environmental Report*." *Id.* (emphasis added).

However, while evidently recognizing that the matters raised by NRDC *should* be admitted, the Commission concluded that in light of 10 C.F.R. § 51.53(c)(3)(ii)(L), "the proper procedural avenue for NRDC to raise its concerns is to seek a waiver of the relevant provision in" that section. Comm. Op. at 13. The Commission further invited NRDC to include other Contentions that had been rejected on the basis of 10 C.F.R. § 51.53(c)(3)(ii)(L). *Id.*

Following that invitation, on November 21, 2012 NRDC filed a Petition, by way of motion, for waiver of 10 C.F.R. § 51.53(c)(3)(ii)(L), as applied to the Limerick Renewal proceeding. Waiver Petition ("Waiver Pet.") (Nov. 21, 2012) (Attached as Exhibit B, along with a Waiver Declaration ("NRDC Waiver Decl.") and a Declaration of Counsel ("Counsel Decl.")). The Waiver Petition explained that if a waiver is necessary for NRDC to pursue its Contentions, a waiver must be granted, and that, in fact, NRDC meets the requirements for a waiver because: (a) application of 10 C.F.R. § 51.53(c)(3)(ii)(L) to exempt Exelon from at all considering new and significant information related to SAMAs in the relicensing process would be contrary to the purpose of the regulation; (b) special circumstances unique to Limerick warrant a waiver; and (c) a waiver is necessary to address a significant environmental concern. Waiver Pet. at 13-27; *see also* Reply in Support of Waiver Petition (Dec. 21, 2012).

On February 6, 2013, the Board denied the Waiver Petition. Second ASLB Op. The Board's rationale was that, contrary to NRDC's arguments (and the Commission's apparent assumption in inviting NRDC to take this procedural path), it is entirely *consistent* with the purpose of 10 C.F.R. § 51.53(c)(3)(ii)(L) for NRDC to be precluded from raising its Contentions, because, in promulgating the regulation, the Commission's evident intent was to excuse, *inter alia*, Exelon from having to do any additional SAMA analysis even if there were new and significant information related to the previous analysis, and thus to preclude anyone from raising such new and significant information during relicensing, for nuclear power plants that had conducted some SAMA analysis before the regulation was issued – which includes Limerick. Second ASLB Op. at 9 ("the purpose of subsection (L) seems quite clear: it evidences the Commission determination that, in effect, one SAMA analysis is enough" and thus "even if it was performed almost 25 years ago, the applicant does not need to perform another, *regardless of whether new SAMA candidates have been discovered in the interim*") (emphasis added).

However, the Board also recognized that this result created "a difficult and ambiguous situation," *id.* at 12, which the Board characterized as a legal "catch-22." *Id.* at 13. On the one hand, the Commission had recognized, as had the Board originally, that "NRDC may challenge the adequacy of the new information provided in the Limerick Environmental Report," Comm. Op. at 12, and, as the Board recognized, the Commission had suggested that a Waiver Petition was the appropriate mechanism to do so. Second ASLB Op. at 13 ("the Commission believed that a petitioner or party could be granted a waiver of 10 C.F.R. § 51.53(c)(3)(ii)(L)"). On the other hand, the Board had concluded that a waiver was not appropriate, because applying the regulation in this instance would be consistent with the regulation's purposes. Second ASLB Op. at 13.

Accordingly, the Board referred the issue to the Commission under 10 C.F.R. § 2.323(f)(1), *id.* at 13-14, on the grounds that it is "novel and worthy of the Commission's immediate attention." *Id.* at 1. Subsequently, the Commission afforded an opportunity for further briefing. Order of Feb. 26, 2013.

ARGUMENT

I. NRDC Satisfies The Criteria For A Waiver Of 10 C.F.R. § 51.53(c)(3)(ii)(L) With Respect To Contention 1E As Admitted By The ASLB And Contention 3E.

In *In re Dominion*, CLI-05-24, 62 N.R.C. 551 (2005) which involved a request for a waiver of the NRC's emergency planning regulations, the Commission articulated a four-part waiver test: (i) strict application of the rule sought to be waived "would not serve the purposes for which it was adopted"; (ii) the movant has alleged "special circumstances" that were "not considered, either explicitly or by necessary implication, in the rulemaking proceeding leading to the rule sought to be waived"; (iii) those circumstances are "unique" to the facility rather than "common to a large class of facilities"; and (iv) a waiver of the regulation is necessary to reach a significant issue. *Id.* at 560. NRDC's Contentions satisfy this test.[10]

1. Application of 10 C.F.R. § 51.53(c)(3)(ii)(L) in the manner interpreted by the Commission would not serve the purposes for which the regulation was adopted.

In denying NRDC's Waiver Request, the Board determined that NRDC could not demonstrate that application of 10 C.F.R. § 51.53(c)(3)(ii)(L) in this instance would be inconsistent with the regulation's purpose, because it was clear to the Board that the regulations' purpose is *to preclude further consideration of SAMAs during relicensing for Limerick.* Second

[10] Since these precedents concerned safety issues, the fourth prong of the analysis was focused on whether a significant "safety problem" was at issue, but where, as here, the waiver request involves an environmental concern this last factor focuses on the significance of the potential environmental impacts involved. *See In re Pacific Gas & Elec. Co.*, LPB-10-15, at 35-36, 38 (ASLB Aug. 4, 2010).

ASLB Op. at 7-12. Thus, reviewing the considerations that went into promulgating the regulation, the Board concluded that it was *designed* to preclude parties like NRDC from challenging Exelon and the Commission's failure to consider SAMAs during the relicensing process, because the Commission had decided that these matters should be considered in other venues. *Id.* at 12 n.43 (discussing the Individual Plant Examination ("IPE") and Individual Plant Examination for External Event ("IPEEE") Programs).

As NRDC explained to the Board, this reading is not compelled by 10 C.F.R. § 51.53(c)(3)(ii)(L) or the Statement of Consideration. Waiver Pet. (Exh. B) at 16-22. Rather, the regulation's purpose can – and should – be interpreted to simply limit facilities that had previously considered SAMAs from being obligated to reconsider the *same* SAMAs during relicensing. Alternatively, the Commission should conclude that a waiver must be granted in order to reconcile the regulation with NEPA.

a. The purpose of the regulation was to avoid revisiting SAMAs previously considered.

As noted, the Commission developed its Category 1 and 2 regulations to distinguish between issues that have been "considered and addressed generically for all plants," *Turkey Point*, 54 N.R.C. at 15 (Category 1), and those that may "requir[e] further analysis" in light of "significant new information." 10 C.F.R. Part 51, preamble to App. B to Subpart A (Category 2). The Commission intended that consideration of mitigation alternatives, as to which the regulations provide for consideration of "alternatives to mitigate severe accidents," be considered a Category 2 issue, and thus be adequately considered in the ER for relicensing. *Id.* Table 3-1.

Indeed, the Proposed Rule had put this issue into Category 1, and it was in response to comments that the Commission made it a Category 2 issue, recognizing that *severe accident* *mitigation should generally be addressed on a site-specific basis*. *See* 61 Fed. Reg. at 28,480-82. Thus, in the Statement of Consideration the Commission stated that the *purpose* of the regulatory exception here was simply to limit the analysis during relicensing to exclude "consideration of *such alternatives* regarding plant operation" that were previously considered. *Id.* (emphasis added). Accordingly, it would be entirely consistent with the approach the Commission took in promulgating the regulation to conclude that the *purpose* of 10 C.F.R. § 51.53(c)(3)(ii)(L) was simply to exempt companies such as Exelon from being forced to reconsider *specific SAMA alternatives previously considered*, from which it necessarily follows that any *new* alternatives that would mitigate severe accidents should be subject to the standard for "new and significant information." 10 C.F.R. § 51.53(c)(3)(iv); *see* NRDC Counsel Decl. ¶¶ 1-3.[11]

This more limited purpose for 10 C.F.R. § 51.53(c)(3)(ii)(L) is supported by other portions of the Statement of Consideration. Thus, in multiple sections the Commission provided assurances that "any new and significant information presented during the review of individual license renewal applications" *will be considered*. *E.g.* 61 Fed. Reg. at 28,468; *see also id.* at 28,472 ("For individual plant reviews, information codified in the rule, information developed in the GEIS, and *any significant new information introduced during the plant-specific review* . . . will be considered in reaching conclusions in the supplemental EIS")(emphasis added); *id.* at 28,470.

[11] Before the Board, Staff and Exelon urged that this more limited reading of the provision's purpose must be rejected because it would be inconsistent with the plain language of the regulation. *E.g.* NRC Staff Ans. To Waiver Pet. (Dec. 14, 2012) at 16. This argument, however, misses the entire point of a waiver request, which proceeds on the *premise* that the action requested is inconsistent with the regulation, and thus seeks a *waiver* of the regulation's application in a particular instance.

This view of the purpose of the regulation is further supported by the Third Circuit's ruling in *N.J. Dep't. of Envtl. Prot. v. NRC,* 561 F.3d 132, 135 (3d Cir. 2009), where the Court explained that the purpose of the Category 2 regulations, including this one, is to require "evaluations of site-specific Category 2 issues – including a consideration of [SAMAs] for *those issues that have not previously been considered*." *Id.* (emphasis added). Thus, since the purpose of the exemption for previously conducted SAMAs, as explained both in the regulatory preamble and the case law, was to simply exempt "those *issues*" previously considered, rather than to wholly exempt from any future environmental impact statement consideration of severe accident mitigation alternatives that had not been previously considered, it would not serve the purpose of 10 C.F.R. § 51.53(c)(3)(ii)(L) to apply it in a way that would prevent NRC from considering newly identified mitigation alternatives, from evaluating those newly identified mitigation alternatives in light of their off-site economic consequences, and from using the most advanced and established methodologies for evaluating the costs and benefits of those newly identified mitigation alternatives – and that would prevent NRDC from challenging Exelon's ER for its failure to properly fulfill these obligations. NRDC Counsel Decl. ¶¶ 1-3.[12]

In reaching its conclusion, the Board reasoned that because the Commission was aware of ongoing safety analyses such as IPE and IPEEE at the time it promulgated subsection (L)

[12] In the Statement of Consideration, the Commission also recognized that, in light of inevitable changes that occur over time, "10 years is a suitable period" to delimit the outer bounds of when the Commission will assume that changes in condition and technology do not warrant additional NEPA review. 61 Fed. Reg. at 28,471. The last consideration of mitigation alternatives for severe accidents at Limerick occurred in 1989 – 24 years ago. Accordingly, it would also plainly be inconsistent with the purpose of these regulations to limit the scope of these severe accident mitigation alternatives, the offsite economic impacts of severe accidents, and the methodology for assessing the costs and benefits of such mitigation alternatives to alternatives to those that were considered so long ago.

exception, it must have not intended that new and significant information relevant to the Commission's environmental obligations under NEPA would be a basis for supplementing a previous SAMA analysis. Second ASLB Op. at 12-13. However, this attempt to have a program under the Atomic Energy Act function as a substitute for NEPA obligations had already been firmly rejected by the Third Circuit in *Limerick Ecology*:

> The language of NEPA indicates that Congress did not intend that it be precluded by the AEA. Section 102 of NEPA requires agencies to comply "to the fullest extent possible." 42 U.S.C. § 4332. Although NEPA imposes responsibilities that are purely procedural . . . there is no language in NEPA itself that would permit its procedural requirements to be limited by the AEA. Moreover, there is no language in AEA that would indicate AEA precludes NEPA.

Limerick Ecology, 869 F.2d at 729.

b. The Commission may not apply 10 C.F.R. § 51.53(c)(3)(ii)(L) in a manner that violates NEPA.

More fundamentally, it would be flatly contrary to NEPA to conclude that both the language and purpose of 10 C.F.R. § 51.53(c)(3)(ii)(L) is to preclude any obligation to consider new and significant information relevant to a 24 year old SAMDA analysis during the Limerick relicensing process. In short, NEPA's mandate for consideration of new and significant information, *e.g.*, *Marsh v. Oregon Natural Res. Council*, 490 U.S. at 365, plainly trumps any contrary regulation, *e.g. Chevron, U.S.A., Inc. v. NRDC*, 467 U.S. 837, 844 (1984) (explaining that an agency may not apply a regulation that is "manifestly contrary to the statute"), and *requires* that the regulation be construed and applied in a manner that is consistent with Congressional commands.

Indeed, this is especially true here, where the regulation is accompanied by *another* regulation which, faithfully implementing NEPA's statutory mandate, *expressly provides* that the

NEPA review for license renewal "must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware." 10 C.F.R. § 51.53(c)(iv).

Accordingly, even in the event the Commission were to conclude that the apparent purpose of 10 C.F.R. § 51.53(c)(3)(ii)(L) was to avoid these NEPA obligations, the Commission should grant a waiver on the more basic ground that a waiver is necessary where a regulation is in conflict with a statute such as NEPA.

This result is also consistent with the Commission's prior decisions. For example, after the regulations at issue here were promulgated several other plants complained that the Commission had erred in making SAMAs a Category 2 issue, on the grounds that soon all plants will have considered the issue in an IPE or an IPEE. 61 Fed. Reg. 66,547, 66,540 (Dec. 18, 1996). The Commission *rejected* this argument, reiterating that these issues must be considered in site-specific NEPA reviews, as an IPE or IPEE *cannot substitute for NEPA review*. *Id.* Several years later, the Nuclear Energy Institute submitted a formal rulemaking petition seeking to make SAMAs a Category 1 issue, and, again, the Commission expressly rejected that proposal. 66 Fed. Reg. 10,834, 10,834 (Feb. 20, 2001). Thus, the Commission has elsewhere recognized that it may not abrogate its fundamental NEPA obligation to consider new and significant information concerning SAMAs.[13]

Moreover, as noted, even the Statement of Consideration noted that if a commenter puts forward "new, site specific information which demonstrates that the analysis of an impact

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[13] These decisions also refute the Board's conclusion that the reference to the IPE IPEE programs in the Statement of Consideration demonstrates that the Commission intended to rely solely on these programs to address changed circumstances, rather than allowing them to be raised in the NEPA process. Second ASLB Op. at 12 n.43.

codified in the rule is incorrect with respect to the particular plant, the NRC staff *will seek Commission approval to waive the application of the rule* with respect to that analysis in that specific renewal proceeding." 61 Fed. Reg. at 28,470 (emphasis added). Thus, the Commission recognized that, at bottom, the Rule could not be applied in a situation like the one here, because doing so would be contrary to NEPA.

It also bears noting in this regard that, consistent with NEPA, the NRC's regulations also require that an ER consider "appropriate alternatives to recommended courses of action," including "alternatives available for *reducing or avoiding adverse environmental effects*." 10 C.F.R. § 51.45(b)(3), (b)(5) (emphasis added); see also 10 C.F.R. § 51.103 (requiring discussing of alternatives in the Record of Decision, including, inter alia, the "preferences among alternatives" and "whether the Commission has taken all practicable measures . . . to avoid or minimize environmental harm from the alternative selected"). This regulation similarly applies here, as it requires consideration of alternatives that mitigate against severe accidents and their consequences. *E.g. Limerick Ecology*, 869 F.2d at 741.

In short, regardless of the purpose for which the Commission promulgated 10 C.F.R. § 51.53(c)(3)(ii)(L), a waiver must be granted to insure compliance with NEPA, and thus the Commission must allow NRDC to pursue the following contentions:

i. Exelon has omitted from its ER a required analysis of new and significant information regarding potential new severe accident mitigation alternatives previously considered for other BWR Mark II Containment reactors (Contention 1E-1)

NRDC's Contention 1E, and supporting declaration, contends that the ER is deficient because it ignores new severe accident mitigation alternatives previously considered for other

BWR Mark II Containment reactors. NRDC Cont. at 16-19; *see also* First ASLB Op. at 40; NRDC Decl. ¶¶ 5-13. For the foregoing reasons, it would not serve the purposes of 10 C.F.R. § 51.53(c)(3)(ii)(L) for the regulation to bar consideration of this basis for Contention 1E here. *See also* NRDC Counsel Decl. ¶ 1.

ii. Exelon's reliance on data from TMI in its analysis of the significance of new information regarding economic cost risk constitutes an inadequate analysis of new and significant information (1E-2).

NRDC's Contention 1E, and supporting declaration, also contends that the ER is deficient in relying on data from TMI in order to consider the significance of the new information concerning economic cost risks. NRDC Cont. at 18 (¶ 5); *see also* First ASLB Op. at 40; NRDC Decl. ¶¶ 17-24. For the foregoing reasons, it would not serve the purposes of 10 C.F.R. § 51.53(c)(3)(ii)(L) for the regulation to bar consideration of this basis for Contention 1E here either. *See also* NRDC Counsel Decl. ¶ 2.

iii.. A legally sufficient analysis of newly identified severe accident mitigation alternatives for Limerick must utilize modern techniques for assessing whether those alternatives are cost-beneficial, and Exelon's ER erroneously concluded that new mitigation alternatives can be evaluated without use of those modern techniques (3E)

As noted, the Commission invited NRDC to seek a waiver of 10 C.F.R. § 51.53(c)(3)(ii)(L) not only as to the two modified bases for Contention 1E that were admitted by the ASLB, but also as to Contention 3E. NRDC seeks a waiver as to one basis for Contention 3E not covered by Contention 1E – the adequacy of the ER vis-à-vis techniques used to assess whether SAMDA's are cost-beneficial. NRDC Cont. at 22 (¶¶ 1, 3). In particular, this basis for Contention 3E contends that the 1989 SAMDA failed to use a probabilistic safety assessment severe accident consequences code system comparable to the MELCOR Accident Consequence Codes Systems ("MACCS") 2. *Id.* This basis for Contention 3E seeks to require Exelon and NRC Staff to use the more accurate and reliable methods available *today* for assessing the consequences of a severe accident, including economic consequences, and assessing the costs and benefits of the additional mitigation alternatives that are appropriate for BWRs. *Id.* For the foregoing reasons, it would also not serve the purposes of 10 C.F.R. § 51.53(c)(3)(ii)(L) for the regulation to bar consideration of this basis for Contention 3E. *See also* NRDC Counsel Decl. ¶ 3.

2. There are special circumstances unique to Limerick that warrant the waiver and were not considered in the rulemaking leading to 10 C.F.R. § 51.53(c)(3)(ii)(L).[14]

NRDC also plainly meets the "special circumstances" test here with respect to all three Contentions. As a threshold matter, this issue was arguably resolved in the *Limerick Ecology* case, where the Third Circuit considered the argument that the Commission need not consider mitigation for severe accidents at Limerick *specifically* because there were no special circumstances warranting such an individual review. As noted, the Commission had concluded that "there [we]re *no special or unique circumstances*" warranting consideration of these alternatives at Limerick, and the Board in that case similarly concluded that there were "*no special or unique circumstances* about the Limerick site" that warranted further review. 859 F.2d at 732 (emphasis added). The Third Circuit *rejected this conclusion*, finding that addressing severe accident mitigation at Limerick *is unique*, because, *inter alia*, these issues "*vary tremendously* across all plants," and at Limerick in particular in light of its "particular

[14] Because it found that NRDC did not meet the first part of the test, the Board did not consider whether NRDC met the other factors here.

plant's design, construction and location." *Id.* at 738 (emphasis added); *see also id.* at 738 (population "affects the magnitude and location of potential consequences from radiation releases," which "*is particularly true for plants such as Limerick which were built near densely populated areas*") (emphasis added).

In any event, it is evident that NRDC's Contentions raise issues that are both unique to Limerick and were not considered in the 10 C.F.R. § 51.53(c)(3)(ii)(L) rulemaking. NRDC's fundamental concern, reflected in its Contentions, is that there are a number of potentially cost-beneficial measures to address severe accidents at Limerick that, to date, Exelon has refused to consider; that the evaluation of the costs and benefits of these mitigation alternatives must include offsite economic consequences that reflect the current status and reasonably foreseeable changes to the population and economic value at risk within the 50 mile radius of the Limerick Plant's potential radionuclide ingestion pathway, in the event of a severe accident occurring within the extended license period under review; and that the methodology used to assess the cost and benefits of these additional mitigation alternatives must be the most advanced techniques available for such analyses.

Every other BWR nuclear power plant in the country that has undergone relicensing to date has conducted an analysis of SAMAs that is more inclusive of potential alternatives, includes the offsite economic consequences of a severe accident and utilizes the advanced computer methodology of MACCS2 to determine costs and benefits. NRDC Decl. ¶¶ 5-13. For none of these has the existence of the IPE and IPEEE programs served as a substitute for a NEPA cost/benefit analysis of mitigation alternatives, and for all of these some cost beneficial mitigation measures have been identified, none of which are being considered for Limerick.

Thus, the Contentions apply only to Limerick, and, more importantly, absent the waiver sought here, the Limerick plant will be the *only* BWR nuclear power plant that will be relicensed without the operator or the NRC giving NEPA consideration to the most recent mitigation alternatives, assessment methodologies, and economic considerations regarding severe accident mitigation alternatives. Rather, while all other plants conduct such analyses, and provide them to the public for public comment, the millions of people living near Limerick during the license extension period will be forced to rely on an analysis publish 24 years ago. NRDC Counsel Decl. ¶ 4.

Absent a waiver, or some other mechanism for consideration of these issues, by the time Limerick Unit 2 completes its license renewal period, in 2049, its NEPA analysis of SAMAs will potentially be *sixty years* old, without any obligation to adequately update the analysis in the light of new and significant information, and without affording the interested public their rights under NEPA to challenge the licensee's use of such information and/or failure to apprehend its importance to identification of cost-effective measures for mitigating the environmental consequences of severe accidents. Such anomalous, highly prejudicial, and NEPA-violative outcomes are a possible and readily foreseeable result of failing to waive application of Subpart L to the relicensing of Limerick, and thus also comprise the "special circumstances" satisfying this prong of the waiver analysis.

These issues certainly were not considered in the 10 C.F.R. § 51.53(c)(3)(ii)(L) rulemaking. To the contrary, as discussed above, the Commission was focused first and foremost on insuring that these kind of alternatives *are* considered in relicensing proceedings (which is why the Commission made them Category 2 issues), and, secondarily, it sought to avoid *duplicative* NEPA processes by exempting specific mitigation alternatives that had previously been considered from being subject to reconsideration. Nothing in the regulatory preamble suggests that the Commission contemplated that the regulation would forever preclude Exelon from being required to consider new, previously unconsidered, mitigation alternatives during relicensing.[15]

Exelon's own contradictory approach to this issue is also a special circumstance plainly not contemplated when this regulation was adopted. NRDC Counsel Decl. ¶ 4. It is critical to recognize in this regard that the ER *does discuss alternatives to mitigate for severe accidents*. *See* ER at 5-1 to 5-9. In conducting this analysis, Exelon recognized that it has an obligation to "identify any new and significant information of which" it is aware. *Id.* at 5-2. According to Exelon, it was because it did *not identify* any information that met the standard that no specific design alternatives were identified or discussed. *Id.* at 5-9.

The net effect of the Board's decision that subsection (L) cannot be waived is that although the NEPA analysis includes a discussion of new and significant information related to the prior SAMDA, there is no opportunity to challenge that discussion in the licensing process. This is akin to what the Court addressed when it first overturned AEC NEPA regulations that failed to include NEPA issues among the matters that had to be addressed in licensing proceedings.

> We believe that the Commission's crabbed interpretation of NEPA makes a mockery of the Act. What possible purpose could there be in the Section 102(2)(c) requirement (that the "detailed statement" accompany proposals through agency review processes) if

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[15] The fact that the issue is unique is also highlighted by the fact that although three plants are arguably covered by the exception – Limerick, Comanche Peak, and Watts Bar. 61 Fed. Reg. at 28,481 – only Limerick is a BWR, while the other two are Pressurized Water Reactors. Accordingly, the mitigation measures at issue only apply to Limerick.

> "accompany" means no more than physical proximity mandating no more than the physical act of passing certain folders and papers, unopened, to reviewing officials along with other folders and papers? What possible purpose could there be in requiring the "detailed statement" to be before hearing boards, if the boards are free to ignore entirely the contents of the statement? NEPA was meant to do more than regulate the flow of papers in the federal bureaucracy.

Calvert Cliffs' Coordinating Committee v. AEC, 449 F.2d 1109, 1117 (D.C. Cir. 1971).

NRDC's Contentions focus both on flaws in the way the ER analyzed the significance of new information, and the failure to consider all relevant new information related to SAMAs. Had Exelon claimed the "new and significant information" standard in 10 C.F.R. § 51.53(c)(3)(iv) does not apply *at all* in light of 10 C.F.R. § 51.53(c)(3)(ii)(L), then it would not have conducted this review, and its position here would at least be consistent with its approach to preparing the ER. *See also* NRDC Counsel Decl. ¶ 4.

In adopting 10 C.F.R. § 51.53(c)(3)(ii)(L) the Commission certainly did not contemplate that in a license renewal, an applicant could, on the one hand, recognize that 10 C.F.R. § 51.53(c)(3)(iv) *does apply*, and on the other hand claim that an intervenor has no right to challenge the adequacy of that analysis. Rather, such an anomalous approach is plainly contrary to both the regulations and NEPA mandates, particularly where, as here, the new and significant information is *uniquely relevant to this one plant*. All other plants licensed to date have evaluated a wider range of mitigation alternatives, are conducting analyses of off-site economic consequences, and are using the most up-to-date methodology for analyzing the costs and benefits of SAMAs.

Accordingly, NRDC meets the "special circumstances" part of the waiver test as well.

3. Waiver of the regulation is necessary here to address a significant environmental concern.

Finally, the issues NRDC seeks to raise also plainly address a significant environmental concern. *See In re Pacific Gas & Elec. Co.*, LPB-10-15, at 35-36, 38 (finding that this factor "should be construed in this instance to permit a waiver if it is necessary to reach a significant environmental issue"). By definition, NRDC's Contentions concern how to best mitigate for "severe" accidents. Courts, including in *Limerick Ecology*, have repeatedly *rejected* the notion that a small risk of a severe accident is an insignificant problem that need not be addressed in the NEPA process. 869 F.2d at 738 ("risk equals the likelihood of an occurrence times *the severity of the consequences*") (emphasis added); *accord New York v. NRC*, 681 F.3d 471, 478-79 (D.C. Cir. 2012); *cf. Mountain States Legal Found. v. Glickman*, 92 F.3d 1228, 1235 (D.C. Cir. 1996) ("the more drastic the injury that government action makes more likely, the lesser the increment in probability necessary to establish standing").

During the life of a relicensed Limerick plant the surrounding population within 50 miles will grow to over 9 million people, including more than 400,000 people living within 10 miles of the site. NRDC Waiver Decl. ¶¶ 14-16. It is vital that appropriate mitigation alternatives be considered to ameliorate the risks to these residents.

The alternatives NRDC contends Exelon must consider are all designed to address these risks, which is why they have been considered for other BWR Mark II Containment plants. Severe accidents could result from external events such as tornadoes, floods, earthquakes, fires, or even sabotage, and could result in substantial damage to the reactor core. Where there are inadequate means to achieve backup power in the event of a power failure, for example, that could lead to a severe accident, as at the Fukushima plant. Or where inadequate training allows operation of a reactor while auxiliary feed pumps are closed for maintenance, a malfunction in the primary pumps can lead to a severe accident, as occurred at TMI. The mitigation alternatives NRDC has identified from the SAMA analyses for other BWRs are designed either to reduce the likelihood of severe accidents, or to mitigate the severity of their consequences should they nonetheless occur. NRDC Decl. ¶¶ 16. Because, absent the waiver, Exelon will not be required to consider these measures, the waiver is plainly necessary to address significant environmental issues regarding cost-beneficial mitigation alternatives. *See also* NRDC Counsel Decl. ¶ 5.

II. Alternatively, NRDC Is Entitled To Pursue Its Contention That Exelon Must Consider A Reasonable Range of Severe Accident Mitigation Alternatives As Mandated By NEPA Without A Waiver.

Finally, even assuming *arguendo* that the Commission were to conclude the waiver criteria set forth in 10 C.F.R. § 2.335(a) were not satisfied here, NRDC nonetheless would be entitled to have its Contentions admitted. Consistent with NEPA, NRC's regulations provide that in conducting an environmental review – be it in an initial EIS, a supplemental review, or a further supplemental stage – the Commission must consider "*any new and significant information* regarding the environmental impacts of license renewal of which the applicant is aware." 10 C.F.R. § 51.53(c)(3)(iv) (emphasis added). This regulation fulfills the NEPA obligation to supplement a NEPA review in appropriate circumstances, even when a prior NEPA review has been completed. *E.g., Marsh*, 490 U.S. at 365.

Arrayed against this Supreme Court and NEPA mandated obligation to consider new and significant information regarding prior environmental analyses prior to taking a major federal action, is the exception in subsection (L). Unlike the obligation imposed by NEPA and the Supreme Court, the subsection (L) exception is, at most, a paperwork convenience provision, instituted to alleviate an applicant of the obligation to undertake two SAMA analyses. Undoubtedly, if that second SAMA analysis were merely a repeat of the first analysis and if no new and significant information were available, the Commission would have a basis to enforce the subsection (L) exception. However, where, as here, the exception, if allowed to stand, would prevent the Commission from complying with its NEPA obligations and the Supreme Court's mandate in *Marsh*, the lesser rule must be set aside to allow the more substantively important requirements of 10 C.F.R. § 51.53(c)(iv) to be met. Otherwise, the NEPA analysis for Limerick will be fatally flawed as it will be based on a demonstrably outdated and inaccurate, 24-year old, SAMDA analysis.

Indeed the Commission's earlier ruling strongly suggested this very outcome, noting both that "Exelon has put forward in its license renewal application *new information* regarding its [SAMA] analysis," and that "*NRDC may challenge the adequacy of the new information provided in the Limerick Environmental Report.*" Comm. Op. at 13 (emphasis added). This result is also entirely consistent with recent court rulings, which have emphasized both that, "under NEPA [the NRC] must look at both the probabilities of potentially harmful events and the consequences if those events come to pass," *New York*, 681 F.3d at 478, and that, more specifically, an NRC environmental "report for a license renewal must analyze the environmental impacts of the proposed action *and include a severe accident mitigation alternatives ("SAMA") analysis*." *Massachusetts v. NRC*, 2013 WL 668468, at *2 (emphasis added); *see also Beyond Nuclear v. NRC*, 704 F.3d 12, 17 n.4 (1st Cir. 2013) (discussing an "admitted contention . . . that the severe accident mitigation analysis in the report minimizes or underestimates the potential amount of radioactive release in a severe accident").

Accordingly, because an agency rule cannot be construed in such a manner as to violate a statutory mandate, *e.g. Auer v. Robbins*, 519 U.S. 452, 463 (1997) (while agency "is free to write [ ] regulations as broadly as [it] wishes," that discretion is subject "to the limits imposed by the statute"), the Contentions should be admitted irrespective of 10 C.F.R. § 51.53(c)(3)(ii)(L) and the waiver process.[16]

CONCLUSION

For the foregoing reasons, NRDC respectfully requests that the Commission admit NRDC's Contention 1E-1 and 1E2, as originally admitted by the ASLB, as well as that aspect of Contention 3E that concerns appropriate techniques to analyze SAMAs.

Respectfully Submitted,

s/ (electronically signed)
Howard M. Crystal
Meyer Glitzenstein & Crystal
1601 Connecticut Ave., N.W., Suite 700
Washington, D.C. 20009
(202) 588-5206
hcrystal@meyerglitz.com

s/ (electronically signed)
Anthony Z. Roisman
National Legal Scholars Law Firm, P.C.
241 Poverty Lane, Unit 1
Lebanon, NH 03766
603-443-4162
aroisman@nationallegalscholars.com

s/(electronically signed)
Geoffrey H. Fettus
Natural Resources Defense Council
1152 15th Street, NW, Suite 300
Washington, D.C. 20005
202-289-2371
gfettus@nrdc.org

Filed this date of March 13, 2013

[16] As the D.C. Circuit recently explained, on review the Commission will not be entitled to deference for its interpretation of the regulation. *Shieldalloy Met. Corp. v. NRC*, No. 11-1449, 2013 WL 599469 (D.C. Cir. Feb. 19, 2013) ("Hand-waving about complexity seems especially unsuitable where the text's opacity is all of the agency's choosing and it concerns a complex regulatory program with immense public safety implications").

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE COMMISSION

In the Matter of:	)	
	)	
EXELON GENERATION COMPANY, LLC	)	Docket No. 50-352-LR
	)	Docket No. 50-353-LR
(Limerick Generating Station, Units 1 and 2)	)	
		March 20, 2013
(License Renewal Application)		

NATURAL RESOURCES DEFENSE COUNCIL'S RESPONSE BRIEF IN SUPPORT OF WAIVER OF 10 C.F.R. § 51.53(c)(3)(ii)(L) AS APPLIED TO APPLICATION FOR RENEWAL OF LICENSES FOR LIMERICK UNITS 1 AND 2

Howard M. Crystal
Meyer Glitzenstein & Crystal
1601 Connecticut Ave., N.W., Suite 700
Washington, D.C. 20009
(202) 588-5206
hcrystal@meyerglitz.com

Anthony Z. Roisman
National Legal Scholars Law Firm, P.C.
241 Poverty Lane, Unit 1
Lebanon, NH 03766
603-443-4162
aroisman@nationallegalscholars.com

Geoffrey H. Fettus
Natural Resources Defense Council
1152 15th Street, NW, Suite 300
Washington, D.C. 20005
202-289-2371
gfettus@nrdc.org

TABLE OF CONTENTS

TABLE OF AUTHORITIES

STATUTES

REGULATIONS

GLOSSARY

APA	Administrative Procedure Act
Comm. Op.	*In re Exelon Generation Co.*, CLI -12-19
ER	Environmental Report
EIS	Environmental Impact Statement
Ex. Br.	Mar. 13, 2013 Initial Brief of Exelon Generation Company, LLC
Exelon	Exelon Generating Co., LLC
First ASLB Op.	*In re Exelon Generation Co.*, LBP-12-8
NEPA	National Environmental Policy Act
NRDC	Natural Resources Defense Council
SAMAs	Severe Accident Mitigation Alternatives
Second ASLB Op.	*In re Exelon Generation Co.* LBP-13-1
Staff	NRC Staff
Staff Br.	Mar. 13, 2013 Brief of NRC Staff

INTRODUCTION[1]

Acknowledging, as they must, that a waiver of 10 C.F.R. § 51.53(c)(3)(ii)(L) *could* be granted, Exelon Generating Co., LLC ("Exelon") and NRC Staff ("Staff") seek to erect an insurmountable barrier to waiver by conflating the standard for waiver with their own, unsupported assertion that to obtain a waiver a party must meet heightened contention pleading standards. Thus, they assert that Natural Resources Defense Council ("NRDC") can only obtain a waiver by proving, *at the contention admissibility stage*, the existence of "*major* design changes or *major* plant modifications that would be cost-beneficial at Limerick." Ex. Br. at 2 (emphasis added); Staff Br. at 14. *Millstone* contains no such requirement.

Moreover, they fail to explain how this approach can be reconciled with the framework governing their compliance with – and a petitioners' opportunity to *challenge* their compliance with – the National Environmental Policy Act ("NEPA"), 42 U.S.C. § 4321, *et seq.*, particularly where, as here, NRDC challenges a *failure* to adequately address an issue required to be addressed in the Environmental Report ("ER"). Under NEPA, governing case law, and the Commissions' regulations, when a prior Environmental Impact Statement ("EIS") has been completed, *additional* environmental analysis is required to address any "significant new circumstances," or new "information relevant to environmental concerns." 40 C.F.R. § 1502.9(c); *Marsh v. Or. Natural Res. Council*, 490 U.S. 360, 368 (1989); 10 C.F.R. § 51.53(c)(3)(iv). Thus, if NRDC ultimately demonstrates that new information may have significant environmental impacts, further NEPA review is necessary. *E.g. Ramsey v. Kantor*, 96 F.3d 434, 445 (9th Cir. 1996). This is a far cry from Exelon and Staff's attempt to impose a

[1] The parties concur that the Commission should "accept review" of the Board's referral. *See* Mar. 13, 2013 Initial Brief of Exelon Generation Company, LLC's ("Ex. Br.") at 2; Mar. 13, 2013 Brief of NRC Staff ("Staff Br.") at 10.

burden of definitive proof, at the contention pleading stage, that the missing mitigation measures will result in a "major" environmental improvement.

Under the Administrative Procedure Act ("APA"), an interested party is also entitled to *challenge* whether an agency has adequately complied with this fundamental NEPA obligation. 5 U.S.C. § 702. An agency may not remove this right to judicial review. Accordingly, because NRDC has easily satisfied its obligation to come forward with sufficient allegations and evidence that there is new information relevant to environmental concerns at Limerick – in particular, that the ER fails to adequately address new and significant information relevant to Severe Accident Mitigation Alternatives ("SAMAs") – and meets the waiver standards, the Commission should grant the waiver and allow NRDC's contentions to be heard.

ARGUMENT

A. New and Significant Information Concerning SAMAs Must be Considered During Relicensing, and a Petitioner May Challenge the Adequacy of That Consideration.

As Exelon concedes, "Exelon and NRC Staff *have obligations* to address new and significant information related to SAMA's in their NEPA analyses . . . ." Ex. Br. at 16, n.77 (emphasis added); *see also* Staff Br. at 8. Thus, in its ER Exelon included a purported discussion of new and significant information concerning SAMAs. *See* NRDC March 13, 2013 Opening Brief at 1 n.1 (citing ER). The parties' real dispute, then, is not *whether* new and significant information informing SAMAs must be considered during relicensing, but, rather, what burden NRDC must meet in order to *challenge the adequacy* of that analysis in the ER.

Under Exelon and Staff's view, because of 10 C.F.R. § 51.53(c)(3)(ii)(L), it is insufficient for a petitioner like NRDC to simply *identify* new and significant information concerning SAMAs for Limerick. Rather, they claim that in order to pursue its Contentions

NRDC must meet an "extremely high burden" to demonstrate – at the outset – the existence of cost-beneficial "major design changes or major plant modifications." Ex. Br. at 2, 18 (emphasis added); Staff Br. at 14. This argument fails on several levels.

First, it is well-established that a petitioner is not required to *prove* its contentions in order to have them admitted. Rather, a petitioner must simply raise a *material issue of fact* on the matter. *Entergy Nuclear Vermont Yankee, L.L.C.*, 60 N.R.C. 548, 555-556 (2004) ("At the contention admissibility stage all that is required is some alleged fact or facts in support" and "[d]etermining whether the contention is adequately supported by a concise allegation of the facts or expert opinion is . . . not a hearing on the merits")(citations omitted); *Private Fuel Storage, L.L.C.*, 60 N.R.C. 125, 139 (2004) ("we do not expect a petitioner to prove its contention at the pleading stage").[2]

Exelon and Staff's arguments conflate the standards for a waiver with those for contention *admissibility*. The waiver standards do not require proof that specific additional analyses sought will cause a major change, only that the issues sought to be raised are significant. Indeed, the requirement to fully consider mitigation measures, and new and significant information regarding mitigation, are embodied in NRC regulations, and thus have already been deemed to be significant issues. *See* 10 C.F.R. §§ 51.53(c)(3)(iv), 51.103(a)(4). While Staff and Exelon seek to require NRDC *itself* to come forward with the analysis demonstrating whether there are new cost-effective SAMAs for Limerick, *that is Exelon's (and*

[2] Exelon claims "NRDC alleges that the mere assertion" of new information warrants admission. Ex. Br. at 3. NRDC's Contentions included a declaration explaining *in detail* the bases for NRDC's claims, *see* NRDC Opening Br., Ex. A at 36-85 – claims that: (a) the Board found meet contention admissibility standards (First ASLB Op. at 20-21, 23-25) and (b) the Commission concluded may be admitted if NRDC meets waiver standards. Comm. Op. at 13.

NRC's) *job*. The purpose of a NEPA analysis is to, *inter alia*, require the applicant – and ultimately the agency – to analyze appropriate alternatives and their environmental impacts. Accordingly, NRDC need only come forward with sufficient information showing an aspect of the required analysis is *missing*. If the admitted contention succeeds, then the agency/applicant must *conduct* the requisite analysis. *E.g.* 10 C.F.R. 2.309(f)(1)(vi); *N. States Power Co.*, 68 N.R.C. 905, 932 (2008) ("Because Petitioner sets forth a contention of omission . . . Petitioner is not required to provide supporting facts or expert opinion at this stage").

Second, Exelon and Staff's approach would deny Petitioner's their basic APA rights to *challenge* compliance with NEPA. The APA affords NRDC a *statutory right* to review of NRC's compliance with NEPA. 5 U.S.C. § 702 ("a person suffering legal wrong because of agency action, or adversely affected or aggrieved by agency action within the meaning of a relevant statute, is entitled to judicial review thereof"). That right cannot be reconciled with Exelon's assertion that, while it and the Commission must "address new and significant information related to SAMA's" during relicensing, "*there is no inherent right under NEPA to litigate an ER's discussion of new and significant information.*" Ex. Br. at 16, n.77 (emphasis added). In short, if new and significant information concerning SAMAs must be considered during the relicensing process, NRDC is entitled to *challenge* the adequacy of that analysis, without proving up front that such an analysis will require major plant modifications. *E.g. Abbott Lab. v. Gardner*, 387 U.S. 136, 140 (1967) ("judicial review of a final agency action by an aggrieved person will not be cut off unless there is persuasive reason to believe that such was the purpose of Congress"); *Ala. Wilderness Recreation & Tourism Ass'n v. Morrison*, 67 F.3d 723, 729 (9th Cir. 1995) (alternatives are "the heart of the environmental impact statement," and when new reasonable alternatives arise following completion of an EIS they must be independently considered in the NEPA process).

Finally, Exelon and Staff fail to recognize the Commission's own regulatory scheme already *recognizes the obligation* to supplant prior NEPA analyses, requiring the EIS for license renewal to "contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware." 10 C.F.R. § 51.53(c)(3)(iv) (emphasis added). Nowhere does this – or any other – NRC regulation state or imply that this obligation is only triggered if the Petitioner proves that "major design changes or major plant modifications" will result. Accordingly, Exelon's extended discussion of why the issues raised by NRDC do not meet its self-created "major modification" standard – which, Exelon explains, would require a petitioner to demonstrate the need for a "plant change that results in the permanent installation of a new structure, system, or a redundant train of an existing system that changes the footprint of the facility," Ex. Br. at 18-19 – is a non-sequitur, as no such standard exists. Moreover, the fact that Exelon found it necessary to submit a *declaration* challenging NRDC's evidence of the existence and potential importance of additional SAMA's merely serves to highlight the existence of a factual dispute that cannot be resolved at the Contention admissibility stage.

10 C.F.R. § 51.53(c)(3)(ii)(L) does not, and cannot, change this result. The Commission may have "anticipated" that any additional SAMAs in the future would be "minor" (and thus presumably would fall below the "significant new information standard"), Staff Br. at 28, and that as a result they could be more appropriately addressed "outside of the SAMA context," Staff Br. at 28-29, but the only purpose for the regulation that would be consistent with NEPA (and the APA) would be that this simply meant that if, after a contention is admitted based on the

failure to consider new and significant information, a Petitioner was unable to demonstrate that that the new information is "significant," new SAMAs need not be considered. It could *not* have been the Commission's purpose to set a *higher* burden, or to otherwise substitute the IPE and IPEE processes for further NEPA review. *E.g. United States v. Coal. For Buzzards Bay*, 644 F.3d 26, 38 (1st Cir. 2011) (rejecting argument that alternative process can substitute for NEPA); *Limerick Ecology Action, Inc. v. NRC*, 869 F.2d 719, 729 (3d Cir. 1989) (AEA procedures cannot substitute for compliance with NEPA).[3]

Accordingly, an adequate consideration of new and significant information related to SAMA must be included in the ER for Limerick relicensing, and NRDC has the right to challenge the adequacy of that analysis.

B. <u>NRDC Meets The Standards For Waiver of 10 C.F.R. § 51.53(c)(3)(ii)(L).</u>

1. Barring NRDC's Contentions Based on the Regulation Would Violate NEPA And Run Contrary To The Regulation's Purpose.

Before the Board, it was Staff's position that the "purpose of 10 C.F.R. § 51.53(c)(3)(ii)(L) is . . . that a plant that has previously considered [SAMAs] *need not reassess severe accident mitigation for license renewal*." NRC Staff Answer to Waiver Petition (Dec. 14, 2012) at 12-13 (emphasis added). The Board accepted this argument, concluding that the purpose of the regulation "is to exempt those plants that have already performed SAMA analyses

[3] Staff suggests that the regulation is intended to foreclose further NEPA review on SAMAs unless they will result in major plant modifications because the Commission recognized that the risk of severe accidents was "small." Staff Br. at 14-15. But this seeks to reargue the position that the Third Circuit *rejected* in *Limerick Ecology*, where the Court expressly ruled that, particularly in light of the significant harms that a severe accident would cause, SAMA analysis is required in the NEPA process irrespective of the fact that the risk of an accident may be small. *Limerick Ecology Action, Inc. v. U.S. Nuclear Regulatory Comm'n*, 869 F.2d at 741 ("after Three Mile Island, it would be irrational for the NRC to maintain that severe accident risks are too remote to require consideration").

from [considering SAMAs] at license renewal," and thus, that "[e]ven if a petitioner could demonstrate that there exists a group of cost-effective SAMA candidates that would greatly reduce the impacts of severe accidents and that have not been considered in the previous analysis, that petitioner could not successfully seek a waiver . . . ." Second ASLB Op. at 10. The Board's referral to the Commission was based on that conclusion, because it would mean that a waiver could *never* be granted.

Recognizing this problem, Staff now take a *contrary* position, claiming that a waiver *could* be granted, and that it *would be* within the purpose of the regulation to require further consideration of SAMAs, *if* a petitioner could demonstrate, at the outset, that those SAMAs would "provide a serious reduction in the risk of severe accidents . . . ." Staff Br. at 27. We have explained above why this newly minted standard is inappropriate, *see supra* at 2-6, but in any event this kind of bait-and-switch approach should not be permitted. *New Hampshire v. Maine*, 532 U.S. 742, 749 (2001) ("[W]here a party assumes a certain position in a legal proceeding, and succeeds in maintaining that position, he may not thereafter, simply because his interests have changed, assume a contrary position"). Rather, the Commission should simply reject Staff's *original* argument, and conclude that, as compelled by the Commission's regulations and NEPA, further analysis is *required* where, as here, a petitioner sufficiently alleges that an ER inadequately addresses new and significant information concerning SAMAs.[4]

[4] Elsewhere Staff itself suggests this standard, stating that the Board's conclusion – which Staff itself had urged – must be wrong because otherwise "NRDC would have no opportunity to bring claims of new and significant information regarding SAMAs in this adjudication." Staff Br. at 18.

This result is arguably compelled by the Commission's earlier decision remanding this proceeding to the Board, where the Commission explained that "NRDC *may challenge the adequacy of the new information provided in the Limerick*" ER, Comm. Op. at 13 (emphasis added), but stated that the appropriate vehicle to pursue such a claim concerning "new and significant information" is a waiver petition. *Id.* at 10. Accordingly, the Commission should conclude that it would be contrary to the purpose of the regulation to preclude such a waiver based on the impossibility that such a waiver could be granted.

Alternatively, the Commission should conclude that the narrow purpose of 10 C.F.R. § 51.53(c)(3)(ii)(L) is to exempt Exelon from reconsidering the SAMA candidates that were previously considered. *See* NRDC Mar. 13, 2013 Opening Brief at 15-18. This more narrow purpose would reconcile the regulations with NEPA and with 10 C.F.R. § 51.53(c)(3)(iv) by allowing NRDC to challenge whether Exelon has adequately considered new and significant information that may serve to identify *new* SAMA candidates, and has used more current analyses and cost considerations in doing so.

2. Special Circumstances Unique to Limerick and Concerning a Significant Environmental Concern Warrant A Waiver Here.[5]

Exelon does not contest that NRDC meets the remainder of the waiver test, and should not be permitted to so argue in its response brief. *Bonte v. U.S. Bank, N.A.*, 624 F.3d 461, 466 (7th Cir. 2010); *Louisiana Energy Services, L.P.*, 60 N.R.C. 223, 225 (2004) ("new arguments

[5] The Board concluded that the *Millstone* test contains "an appreciably higher burden for would-be waiver seekers than does 10 C.F.R. § 2.335(b)," because the regulation does not require the waiver request to be 'unique' to the facility or concern a 'significant safety issue.'" Second ASLB Op. at 7. While NRDC agrees with the Board that it should not be required to satisfy these factors here, they are nonetheless amply met.

may not be raised for the first time in a reply brief"). While Staff contests whether NRDC meets the remaining factors, the arguments have no merit.

First, Staff claims that NRDC's request is not unique because the regulation could apply to other license renewals or "reactors applying for subsequent license renewal . . . ." Staff Br. at 26. Of course, if there were any such plants Staff would have named them, and NRDC is aware of none. As for subsequent renewals, the notion that the regulation will exempt further SAMA analysis when plants are again renewed in the mid-twenty-first century flatly contradicts the GEIS, which was prepared only to address environmental impacts of "renewing the licenses of and operating individual nuclear power plants for an additional twenty years," not second – and third, and fourth – generation renewals. *See* GEIS Executive Summary; *id.* at § 1.1. Thus, in fact, the request *only* covers Limerick, since, of the three plants covered by the exception to 10 C.F.R. § 51.53(c)(3)(ii)(L) – Limerick, Companche Creek, and Watts Barr – only Limerick is a Boiling Water Reactor. *See* 61 Fed. Reg. at 28,481.

Second, Staff claims there are no "special circumstances" or "significant environment concerns" because, in promulgating 10 C.F.R. § 51.53(c)(3)(ii)(L), the Commission anticipated that additional cost-effective SAMAs would be developed in the future. Staff Br. at 25; *id.* at 28 (arguing that in promulgating the regulation the Commission "explicitly recognized that future SAMA analyses done at other plants may identify other cost-beneficial SAMAs"). Of course, if that were the governing standard then, again, a waiver could *never* be granted. But, having already determined that "NRDC *may challenge* the adequacy of the new information" Exelon provided concerning SAMAs, Comm. Op. at 13 (emphasis added), and that the appropriate mechanism through which to do so is the waiver process, the Commission has already, in effect, concluded that such a challenge meets these remaining criteria.[6]

Moreover, Staff's view of how these factors can be satisfied here is at odds with the Statement of Consideration, where, in responding to concerns that new information may undermine the bases for generic licensing determinations, the Commission itself recognized that if subsequent information demonstrates that "the analysis of an impact codified in the rule is incorrect with respect to [a] particular plant," *a waiver of the rule will be appropriate*. 61 Fed. Reg. at 28,470. NRDC has produced more than sufficient information to challenge the adequacy of Exelon's analysis of new and significant information concerning SAMAs in its ER. Thus, a waiver must be granted.

Respectfully Submitted,

s/ (electronically signed)
Howard M. Crystal
Meyer Glitzenstein & Crystal
1601 Connecticut Ave., N.W., Suite 700
Washington, D.C. 20009
(202) 588-5206
hcrystal@meyerglitz.com

s/(electronically signed)
Geoffrey H. Fettus
Natural Resources Defense Council
1152 15th Street, NW, Suite 300
Washington, D.C. 20005
202-289-2371
gfettus@nrdc.org

s/ (electronically signed)
Anthony Z. Roisman
National Legal Scholars Law Firm, P.C.
241 Poverty Lane, Unit 1
Lebanon, NH 03766
603-443-4162
aroisman@nationallegalscholars.com

Filed this date of March 20, 2013

[6] Staff's reliance on a decision rejecting an effort to *reopen* the record in another proceeding based on contentions concerning a SAMA analysis is misplaced. Staff Br. at 29 n.158. The reopening standards are not at issue here, and, the fact that "claims related to" SAMAs "are not *necessarily* significant," Staff Br. at 29 (emphasis added), has nothing to do with whether NRDC has raised significant issues *here*.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD

Before Administrative Judges:

William J. Froehlich, Chairman
Dr. Michael F. Kennedy
Dr. William E. Kastenberg

In the Matter of	Docket Nos. 50-352-LR, 50-353-LR
EXELON GENERATION COMPANY, LLC	ASLBP No. 12-916-04-LR-BD01
(Limerick Generating Station, Units 1 and 2)	July 12, 2013

MEMORANDUM AND ORDER
(Ruling on Resubmission of Contentions)

Before this Atomic Safety and Licensing Board (Board) is a motion by the Natural Resources Defense Council (NRDC) to resubmit a number of contentions.[1] Essentially, these contentions are identical to contentions previously proffered in this proceeding, but they are directed toward the Nuclear Regulatory Commission's (NRC) Draft Supplemental Environmental Impact Statement (DSEIS) rather than Exelon Generation Company, LLC's ("Exelon") Environmental Report (ER). NRDC does not seek to litigate the admissibility of these contentions at this juncture, but simply asks that the Board "accept" these contentions.[2] For the reasons discussed below, the Board does not "accept" these new contentions, but tolls the deadline for NRDC to resubmit these contentions pending resolution of a waiver proceeding currently pending before the Commission.

[1] [NRDC's] Resubmission of Contentions in Response to Staff's Supplemental Draft Environmental Impact Statement (May 30, 2013) [hereinafter "Motion"].

[2] See id. at 9.

I. BACKGROUND

The history of this proceeding is somewhat convoluted, and need not be fully recounted here, as we have adequately explained it elsewhere.[3] It is sufficient here simply to note that NRDC has submitted a waiver petition pursuant to 10 C.F.R. § 2.335(b) in order to litigate its original contentions. This Board ruled on that waiver petition in LBP-13-01, finding that NRDC had not met the standards for waiver of a regulation, and referring our ruling to the Commission pursuant to 10 C.F.R. § 2.323(f)(1) because NRDC's petition presented a novel issue of law that deserved the Commission's immediate attention.[4] Our referral of LBP-13-01 is presently pending before the Commission.

On April 30, 2013, the NRC published the DSEIS for Limerick Generating Station, Units 1 and 2 ("Limerick").[5] NRDC filed the instant motion on May 30, 2012. Exelon and the NRC Staff filed answers opposing the motion on June 24, 2013.[6] NRDC filed a reply to these answers on July 8, 2013.[7]

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[3] See LBP-13-01, 77 NRC __, __-__ (slip op. at 1-5) (Feb. 6, 2013).

[4] Id. at 13.

[5] See Office of Nuclear Reactor Regulation, Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supp. 49, Regarding Limerick Generating Station, Units 1 and 2, Draft Report for Comment (Apr. 2013) (ADAMS Accession No. ML13120A078).

[6] See Exelon's Answer Opposing [NRDC's] Resubmission of Contentions in Response to Staff's Supplemental Draft Environmental Impact Statement (June 24, 2013) [hereinafter "Exelon Answer"]; NRC Staff Answer to [NRDC's] Resubmission of Contentions in Response to Staff's Supplemental Draft Environmental Impact Statement (June 24, 2013) [hereinafter "NRC Staff Answer"].

[7] See [NRDC's] Reply in Support of Resubmission of Contentions (July 8, 2013) [hereinafter "Reply"].

II. ANALYSIS AND RULING

A. Positions of the Parties

NRDC states that "the purpose of the update is to simply direct the original Contentions to the DSEIS rather than the [ER], since the bases for the Contentions has not changed."[8] That is, NRDC does not appear to argue that there is some new and significant information within the DSEIS that makes its previously inadmissible[9] contentions admissible. Indeed, NRDC states that "[o]ther than accepting these updated Contentions NRDC seeks no action from the Board at this time."[10] Both Exelon and the NRC Staff oppose this request.

Exelon contends that NRDC's motion is "without legal basis," and argues that "the Board should reject the Resubmitted Contentions."[11] Exelon claims that this Board lacks jurisdiction to "accept" these resubmitted contentions because NRDC's waiver petition (which seeks a waiver in order to litigate an essentially identical set of contentions) is currently pending before the Commission.[12] Exelon also contends that the motion is untimely and fails to satisfy the Commission's contention admissibility requirements.[13]

The NRC Staff argues that "[t]he Board should not accept or admit any of NRDC's resubmitted contentions because NRDC has not demonstrated that its contentions meet" the

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[8] Motion at 2.

[9] In addition to finding NRDC's waiver petition lacking in LBP-13-01, this Board earlier found a number of NRDC's contentions inadmissible in its initial ruling on NRDC's initial petition to intervene in LBP-12-08. 75 NRC 539, 570-71 (2012).

[10] Motion at 9.

[11] Exelon Answer at 3.

[12] Id. at 10.

[13] Id. at 10-18.

Commission's timeliness and contention admissibility requirements.[14] The NRC Staff does note, however, that it "is not opposed to tolling the deadline for NRDC to file updated SAMA contentions based on the Staff's DSEIS until the Commission rules on NRDC's pending Waiver Petition."[15]

B. Analysis

It appears to us that Exelon and the NRC Staff have built up and burned down a "straw man" version of NRDC's request. Despite NRDC's explanation that its motion is "not intended to litigate any issue not yet ripe for resolution"[16] and does not seek any action from the Board other than "acceptance" of its new contentions,[17] both Exelon and the NRC Staff stress that NRDC has not satisfied the Commission's contention admissibility criteria.[18] As NRDC states in its reply, "each of Exelon and Staff's arguments ignore that NRDC is not asking the Board to admit Contentions previously rejected, but simply to accept that NRDC has directed them to the DSEIS so they are preserved for further review."[19] We agree with NRDC and therefore do not analyze the admissibility of these new contentions.

Some confusion on the part of Exelon and the NRC Staff is surely understandable, though, as it is unclear what, if any, regulatory basis NRDC has for asking this Board to "accept," but not admit, new contentions. Despite this regulatory ambiguity, NRDC's intent in filing this motion is clear – it simply wishes to preserve its right to litigate these contentions

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[14] NRC Staff Answer at 2.

[15] Id. at 5.

[16] Motion at 2.

[17] Id. at 9.

[18] Exelon Answer at 12-18; NRC Staff Answer at 2-3.

[19] Reply at 6.

directed at the DSEIS should the Commission rule in its favor on the pending waiver petition. In other words, it seems that NRDC is reasonably concerned that if it had waited to submit these new contentions until after a potential ruling in its favor by the Commission on the pending waiver petition, Exelon and/or the NRC Staff would have opposed the contentions on the grounds that they are untimely – that is, that they were filed too late after the publication of the DSEIS.[20]

We believe that the NRC Staff's proposal of tolling the deadline to submit DSEIS-related contentions (or, we might add, Final SEIS-related contentions, should the NRC issue the FSEIS prior to a Commission ruling on the waiver petition) pending Commission action on the waiver petition is a reasonable approach to addressing NRDC's concerns. Indeed, NRDC states in its reply that "if the Board is not inclined to [accept the contentions], at minimum it should adopt the Staff's suggested approach."[21] Because we are unaware of any regulatory authority for licensing boards to "accept," but not admit, contentions (and indeed, because we are unaware what such "acceptance" would even entail, from an administrative perspective), we do not do so here. Rather, we will toll the deadline for NRDC to resubmit these contentions after the Commission rules on the pending waiver petition, should NRDC deem it appropriate to do so.

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[20] See Reply at 6.

[21] Id. at 2.

III. CONCLUSION

For the reasons discussed above, NRDC's motion for the Board to "accept" its new contentions is DENIED. However, consistent with the approach advanced by the NRC Staff, we hereby toll the deadline for NRDC to re-file these DSEIS-related contentions.[22] NRDC may re-submit these contentions within 30 days of the issuance of any Commission order granting the currently pending waiver petition.

It is so ORDERED.

THE ATOMIC SAFETY AND
LICENSING BOARD

/RA/

William J. Froehlich, Chairman
ADMINISTRATIVE JUDGE

/RA/

Dr. Michael F. Kennedy
ADMINISTRATIVE JUDGE

/RA/

Dr. William E. Kastenberg
ADMINISTRATIVE JUDGE

Rockville, Maryland
July 12, 2013

[22] Should the NRC issue the Limerick FSEIS prior to ruling on the waiver petition, NRDC's deadline to update these contentions to challenge the FSEIS will be tolled as well. The NRC Staff currently projects that the FSEIS will be issued in November 2013. See http://www.nrc.gov/reactors/operating/licensing/renewal/applications/limerick.html.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD

Before Administrative Judges:

William J. Froehlich, Chairman
Dr. Michael F. Kennedy
Dr. William E. Kastenberg

In the Matter of	Docket Nos. 50-352-LR, 50-353-LR
EXELON GENERATION COMPANY, LLC	ASLBP No. 12-916-04-LR-BD01
(Limerick Generating Station, Units 1 and 2)	August 6, 2013

MEMORANDUM
(Clarifying the Board's July 12, 2013 Order)

On July 12, 2013, this Board issued a brief order tolling the deadline for the Natural Resources Defense Council (NRDC) to submit certain contentions relating to the Nuclear Regulatory Commission (NRC) Staff's Draft Supplemental Environmental Impact Statement.[1] On July 22, 2013, Exelon Generation Company, LLC ("Exelon") filed a motion to clarify that order, or in the alternative, for leave to seek reconsideration of that order.[2] NRDC filed an answer in opposition to the motion on July 31, 2013.[3] The NRC Staff did not file a response to Exelon's motion.

The confusion appears to center around our use of the phrase "these contentions" in the July 12 order. In using this phrase, we intended to toll the deadline for NRDC to re-submit the contentions that are currently pending before the Commission in NRDC's waiver petition. These contentions (enumerated Contentions 1-E-1, 1-E-2, and 3-E) are reflected on page 6 of NRDC's

[1] Licensing Board Memorandum and Order (Ruling on Resubmission of Contentions) (July 12, 2013) (unpublished) [hereinafter "July 12 Order"].

[2] Exelon's Motion for Clarification or, in the Alternative, for Leave to Request Partial Reconsideration of the Board's July 12 Order (July 22, 2013) [hereinafter "Motion"].

[3] [NRDC's] Opposition to Exelon's Motion for Clarification or, in the Alternative, for Leave to Request Partial Reconsideration of the Board's July 12 Order (July 31, 2013) [hereinafter "Answer"].

May 30 motion re-submitting its contentions.[4] Because the Commission's pending decision on NRDC's waiver petition would affect these contentions only, the deadline for NRDC to re-submit these contentions is tolled. We do not toll the deadline for the remaining portions of Contention 1-E or for Contentions 2-E and 4-E because the Commission's decision on the waiver petition will have no impact on those contentions. That is, the Board's ruling on NRDC's initial petition to intervene is the final word on those contentions.[5]

Finally, we do not toll the deadline for NRDC to re-submit its Waste Confidence Decision-related contention because the Commission has ordered that the Boards hold such contentions in abeyance pending further Commission order.[6] Because we are aware of no Commission order on this subject, this contention remains in abeyance.

FOR THE ATOMIC SAFETY
AND LICENSING BOARD

/RA/

____

William J. Froehlich, Chairman
ADMINISTRATIVE JUDGE

Rockville, Maryland
August 6, 2013

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[4] [NRDC's] Resubmission of Contentions in Response to Staff's Supplemental Draft Environmental Impact Statement (May 30, 2013).

[5] See LBP-12-08, 75 NRC 529 (2012). Specifically, the Board held that "[i]n all other respects, we find Contention 1-E is inadmissible," id. at 562; Contention 2-E is "inadmissible because NRDC has not raised a dispute with Exelon's application, contravening 10 C.F.R. § 2.309(f)(1)(vi), and because it is outside the scope of this proceeding," id. at 564; and "Contention 4-E is inadmissible because it fails to provide "a concise statement of the alleged facts or expert opinions which support the petitioner's position on the issue."" Id. at 570.

[6] See Calvert Cliffs 3 Nuclear Project, LLC (Calvert Cliffs Nuclear Power Plant, Unit 3) et al., CLI-12-16, 76 NRC 63, 68-69 (2012).

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

COMMISSIONERS:

Allison M. Macfarlane, Chairman
Kristine L. Svinicki
George Apostolakis
William D. Magwood, IV
William C. Ostendorff

In the Matter of	
EXELON GENERATION COMPANY, LLC	Docket Nos. 50-352-LR & 50-353-LR
(Limerick Generating Station, Units 1 and 2)	

CLI-13-07

MEMORANDUM AND ORDER

The Licensing Board has referred to us its ruling denying Natural Resources Defense Council's (NRDC) petition to waive a provision of our regulations.[1] For the reasons set forth below, we take review of the referred ruling. We find that the Board erred in its reasoning for denying NRDC's waiver petition, but we affirm the Board's decision on a different ground.

I. BACKGROUND

Exelon Generation Company, LLC, has applied to renew its operating licenses for Limerick Generating Station, Units 1 and 2, for an additional twenty years. NRDC requested a hearing on Exelon's license renewal application, proposing four contentions.[2] Of those

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[1] LBP-13-1, 77 NRC 57 (2013).

[2] *Natural Resources Defense Council Petition to Intervene and Notice of Intention to Participate* (Nov. 22, 2011).

contentions, the Board admitted only one—a narrowed version of Contention 1-E, which claimed that Exelon's Environmental Report failed to include new and significant information relating to severe accident mitigation.[3]

Exelon and the NRC Staff appealed the Board's contention admissibility ruling.[4] Both Exelon and the Staff argued that Contention 1-E constituted a collateral attack on 10 C.F.R. § 51.53(c)(3)(ii)(L).[5] The rule exempts Exelon from including in its Environmental Report a site-specific severe accident mitigation alternatives (SAMA) analysis because the Staff previously considered severe accident mitigation design alternatives (SAMDAs) in the Final Environmental Statement supporting issuance of the Limerick operating licenses.[6] We agreed that the contention impermissibly challenged section 51.53(c)(3)(ii)(L).[7]

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[3] *See* LBP-12-8, 75 NRC 539, 561-62 (2012). NRDC's motion to admit a new waste-confidence-related contention currently is pending before the Board; the Board is holding that contention in abeyance in accordance with our direction in CLI-12-16. *See* Memorandum (Clarifying the Board's July 12, 2013 Order) (Aug. 6, 2013), at 2 (unpublished) (Board Clarification Order); Order (Suspending Procedural Date Related to Proposed Waste Confidence Contention) (Aug. 8, 2012), at 3 (unpublished) (citing *Calvert Cliffs Nuclear Project, LLC* (Calvert Cliffs Nuclear Power Plant, Unit 3), CLI-12-16, 76 NRC 63 (2012)); *NRDC's Motion for Leave to File a New Contention Concerning Temporary Storage and Ultimate Disposal of Nuclear Waste at Limerick* (July 9, 2012); *Natural Resources Defense Council's Resubmission of Contentions in Response to Staff's Supplemental Draft Environmental Impact Statement* (May 30, 2013), at 2-3 (Resubmitted Contentions).

[4] *Exelon's Notice of Appeal of LBP-12-08* (Apr. 16, 2012); *Exelon's Brief in Support of the Appeal of LBP-12-08* (Apr. 16, 2012) (Exelon Appeal); *NRC Staff's Notice of Appeal of LBP-12-08* (Apr. 16, 2012); *NRC Staff's Appeal of LBP-12-08* (Apr. 16, 2012) (Staff Appeal).

[5] *See* Exelon Appeal at 6-7; Staff Appeal at 5-6.

[6] *See generally* "Final Environmental Statement Related to the Operation of Limerick Generating Station, Units 1 and 2," NUREG-0974 Supplement (Aug. 1989) (ADAMS accession no. ML11221A204) (1989 SAMDA Analysis). The 1989 analysis considered SAMDAs, a subset of mitigation alternatives that are based on a plant's design. *See* CLI-12-19, 76 NRC 377, 382 (2012).

[7] CLI-12-19, 76 NRC at 386.

Nonetheless, in light of an apparent ambiguity in our license renewal regulations—which, on the one hand exempt Exelon and similarly-situated license renewal applicants from including a SAMA analysis in their environmental reports, but on the other hand require an applicant to identify "any new and significant information of which it is aware"—we invited NRDC to submit a petition to waive the SAMA-analysis exception.[8] We likened the regulatory conflict to other instances in our license renewal adjudications where a petitioner claimed that purported "new and significant information" called into question a "Category 1," or broadly-applicable, environmental-impact finding codified in 10 C.F.R. Part 51.[9] Challenges to Category 1 findings based on new and significant information require a waiver of 10 C.F.R. Part 51, Subpart A, Appendix B, in order to be litigated in a license renewal adjudication.[10] We held that "the exception in section 51.53(c)(3)(ii)(L) operates as the functional equivalent of a Category 1 issue, removing SAMAs from litigation in this, as well as certain other, case-by-case license

[8] *See id.* at 385-86, 388.

[9] *See id.* at 386. "Category 2" issues, on the other hand, require a site-specific analysis for the plant whose license is up for renewal. "Severe accidents" is a Category 2 site-specific issue in 10 C.F.R. Part 51, Subpart A, Appendix B. Our remand decision provides a brief discussion of Category 1 and Category 2 issues. *See* CLI-12-19, 76 NRC at 381-82. The Generic Environmental Impact Statement for License Renewal (GEIS) provides the environmental analysis that supports our "Category 1" and "Category 2" findings. *See* "Generic Environmental Impact Statement for License Renewal of Nuclear Plants—Main Report" (Final Report), NUREG-1437, Vol. 1 (May 1996) (ML040690705) (GEIS); "Generic Environmental Impact Statement for License Renewal of Nuclear Plants—Main Report" (Final Report), NUREG-1437, Rev. 1, Vol. 1 (June 2013) (ML13106A241) (GEIS Rev. 1). *See generally* Final Rule, Revisions to Environmental Review for Renewal of Nuclear Power Plant Operating Licenses, 78 Fed. Reg. 37,282 (June 20, 2013) (GEIS Revisions). In our recent revisions to the GEIS, we did not change the Category 2 status of severe accidents or the exception in 10 C.F.R. § 51.53(c)(3)(ii)(L). *See* GEIS Revisions, 78 Fed. Reg. at 37,289-90.

[10] *See Entergy Nuclear Vermont Yankee, LLC, and Entergy Nuclear Operations, Inc.* (Vermont Yankee Nuclear Power Station), CLI-07-3, 65 NRC 13, 17, 20 (2007) (Vermont Yankee/Pilgrim).

renewal adjudications."[11] Accordingly, we remanded the case to the Board for the limited purpose of permitting NRDC to file a waiver petition.[12] We included in the remand all of NRDC's SAMA-related contentions, Contentions 1-E, 2-E, and 3-E, to the extent the Board denied them as challenges to section 51.53(c)(3)(ii)(L).[13]

NRDC thereafter filed a waiver petition that again raised the issues that the Board originally had admitted in Contention 1-E, as well as an issue in Contention 3-E that the Board originally had rejected.[14] With regard to Contention 1-E, NRDC sought to litigate its claims that: (1) "Exelon has omitted from its [Environmental Report] a required analysis of new and significant information regarding potential new [SAMAs] previously considered for other [Mark II

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[11] CLI-12-19, 76 NRC at 386.

[12] *Id.* at 388.

[13] We did not include in the remand NRDC's remaining contention, Contention 4-E, which challenged the Environmental Report's discussion of the "no-action alternative," an unrelated issue. *See id.* at 388 & n.58. The Board rejected Contention 4-E as inadmissible. *See* LBP-12-8, 75 NRC at 570.

[14] *Natural Resources Defense Council's Petition, By Way of Motion, for Waiver of 10 C.F.R. § 51.53(c)(3)(ii)(L) as Applied to Application for Renewal of Licenses for Limerick Units 1 and 2* (Nov. 21, 2012) (Waiver Petition). NRDC attached two declarations in support of its waiver petition. *Declaration of Christopher J. Weaver, Ph.D., on Behalf of the Natural Resources Defense Council in Support of Motion for Waiver* (Nov. 21, 2012) (Weaver Declaration); *Declaration of Geoffrey H. Fettus, Counsel for the Natural Resources Defense Council (NRDC), Regarding Waiver of 10 C.F.R. § 51.53(c)(3)(ii)(L) as Applied to Application for Renewal of Licenses for Limerick Units 1 and 2* (Nov. 21, 2012) (Fettus Declaration).

NRDC continues to assert its disagreement with our determination in CLI-12-19 that a waiver is required. *See Natural Resources Defense Council's Brief in Support of Waiver of 10 C.F.R. § 51.53(c)(3)(ii)(L) as Applied to Application for Renewal of Licenses for Limerick Units 1 and 2* (Mar. 13, 2013), at 28 (NRDC Initial Brief); Waiver Petition at 13. To the extent that NRDC's claim is, in substance, a motion for reconsideration of our determination in CLI-12-19, its request is procedurally defective, out of time, and fails to assert compelling circumstances justifying reconsideration. *See* 10 C.F.R. § 2.323(e); *Progress Energy Carolinas, Inc.* (Shearon Harris Nuclear Power Plant, Units 2 and 3), CLI-10-9, 71 NRC 245, 252 (2010).

boiling water reactors]"; and (2) "Exelon's reliance on data from Three Mile Island . . . in its analysis of the significance of new information regarding economic cost risk constitutes an inadequate analysis of new and significant information."[15] With regard to Contention 3-E, NRDC sought to litigate the claim that Exelon must use "modern techniques for assessing whether the newly considered [SAMAs] are cost-beneficial."[16] Exelon and the Staff opposed NRDC's waiver petition, arguing that it failed to satisfy our waiver standard in 10 C.F.R. § 2.335(b).[17]

We review waiver petitions under section 2.335, as well as our case law.[18] In interpreting section 2.335, we identified four factors—often referred to as the "*Millstone* factors"—that waiver petitioners must satisfy. The Board's analysis began and ended with the first *Millstone* factor—a demonstration that applying the rule would not serve its intended purpose.[19] The Board determined that the purpose of the exception in section 51.53(c)(3)(ii)(L)

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[15] Waiver Petition at 3.

[16] *Id.*

[17] *Exelon's Response Opposing NRDC's Petition for Waiver of 10 C.F.R. § 51.53(c)(3)(ii)(L)* (Dec. 14, 2012), at 3-4 (Exelon Answer); *Exelon's Counter Affidavit Supporting Exelon's Response Opposing NRDC's Petition for Waiver of 10 C.F.R. § 51.53(c)(3)(ii)(L)* (Dec. 14, 2012) (Exelon Affidavit); *NRC Staff Answer to Natural Resources Defense Council Petition for Waiver of 10 C.F.R. § 51.53(c)(3)(ii)(L)* (Dec. 14, 2012), at 1 (Staff Answer). NRDC replied. *Reply of Natural Resources Defense Council in Support of Petition, By Way of Motion, for Waiver of 10 C.F.R. § 51.53(c)(3)(ii)(L) as Applied to Application for Renewal of Licenses for Limerick Units 1 and 2* (Dec. 21, 2012).

[18] *See generally Dominion Nuclear Connecticut, Inc.* (Millstone Nuclear Power Station, Units 2 and 3), CLI-05-24, 62 NRC 551, 559-60 & nn.29-34 (2005).

[19] *See* LBP-13-1, 77 NRC at 66; *Millstone*, CLI-05-24, 62 NRC at 560; 10 C.F.R. § 2.335(b). In denying NRDC's waiver petition, the Board declined to apply the *Millstone* test, opining that it "establishes an appreciably higher burden for . . . waiver seekers than does [section 2.335(b)]." LBP-13-1, 77 NRC at 64. According to the Board, only the first two *Millstone* factors are consistent with the requirements of section 2.335(b). *Id.* We disagree. The *Millstone* decision, which aggregates cases interpreting the waiver standard, is an example of a uniform, permissible interpretation of our regulations. *See U.S. Steel Mining Co., LLC v. Director,* (continued . . .)

"is to exempt those plants that have already performed SAMA analyses from considering [SAMAs] at license renewal."[20] The Board then reasoned that the purpose of the SAMA-analysis exception "will always be met if no further analysis is required or submitted by the applicant."[21] Based on its interpretation of the rule, the Board therefore concluded that the exception in section 51.53(c)(3)(ii)(L) is "unwaivable."[22] Accordingly, the Board denied the waiver petition. Finding our remand of the proceeding incompatible with its own finding that waiver of section 51.53(c)(3)(ii)(L) is an "impossibility," however, the Board referred to us its ruling, seeking a clarification of the interplay between section 51.53(c)(3)(ii)(L) and our waiver criteria in section 2.335(b).[23] The parties have filed initial and response briefs to offer their views on the Board's decision.[24]

(. . . continued)
OWCP, 386 F.3d 977, 985 (11th Cir. 2004). All four of the *Millstone* requirements derive from the language and purpose of section 2.335(b). Further, a licensing board may not disregard binding Commission case law. *Cf. Nat'l Fed'n of Federal Employees v. FLRA*, 412 F.3d 119 (D.C. Cir. 2005) ("[A]gencies act arbitrarily and capriciously when they 'ignore [their] own relevant precedent.'" (quoting *BB&L, Inc. v. NLRB*, 52 F.3d 366, 369 (D.C. Cir. 1995))). *Accord Calvert Cliffs 3 Nuclear Project, LLC, and UniStar Nuclear Operating Services, LLC* (Calvert Cliffs Nuclear Power Plant, Unit 3), LBP-09-4, 69 NRC 170, 184 (2009), *aff'd*, CLI-09-20, 70 NRC 911, 917-18, 924 (2009) (acknowledging that a licensing board is bound by Commission precedent; "it is for the Commission, not licensing boards, to revise its rulings").

[20] LBP-13-1, 77 NRC at 66.

[21] *Id.* (emphasis omitted).

[22] *Id.*

[23] *Id.* at 69. *See* 10 C.F.R. § 2.323(f)(1).

[24] NRDC Initial Brief; *Exelon's Initial Brief in Response to the Referral of LBP-13-1 to the Commission* (Mar. 13, 2013); *NRC Staff's Brief on the Board's Referred Ruling in LBP-13-1* (Mar. 13, 2013); *Natural Resources Defense Council's Response Brief in Support of Waiver of 10 C.F.R. § 51.53(c)(3)(ii)(L) As Applied to Application for Renewal of Licenses for Limerick Units 1 and 2* (Mar. 20, 2013); *Exelon's Reply Brief in Response to the Referral of LBP-13-1 to the Commission* (Mar. 20, 2013); *NRC Staff's Reply on the Board's Referred Ruling in LBP-13-1* (Mar. 20, 2013). *See generally Unopposed Motion Requesting Briefing* (Feb. 19, 2013); Order (continued . . .)

As discussed below, we take review of the Board's referred ruling, and find that the Board erred in concluding that it is impossible to waive the exception in section 51.53(c)(3)(ii)(L). Nevertheless, we affirm, on different grounds, the Board's denial of the waiver petition.

II. DISCUSSION

Although we disfavor piecemeal review of licensing board decisions, boards may refer rulings that, although interlocutory, raise "significant and novel legal or policy issues" or require our "resolution . . . to materially advance the orderly disposition of the proceeding."[25] We find that the Board has raised a significant and novel issue that warrants our attention. The Board's referral questions the applicability of one of our basic rules of practice, and it could have broad-reaching implications in future license renewal proceedings.[26] We therefore take review of the Board's referred ruling. We begin with an overview of our waiver criteria in section 2.335(b).

Section 2.335(b) provides a limited exception to our general prohibition against challenges to NRC rules or regulations in adjudicatory proceedings.[27] To litigate an issue that

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(. . . continued)
(Feb. 26, 2013) (unpublished) (granting unopposed motion requesting briefing and setting briefing schedule).

[25] 10 C.F.R. § 2.341(f)(1). We revised Part 2 of our rules of practice last year, including section 2.341(f)(1). Prior to the rule revision, section 2.341(f)(1) required that the referred ruling raise a "significant and novel legal or policy issue" *and* necessitate "resolution . . . to materially advance the orderly disposition of the proceeding." Amendments to Adjudicatory Process Rules and Related Requirements, 77 Fed. Reg. 46,562, 46,576 (Aug. 3, 2012). *See also Pacific Gas and Electric Co.* (Diablo Canyon Nuclear Power Plant, Units 1 and 2), CLI-12-13, 75 NRC 681, 686 (2012).

[26] For example, the provision in section 51.53(c)(3)(ii)(L) could come into play in a proceeding on an application for a second license renewal term under 10 C.F.R. § 54.31(d), or for the renewal of a license issued under 10 C.F.R. Part 52. Staff Answer at 35. *See infra* note 83 and accompanying text.

[27] *Compare* 10 C.F.R. § 2.335(b), *with id.* § 2.335(a).

otherwise would be outside the scope of an adjudication, a petitioner must file a petition for waiver showing that "special circumstances with respect to the subject matter of the particular proceeding are such that the application of the rule or regulation (or a provision of it) would not serve the purposes for which . . . [it] was adopted."[28] The waiver petitioner must include an affidavit that states "with particularity" the special circumstances that justify waiver of the rule.[29]

Our waiver standard is stringent by design. The NRC has discretion to transact its business broadly, through rulemaking, or case-by-case, through adjudication.[30] When we engage in rulemaking, we are "carving out"[31] issues from adjudication for generic resolution.[32] Therefore, to challenge the generic application of a rule, a petitioner seeking waiver must show that there is something extraordinary about the subject matter of the proceeding such that the rule should not apply.[33]

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[28] *Id.* § 2.335(b).

[29] *Id.*

[30] *See Balt. Gas & Electric Co. v. Natural Res. Def. Council*, 462 U.S. 87, 101 (1983).

[31] *Public Service Co. of New Hampshire* (Seabrook Station, Units 1 and 2), CLI-88-10, 28 NRC 573, 596 (1988).

[32] *See* Restructuring of Facility License Application Review and Hearing Processes, 37 Fed. Reg. 15,127, 15,129 (July 28, 1972) (Waiver Standard) (creating general prohibition on challenges to NRC rules and regulations with limited exceptions "[i]n view of the expanding opportunities for participation in Commission rulemaking proceedings and increased emphasis on rulemaking proceedings as the appropriate forum for settling basic policy issues"). *Accord Duke Energy Corp.* (Oconee Nuclear Station, Units 1, 2, and 3), CLI-99-11, 49 NRC 328, 345 (1999); *Potomac Electric Power Co.* (Douglas Point Nuclear Generating Station, Units 1 and 2), ALAB-218, 8 AEC 79, 85 (1974).

[33] *See* 10 C.F.R. § 2.335(b). *See also, e.g.*, *Entergy Nuclear Generation Co. and Entergy Nuclear Operations, Inc.* (Pilgrim Nuclear Power Station), CLI-12-6, 75 NRC 352, 364-65 (2012); *Seabrook*, CLI-88-10, 28 NRC at 596.

The waiver standard in section 2.335(b) has remained virtually unchanged since its codification in 1972.[34] Since that time, our case law has given meaning to the "special circumstances" requirement.[35] In 2005, in the *Millstone* license renewal proceeding, we compiled the waiver case law to reflect the four-part test that we have long used.[36] To set aside a Commission rule or regulation in an adjudicatory proceeding, a petitioner must demonstrate that:

(i) the rule's strict application would not serve the purposes for which it was adopted;

(ii) special circumstances exist that were not considered, either explicitly or by necessary implication, in the rulemaking proceeding leading to the rule sought to be waived;

(iii) those circumstances are unique to the facility rather than common to a large class of facilities; and

(iv) waiver of the regulation is necessary to reach a significant safety problem.[37]

All four *Millstone* factors must be met to justify a rule waiver.[38] The waiver petitioner faces a

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[34] *See* Waiver Standard, 37 Fed. Reg. at 15,136 (adding then-section 2.758 to permit waiver of a Commission rule or regulation in special circumstances); Changes to Adjudicatory Process, 69 Fed. Reg. 2182, 2224 (Jan. 14, 2004) (Part 2 Amendments) (moving section 2.758 to section 2.335 without substantive change).

[35] *See, e.g.*, *Public Service Co. of New Hampshire* (Seabrook Station, Units 1 and 2), CLI-89-20, 30 NRC 231, 235 (1989); *Seabrook*, CLI-88-10, 28 NRC at 596-97; *Metropolitan Edison Co.* (Three Mile Island Nuclear Station, Unit 1), CLI-80-16, 11 NRC 674, 675 (1980).

[36] *See Millstone*, CLI-05-24, 62 NRC at 559-60. We issued *Millstone* over a year after a major restructuring of our 10 C.F.R. Part 2 rules of practice, thus demonstrating the continued applicability of our waiver case law. *See* Part 2 Amendments, 69 Fed. Reg. at 2182.

[37] *Millstone*, CLI-05-24, 62 NRC at 559-60.

[38] *See id.* at 560.

substantial burden,[39] but not an impossible one.

The *Millstone* factors are derived from the language and purpose of section 2.335. The first two factors, as the Board observed, closely track the plain language of section 2.335(b).[40] The second two factors interpret section 2.335(b) in accordance with the provision's underlying purpose.

A showing of "uniqueness," the third *Millstone* factor, is necessary to justify our setting aside that regulation for the purposes of a specific proceeding.[41] This reflects our view that, in general, challenges to regulations are best evaluated through generic means.[42] Only where a particular challenge to a regulation rests on issues that are legitimately unique to the proceeding and do not imply broader concerns about the rule's general viability or appropriateness would it make sense to resolve the matter through site-specific adjudication. To be sure, if an issue were "common to a large class of facilities," then it would be appropriate for us to address the issue through rulemaking. And in view of the fact that we will not set aside a duly-promulgated regulation lightly, the fourth *Millstone* factor requires a showing that the requested waiver is

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[39] *Cf. Long Island Lighting Co.* (Shoreham Nuclear Power Station), CLI-85-1, 21 NRC 275, 280 (1985) (Separate Views of Commissioner Asselstine).

[40] LBP-13-1, 77 NRC at 64. *See* 10 C.F.R. § 2.335(b) ("The sole ground for petition of waiver or exception is that special circumstances with respect to the subject matter of the particular proceeding are such that the application of the rule or regulation (or a provision of it) would not serve the purposes for which the rule or regulation was adopted.").

[41] *See Seabrook*, CLI-88-10, 28 NRC at 597-98.

[42] If a petitioner's challenge to an agency rule or regulation relates to an issue of broader significance, then filing a petition for rulemaking under 10 C.F.R. § 2.802 is the better approach. *See* 10 C.F.R. § 2.802(a) ("Any interested person may petition the Commission to issue, amend or rescind any regulation."). *See also* Waiver Standard, 37 Fed. Reg. at 15,129; *Pilgrim*, CLI-12-6, 75 NRC at 364-65; *Vermont Yankee/Pilgrim*, CLI-07-3, 65 NRC at 20-21.

necessary to address an issue of some significance. The rationale that we provided over twenty years ago holds true today: our "agenda is crowded with significant regulatory matters . . . . It would not be consistent with [our] statutorily mandated responsibilities to spend time and resources on matters that are of no substantive regulatory significance."[43]

The underlying issue in *Millstone* related to safety, as did the issue in the *Seabrook* proceeding referenced therein.[44] Since our decision in *Millstone*, we have not stated expressly whether "significance" would apply to an environmental question, but we have implied in other cases, including this one, that a waiver could be obtained for an environmental contention as well.[45] We clarify now that the fourth *Millstone* factor also may apply to a significant environmental issue.

A. The Referred Ruling

Here, presented with the perceived "impossibility" of finding a prima facie case for waiver, the Board referred to us the Board's denial of NRDC's waiver petition, asking us to explain the interplay between 10 C.F.R. § 51.53(c)(3)(ii)(L) and 10 C.F.R. § 2.335(b).[46] The Board focused on the language of section 51.53(c)(3)(ii)(L) and determined that the purpose of the provision is to exempt license renewal applicants from considering SAMAs if they have been

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[43] *Seabrook*, CLI-88-10, 28 NRC at 597.

[44] *See Millstone*, CLI-05-24, 62 NRC at 555 (emergency planning); *Seabrook*, CLI-88-10, 28 NRC at 600 (financial qualifications).

[45] *See, e.g.*, CLI-12-19, 76 NRC at 388; *Pilgrim*, CLI-12-6, 75 NRC at 365. Although we need not reach the fourth *Millstone* factor today (as discussed *infra*), we provide clarification on this point to reinforce that waiver of a rule pertaining to the agency's environmental responsibilities is possible.

[46] LBP-13-1, 77 NRC at 69.

considered already.[47] The source of the Board's confusion is its notion of the purpose of the exception in section 51.53(c)(3)(ii)(L).[48] Exempting certain applicants from providing a SAMA analysis at the license renewal stage is certainly the intended effect of the rule, but the rule's underlying purpose is more complex than that. Rather than assuming that a rule's purpose is simply to achieve its stated effect, one must "look further."[49]

Like all of our environmental regulations in 10 C.F.R. Part 51, section 51.53(c)(3)(ii)(L) is aimed at satisfying the NRC's obligations under the National Environmental Policy Act (NEPA).[50] NEPA requires the NRC to prepare a "detailed statement," i.e., an environmental impact statement (EIS), discussing the environmental impacts, alternatives, and mitigation measures for any "major Federal action[] significantly affecting the quality of the human environment."[51] To assist us in the preparation of a supplemental EIS, we require license renewal applicants to prepare an environmental report.[52] Among other Part 51 provisions, section 51.53(c)(3)(ii) describes the types of information that an environmental report must

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[47] *Id.* at 66.

[48] *See id.* at 69.

[49] *Seabrook*, CLI-88-10, 28 NRC at 599. The *Seabrook* case is instructive. In *Seabrook*, we recognized that a superficial reading of the rule sought to be waived—there, a rule that exempted electric utilities from a financial qualifications review at the operating license stage—would lead to a waiver "impossibility" result. *See id*. We explained that "[t]he purpose of the . . . rule sought to be waived is elimination of case-by-case financial qualifications reviews. If we go no further than the . . . rule, no waiver could ever be granted because any waiver, by its nature, would defeat rather than advance the rule's purpose." *Id.* (emphasis omitted). Recognizing that waivers were "clearly contemplated," we reasoned that we must look further than the rule language, by examining "the underlying purpose of the requirement that there be a financial qualifications review." *Id.* at 599-600 (emphasis omitted).

[50] *See* 10 C.F.R. § 51.10.

[51] NEPA § 102(2)(C), 42 U.S.C. § 4332(2)(C).

[52] *See* 10 C.F.R. §§ 51.41, 51.45(a), 51.95(c).

contain.[53] Section 51.53(c)(3)(ii)(L), in particular, requires that an environmental report include a discussion of SAMAs if the NRC has not considered them previously for the applicant's plant.[54] As we explained in the Statements of Consideration adopting section 51.53(c)(3)(ii)(L), we did not require license renewal applicants for whom SAMAs were considered previously to provide a supplemental SAMA analysis because we determined that one SAMA analysis would uncover most cost-beneficial measures to mitigate both the risk and the effects of severe accidents, thus satisfying our obligations under NEPA.[55] Putting all of this together, the purpose of the supplemental-SAMA-analysis exception in section 51.53(c)(3)(ii)(L), then, is to reflect our view that one SAMA analysis, as a general matter, satisfies our NEPA obligation to consider measures to mitigate both the risk and the environmental impacts of severe accidents.

That said, even at that time, we did not foreclose the possibility that cost-beneficial mitigation measures might be identified in future license-application reviews.[56] Indeed, we acknowledged that we are required under NEPA to consider new and significant information in our environmental analyses.[57] Therefore, when promulgating the final Part 51 rule, we included section 51.53(c)(3)(iv), which requires a license renewal applicant to identify in its environmental

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[53] *Id.* § 51.53(c)(3)(ii). *See generally id.* §§ 51.45(a), 51.53.

[54] *Id.* § 51.53(c)(3)(ii)(L).

[55] *See* Final Rule, Environmental Review for Renewal of Nuclear Power Plant Operating Licenses, 61 Fed. Reg. 28,467, 28,481 (June 5, 1996) (Part 51 Amendments) ("The Commission believes it unlikely that any site-specific consideration of [SAMAs] for license renewal will identify major plant design changes or modifications that will prove to be cost-beneficial for reducing severe accident frequency or consequences.").

[56] *See id.* (noting possible cost-beneficial "procedural and programmatic fixes").

[57] *Id.* at 28,468. *See Marsh v. Or. Natural Res. Council*, 490 U.S. 360, 373-74 (1989).

report any "new and significant information of which the applicant is aware" to assist in the preparation of our own new-and-significant-information analysis.[58]

"New and significant information" related to SAMAs could undermine the purpose of the exception in section 51.53(c)(3)(ii)(L). If new and significant information is available, then the original SAMA analysis may be inadequate to satisfy NEPA at the license renewal stage, and may require supplementation.[59] Our rules provide a mechanism for supplementing an original NEPA analysis.[60] But our rules do not guarantee a hearing;[61] nor is a hearing necessary to satisfy our NEPA obligations.[62]

As we explained in CLI-12-19, if a petitioner wishes to litigate the adequacy of a previously-conducted SAMA analysis in a license renewal adjudication, a waiver of section 51.53(c)(3)(ii)(L) would be required. The environmental analysis of severe accidents is designated as a "Category 2" site-specific issue for license renewal, and therefore the SAMA

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[58] *See* 10 C.F.R. § 51.95(c)(4); Part 51 Amendments, 61 Fed. Reg. at 28,468, 28,488.

[59] *See Marsh*, 490 U.S. at 374 ("If there remains 'major Federal actio[n]' to occur, and if the new information is sufficient to show that the remaining action will 'affec[t] the quality of the human environment' in a significant manner or to a significant extent not already considered, a supplemental EIS must be prepared." (alterations in original)). As we stated earlier in this case, "[w]e would expect that, if the Staff had in hand new information that could render invalid the original site-specific analysis, then such information should be identified and evaluated by the Staff for its significance, consistent with our NEPA requirements." CLI-12-19, 76 NRC at 386-87 n.54.

[60] *See, e.g.*, 10 C.F.R. §§ 51.73, 51.95(c)(3), (c)(4).

[61] *See, e.g.*, *id.* §§ 2.309(f)(1), 2.335(b).

[62] *See Blue Ridge Environmental Defense League v. NRC*, 716 F.3d 183, 196 (D.C. Cir. 2013) (deferring to NRC's decision not to admit petitioners' NEPA contentions for hearing where NRC found the contentions did not satisfy 10 C.F.R. Part 2 contention admissibility requirements). *See also Massachusetts v. NRC*, 708 F.3d 63, 78 (1st Cir. 2013); *Vermont Yankee/Pilgrim*, CLI-07-3, 65 NRC at 22.

analysis normally is subject to challenge in a license renewal adjudicatory proceeding.[63] Thus, as a general matter, a petitioner may raise a SAMA-related contention in a license renewal adjudication if it satisfies our general contention admissibility criteria in section 2.309(f)(1).[64] In CLI-12-19, however, we explained that the exception in section 51.53(c)(3)(ii)(L) operates as the "functional equivalent" of a Category 1 designation "[f]or Limerick and similarly-situated plants for which SAMAs were already considered in an Environmental Impact Statement or Environmental Assessment."[65] For Limerick and certain other plants, "the SAMA issue has been resolved by rule," which means that the issue has been carved out from adjudication.[66] Consequently, to litigate a SAMA-related contention in this, as well as other adjudicatory proceedings where the SAMA-analysis exception applies, a petitioner must obtain a waiver by satisfying the requirements in section 2.335(b), in addition to satisfying the contention admissibility criteria in section 2.309(f)(1).[67] Alternatively, a petitioner may submit to the Staff any information that it believes to be new and significant by participating in our parallel NEPA

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[63] *See* 10 C.F.R. § 51.53(c)(3)(ii)(L); 10 C.F.R. pt. 51, subpt. A, app. B; CLI-12-19, 76 NRC at 386. *See, e.g.*, *Entergy Nuclear Generation Co. and Entergy Nuclear Operations, Inc.* (Pilgrim Nuclear Power Station), CLI-12-1, 75 NRC 39 (2012).

[64] *See, e.g.*, *FirstEnergy Nuclear Operating Co.* (Davis-Besse Nuclear Power Station, Unit 1), CLI-12-8, 75 NRC 393, 406-18 (2012); *NextEra Energy Seabrook, LLC* (Seabrook Station, Unit 1), CLI-12-5, 75 NRC 301, 322-37 (2012).

[65] CLI-12-19, 76 NRC at 386.

[66] *Id.* License renewal applicants whose facilities qualify for the SAMA-analysis exception are exempt from addressing severe accident mitigation in their environmental reports, just as they would be exempt from addressing Category 1 issues. *Compare* 10 C.F.R. § 51.53(c)(3)(i), *with id.* § 51.53(c)(3)(ii)(L).

[67] CLI-12-19, 76 NRC at 386.

process. Among other things, the Staff provides an opportunity for public comment on the draft supplemental EIS.[68]

The operation of the SAMA-analysis exception here is analogous to the Board's example of the waiver process relative to bird collisions with cooling towers,[69] which is analyzed in the license renewal Generic Environmental Impact Statement (GEIS) and designated as a "Category 1" issue.[70] As the Board observed, we determined that bird collisions "'have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.'"[71] Because this issue has been designated Category 1, it reflects the NRC's expectation that our NEPA obligations have been satisfied with reference to

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[68] *See* 10 C.F.R. §§ 51.73, 51.74. On April 30, 2013, the Staff published the Limerick draft supplemental EIS for public comment. "Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants Regarding Limerick Generating Station, Units 1 and 2" (Draft Report for Comment), NUREG-1437, Supplement 49 (Apr. 30, 2013) (ML13120A078) (Limerick Draft SEIS). Thereafter, NRDC re-filed all four of its original contentions, as well as its pending waste confidence contention, *see supra* note 3, to apply them to the draft supplemental EIS, and to preserve its "rights to appeal either by a timely motion for reconsideration or to the Commission or an appellate court." Resubmitted Contentions at 2. In addition, NRDC filed comments on the draft supplemental EIS. *See* Fettus, Geoffrey H., et al., Natural Resources Defense Council, Letter to Cindy Bladey, NRC (June 27, 2013) (ML13189A129). The Board tolled the time for NRDC to resubmit the contentions associated with its waiver request until we issued a decision addressing the Board's referred ruling in LBP-13-1, but denied NRDC's request to resubmit its remaining contentions. *See* Memorandum and Order (Ruling on Resubmission of Contentions) (July 12, 2013), at 1 (unpublished); Board Clarification Order at 1-2. (The Board continues to hold the waste confidence contention in abeyance. *See supra* note 3.) Our decision today renders moot the need to toll the deadline for resubmitting the contentions associated with NRDC's waiver petition.

[69] *See* LBP-13-1, 77 NRC at 67.

[70] *See* GEIS at 4-45 to 4-48; GEIS Rev. 1, at 4-70 to 4-74.

[71] LBP-13-1, 77 NRC at 67 (quoting 10 C.F.R. pt. 51, subpt. A, app. B, tbl. B-1)). *See also* GEIS Revisions, 78 Fed. Reg. at 37,320 ("Bird collisions with cooling towers and other plant structures and transmission lines occur at rates that are unlikely to affect local or migratory populations and the rates are not expected to change.").

our previously-conducted environmental analysis in the GEIS.[72] And because it is a Category 1 issue, a license renewal applicant need not address bird collisions in its environmental report unless it is aware of relevant new and significant information.[73]

Continuing with the Board's example, if new and significant information showed that "changes in the migratory habits of a certain bird . . . led to a large number of collisions with the cooling towers at a specific plant," then "a petitioner might well be able to satisfy . . . [our waiver criteria] and, therefore, challenge [an] applicant's lack of consideration of bird collisions with cooling towers" in a license renewal adjudicatory proceeding.[74] In other words, the petitioner must show that new and significant information, unique to a particular plant, exists with regard to bird collisions, such that the Category 1 finding in 10 C.F.R. Part 51, Subpart A, Appendix B should be waived to litigate the issue in a site-specific proceeding. Likewise, the focus in this case is whether there is new and significant information, unique to Limerick, pertaining to the 1989 SAMDA analysis for Limerick's original operating licenses, such that the exception in section 51.53(c)(3)(ii)(L) should be waived to litigate NRDC's claims in this proceeding.[75]

B. NRDC's Waiver Petition

With this framework in mind, we turn to NRDC's waiver petition. As discussed above, NRDC raised three challenges to Exelon's Environmental Report, claiming that Exelon (and,

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[72] *See* GEIS at 1-7 to 1-11, 4-45 to 4-48; GEIS Rev. 1, at 1-16 to 1-19, 4-70 to 4-74.

[73] *See* 10 C.F.R. §§ 51.53(c)(3)(i), 51.53(c)(3)(iv). But even then, a waiver would be necessary to litigate the issue of potentially new and significant information pertaining to bird collisions in an adjudicatory proceeding. *See Vermont Yankee/Pilgrim*, CLI-07-3, 65 NRC at 20-21.

[74] LBP-13-1, 77 NRC at 67.

[75] *See* CLI-12-19, 76 NRC at 386-87. *See generally* 1989 SAMDA Analysis.

ultimately, the NRC in the supplemental EIS)[76] must: (1) consider potential new SAMAs that have been considered for other Mark II boiling water reactors; (2) use economic cost information specific to Limerick, rather than Three Mile Island; and (3) use "modern techniques for assessing whether the newly considered [SAMAs] are cost-beneficial."[77]

Exelon and the Staff argued that NRDC's waiver petition failed to meet any of the four *Millstone* factors.[78] Based on our review of NRDC's petition, we find that a waiver is not warranted here. We agree with Exelon and the Staff that NRDC has not shown that the issues it raises are unique to Limerick.[79]

NRDC's witnesses, Dr. Weaver and Mr. Fettus, claimed that Limerick is unique because it will be the only boiling water reactor not to update its SAMA analysis with the potentially new and significant information that NRDC identifies.[80] But at bottom, NRDC's challenge to Exelon's Environmental Report amounts to a general claim that could apply to any license renewal applicant for whom SAMAs already were considered. Due to the nature of the rule, twenty or more years may pass between an original SAMA analysis and the submission of a license

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[76] *See* 10 C.F.R. § 2.309(f)(2) ("On issues arising under the National Environmental Policy Act, participants shall file contentions based on the applicant's environmental report.").

[77] Waiver Petition at 3 & n.3. *See also* Fettus Declaration; Weaver Declaration. Exelon asserts that the Weaver Declaration is deficient because it is a revised version of the declaration that NRDC submitted with its hearing request that is signed only by Dr. Weaver, and therefore apparently lacks the approval of two of its original signatories. *See* Exelon Answer at 43. We need not address that issue. As discussed below, viewing NRDC's waiver petition and supporting documentation in the light most favorable to NRDC, we find that NRDC has not shown that a waiver is appropriate here.

[78] Exelon Answer at 3-4; Staff Answer at 1.

[79] Because NRDC's claims fail to satisfy the "uniqueness" factor, we need not, and do not, reach the other *Millstone* factors in today's decision.

[80] *See* Fettus Declaration ¶ 4; Weaver Declaration ¶ 9.

renewal application for most, if not all applicants that qualify for the SAMA-analysis exception in section 51.53(c)(3)(ii)(L).[81] For example, if the licensees for Comanche Peak Units 1 and 2, and Watts Bar Unit 1—whose plants also qualify for the SAMA-analysis exception—apply to renew their operating licenses, they may face the same criticism: essentially, that the passage of time between original licensing and renewal has rendered their SAMA analysis out-of-date.[82] Similarly, plants for which a SAMA analysis was conducted for the first time under section 51.53(c)(3)(ii)(L) may face this general criticism upon application for a subsequent renewal term.[83] As the Staff points out, waiver of the provision in section 51.53(c)(3)(ii)(L) based on NRDC's proffered new information alone would create an exception to litigate SAMAs in the

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[81] In other words, this time frame is inherent in our regulatory scheme, which provides for a forty-year license term, with the possibility of license renewal for an additional twenty-year period. *See, e.g.*, 10 C.F.R. §§ 2.109(b), 50.51(a), 54.17(c). The earliest a license renewal application may be submitted is twenty years before the expiration date of the operating license in effect. *Id.* § 54.17(c).

[82] *See* Part 51 Amendments, 61 Fed. Reg. at 28,481 ("NRC staff considerations of [SAMAs] have already been completed and included in an EIS or supplemental EIS for Limerick, Comanche Peak, and Watts Bar. Therefore, [SAMAs] need not be reconsidered for these plants for license renewal."). Although Comanche Peak Units 1 and 2 and Watts Bar Unit 1 are not boiling water reactors, additional SAMAs have been considered for other license renewal applications since they received their operating licenses. In addition, Comanche Peak and Watts Bar received their operating licenses prior to the release of the MACCS2 code. *See* Staff Answer at 29-30; Exelon Answer at 35. As we explained in the Statements of Consideration regarding section 51.53(c)(3)(ii)(L), we did not mandate a specific approach to SAMA analyses; instead, we stated that we would review "each severe accident mitigation consideration provided by a license renewal applicant on its merits and determine whether it constitutes a reasonable consideration of [SAMAs]." Part 51 Amendments, 61 Fed. Reg. at 28,481-82.

[83] *See* 10 C.F.R. § 54.31(d). This also could be the case for new plants licensed under 10 C.F.R. Part 52. *See, e.g.*, *South Carolina Electric & Gas Co. and South Carolina Public Service Authority (also referred to as Santee Cooper)* (Virgil C. Summer Nuclear Station, Units 2 and 3), CLI-12-9, 75 NRC 421 (2012); *Southern Nuclear Operating Co.* (Vogtle Electric Generating Plant, Units 3 and 4), CLI-12-2, 75 NRC 63 (2012).

Limerick proceeding that would "necessarily swallow the rule in [section] 51.53(c)(3)(ii)(L)."[84] Accordingly, "[t]he rulemaking process, as opposed to a site-specific licensing proceeding, is the appropriate venue for such a far-reaching challenge."[85]

That is not to say that a challenge based on new and significant information cannot overcome the "uniqueness" factor of our waiver standard. Here, however, NRDC offers little to show how the information it provides sets Limerick apart from other plants undergoing license renewal whose previous SAMA analyses purportedly also would be in need of updating. For example, some of NRDC's proposed SAMAs could be used for any boiling water reactor, not just those with Mark II containments.[86] And NRDC's argument that a new SAMA analysis should be performed because a newer methodology is available could apply to two other plants now (Comanche Peak and Watts Bar),[87] and presumably to other plants in the future whenever further developments occur regarding other methods of SAMA analysis.

Additionally, with regard to economic cost, NRDC provides data that is specific to Limerick and the surrounding area, but fails to make a sufficient connection between this data and the 1989 SAMDA analysis for Limerick.[88] Instead, Dr. Weaver concludes, without support, that "[n]ew information pertaining to economic risk could plausibly cause materially different results in the assessment of impacts of an accident at Limerick, and materially different cost-

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[84] Staff Answer at 35. *See also id.* at 27.

[85] *Id.* at 35.

[86] *See* Exelon Answer at 34; Exelon Affidavit ¶ 31, tbl. A.

[87] *See* Exelon Answer at 35.

[88] *See* Weaver Declaration ¶¶ 14-24.

benefit results in a new SAMA analysis for Limerick."[89] Similarly, Dr. Weaver asserts, without more, that use of the MACCS2 code or similar methodology would be "specific" to Limerick, and could show that additional mitigation alternatives are cost-beneficial.[90] In other words, NRDC offers new information, but makes no attempt, other than concluding that a change in the SAMA analysis is "plausible," to discuss its potential significance to Limerick.[91] To litigate SAMA-related issues in an adjudicatory proceeding, however, we require the demonstration of "a potentially significant deficiency" in the SAMA analysis—"that is, a deficiency that credibly could render the SAMA analysis unreasonable under NEPA standards."[92] Otherwise, "[i]t always will be possible to conceive of yet another input or methodology that could have been used in the SAMA computer modeling, and many different inputs and approaches may all be reasonable choices."[93] Given that similar updated information could be used for other plants that qualify for the SAMA-analysis exception, there is nothing unique about the information that NRDC identifies to justify waiving the rule for this particular adjudicatory proceeding.

We therefore find that NRDC has not shown that a waiver of section 51.53(c)(3)(ii)(L) is appropriate here. Fundamentally, NRDC claims that the SAMA analysis must be redone due to the passage of time between initial licensing and Exelon's submittal of its license renewal

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[89] *Id.* ¶ 17.

[90] *Id.* ¶ 4, 9, 13.

[91] *See id.* ¶ 17.

[92] *Pilgrim*, CLI-12-1, 75 NRC at 57 (emphasis omitted).

[93] *Id. See also Seabrook*, CLI-12-5, 75 NRC at 323 ("'[T]he proper question is not whether there are plausible alternative choices for use in the analysis, but whether the analysis that was done is reasonable under NEPA. We have long held that contentions admitted for litigation must point to a deficiency in the application, and not merely 'suggestions' of other ways an analysis could have been done, or other details that could have been included.").

application. If our waiver standard is to operate as intended, we decline to set aside the rule based merely on a claim of new and significant information, without the support necessary to show that it is unique to Limerick.[94] For these reasons, we deny NRDC's waiver request.

Nonetheless, we recognize the NRC's continuing duty to take a "hard look" at new and significant information for each "major federal action" to be taken.[95] The issues that NRDC raises are not appropriate for litigation in a site-specific proceeding due to NRDC's failure to demonstrate the need for a rule waiver. We find, however, that NRDC has identified information that bears consideration in our environmental review of Exelon's application outside of the adjudicatory process.[96] Therefore, we refer NRDC's waiver petition to the Staff as additional comments[97] on the Limerick draft supplemental EIS for the Staff's consideration and response.[98]

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[94] *Cf. Vermont Yankee/Pilgrim*, CLI-07-3, 65 NRC at 21 ("Adjudicating Category 1 issues site by site based merely on a claim of 'new and significant information,' would defeat the purpose of resolving generic issues in a GEIS.").

[95] *See Marsh*, 490 U.S. at 374.

[96] We disagree with NRDC's assertion, *see* Waiver Petition at 15, that obtaining a waiver and litigating a previously-considered environmental issue is the only way to consider new and potentially significant information regarding that issue. *See* CLI-12-19, 76 NRC at 387 (noting NRDC's option to participate outside of the adjudication by submitting comments on the draft supplemental EIS); Part 51 Amendments, 61 Fed. Reg. at 28,470 (noting that the NRC will consider all comments on the draft supplemental EIS "regardless of whether the comment is directed to impacts in Category 1 or 2"). *Accord Massachusetts*, 708 F.3d at 74.

[97] *See supra* note 68.

[98] *Cf. Tennessee Valley Authority* (Watts Bar Nuclear Plant, Unit 2), CLI-10-29, 72 NRC 556, 563 (2010) (directing the Staff to consider new information regarding need for power and alternative sources of energy).

We expect that the Staff will incorporate any new SAMA-related information that it finds to be significant in the final supplemental EIS.[99]

III. CONCLUSION

For the reasons set forth above, we *review* the Board's referred ruling, and *find* that the Board erred in interpreting the purpose of the SAMA-analysis exception in 10 C.F.R. § 51.53(c)(3)(ii)(L). We *affirm* the Board's denial of NRDC's waiver petition because NRDC has not shown that the issues it seeks to litigate are unique to Limerick and thereby justify waiver of the rule to permit litigation in this adjudicatory proceeding. Without a waiver, NRDC's SAMA-related contentions impermissibly challenge section 51.53(c)(3)(ii)(L). Nevertheless, we *direct* the Staff to review the significance of any new SAMA-related information in its environmental review of Exelon's license renewal application, including the information presented in NRDC's waiver petition, and to discuss its review in the final supplemental EIS.

IT IS SO ORDERED.

For the Commission

NRC SEAL

/RA/

Annette L. Vietti-Cook
Secretary of the Commission

Dated at Rockville, Maryland,
this 31st day of October, 2013.

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[99] *See Marsh*, 490 U.S. at 374; *Warm Springs Dam Task Force v. Gribble*, 621 F.2d 1017, 1024 (9th Cir. 1980). *See also Watts Bar*, CLI-10-29, 72 NRC at 563; Part 51 Amendments, 61 Fed. Reg. at 28,470. In the Limerick draft supplemental EIS, the Staff already has considered some new information beyond what Exelon included in its Environmental Report, including whether to incorporate potentially cost-beneficial SAMAs identified at other plants, as well as the practicality of using state-of-the-art SAMA methodology. *See* Limerick Draft SEIS at 5-7, 5-11 to 5-13.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

COMMISSIONERS:

Allison M. Macfarlane, Chairman
Kristine L. Svinicki
William D. Magwood, IV
William C. Ostendorff

In the Matter of	
CALVERT CLIFFS 3 NUCLEAR PROJECT, LLC, and UNISTAR NUCLEAR OPERATING SERVICES, LLC (Calvert Cliffs Nuclear Power Plant, Unit 3)	Docket No. 52-016-COL
DTE ELECTRIC CO. (Fermi Nuclear Power Plant, Unit 3)	Docket No. 52-033-COL
DUKE ENERGY CAROLINAS, LLC (William States Lee III Nuclear Station, Units 1 and 2)	Docket Nos. 52-018-COL, 52-019-COL
ENTERGY NUCLEAR OPERATIONS, INC. (Indian Point Nuclear Generating Units 2 and 3)	Docket Nos. 50-247-LR, 50-286-LR
ENTERGY OPERATIONS, INC. (Grand Gulf Nuclear Station, Unit 1)	Docket No. 50-416-LR
ENTERGY OPERATIONS, INC. (Grand Gulf Nuclear Station, Unit 3)	Docket No. 52-024-COL
EXELON GENERATION CO., LLC (Limerick Generating Station, Units 1 and 2)	Docket Nos. 50-352-LR, 50-353-LR
FIRSTENERGY NUCLEAR OPERATING CO. (Davis-Besse Nuclear Power Station, Unit 1)	Docket No. 50-346-LR
FLORIDA POWER & LIGHT CO. (Turkey Point Units 6 and 7)	Docket Nos. 52-040-COL, 52-041-COL
LUMINANT GENERATION CO. LLC (Comanche Peak Nuclear Power Plant, Units 3 and 4)	Docket Nos. 52-034-COL, 52-035-COL
NEXTERA ENERGY SEABROOK, LLC (Seabrook Station, Unit 1)	Docket No. 50-443-LR

NORTHERN STATES POWER CO. (Prairie Island Nuclear Generating Plant Independent Spent Fuel Storage Installation)	)	Docket No. 72-10-ISFSI
NUCLEAR INNOVATION NORTH AMERICA LLC (South Texas Project Units 3 and 4)	)	Docket Nos. 52-012-COL, 52-013-COL
PACIFIC GAS & ELECTRIC CO. (Diablo Canyon Nuclear Power Plant, Units 1 and 2)	)	Docket Nos. 50-275-LR, 50-323-LR
PPL BELL BEND, LLC (Bell Bend Nuclear Power Plant)	)	Docket No. 52-039-COL
PROGRESS ENERGY CAROLINAS, INC. (Shearon Harris Nuclear Power Plant, Units 2 and 3)	)	Docket Nos. 52-022-COL, 52-023-COL
PROGRESS ENERGY FLORIDA, INC. (Levy County Nuclear Power Plant, Units 1 and 2)	)	Docket Nos. 52-029-COL, 52-030-COL
SOUTH TEXAS PROJECT NUCLEAR OPERATING CO. (South Texas Project, Units 1 and 2)	)	Docket Nos. 50-498-LR, 50-499-LR
TENNESSEE VALLEY AUTHORITY (Bellefonte Nuclear Power Plant Units 3 and 4)	)	Docket Nos. 52-014-COL, 52-015-COL
TENNESSEE VALLEY AUTHORITY (Sequoyah Nuclear Plant, Units 1 and 2)	)	Docket Nos. 50-327-LR, 50-328-LR
TENNESSEE VALLEY AUTHORITY (Watts Bar Nuclear Plant, Unit 2)	)	Docket No. 50-391-OL
UNION ELECTRIC CO. (Callaway Nuclear Power Plant, Unit 1)	)	Docket No. 50-483-LR
VIRGINIA ELECTRIC AND POWER CO. d/b/a DOMINION VIRGINIA POWER and OLD DOMINION ELECTRIC COOPERATIVE (North Anna Power Station, Unit 3)	)	Docket No. 52-017-COL

CLI-14-08

MEMORANDUM AND ORDER

Today we lift the suspension on final licensing decisions that we imposed in CLI-12-16, in view of the issuance of a revised rule codifying the NRC's generic determinations regarding the environmental impacts of continued storage of spent nuclear fuel beyond a reactor's licensed operating life. Further, we provide direction on the disposition of pending contentions associated with continued storage.

I. BACKGROUND

In 2012, the U.S. Court of Appeals for the District of Columbia Circuit found that the NRC failed to comply with the National Environmental Policy Act (NEPA) in issuing its 2010 update to the Waste Confidence Decision and accompanying Temporary Storage Rule.[1] As had previous iterations of the Decision and Rule, the 2010 versions supported generic findings in 10 C.F.R. § 51.23 regarding the impacts of spent fuel storage after the cessation of licensed operation of a nuclear power plant. Section 51.23(a) reflected several findings, including, first, that spent fuel "can be stored safely and without significant environmental impacts for at least 60 years beyond the licensed life for operation" and, second, that "there is reasonable assurance that sufficient mined geologic repository capacity will be available . . . when necessary."[2] Section 51.23(b) relied on these findings, among others, to exclude "discussion of any environmental impact of spent fuel storage . . . [during] the period following the term of the reactor operating license" in

[1] *New York v. NRC*, 681 F.3d 471 (D.C. Cir. 2012); *see generally* Final Rule: Consideration of Environmental Impacts of Temporary Storage of Spent Fuel After Cessation of Reactor Operation, 75 Fed. Reg. 81,032 (Dec. 23, 2010); Waste Confidence Decision Update, 75 Fed. Reg. 81,037 (Dec. 23, 2010).

[2] 10 C.F.R. § 51.23(a) (2011).

any environmental impact statement, environmental assessment, environmental report, or other analysis prepared in connection with enumerated power reactor and dry cask licenses.[3]

The court identified three particular deficiencies in the 2010 analysis. First, related to the Commission's conclusion that permanent disposal will be available "when necessary," the court held that the NRC needed to examine the environmental impacts of failing to establish a repository. Second, related to the continued storage of spent fuel, the court held that the Commission had not adequately examined the risk of spent fuel pool leaks. And third, also related to continued storage, the court held that the NRC had not adequately examined the consequences of potential spent fuel pool fires.

In response to the court's ruling, we determined in CLI-12-16 that the NRC would not issue licenses dependent upon the Decision and Rule, pending completion of action on the remanded proceeding.[4] In the same decision, we opted to hold in abeyance a number of new contentions and associated filings concerning continued storage of spent nuclear fuel beyond a reactor's licensed life for operation and prior to ultimate disposal.[5]

We have now approved a final Continued Storage Rule[6] and associated generic environmental impact statement (GEIS).[7] In the GEIS, the NRC has assessed generically the

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[3] *Id.* § 51.23(b) (2011).

[4] CLI-12-16, 76 NRC 63, 67 (2012).

[5] *Id.* at 68-69.

[6] The title of the rule has been changed to reflect issuance of a generic environmental impact statement in lieu of a separate Waste Confidence Decision. *See* "Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel," NUREG-2157 (Aug. 2014), at xxiii; D-11 to D-12 (discussing public comments on the name change) (ADAMS accession no. ML14188B749) (GEIS).

[7] Staff Requirements—SECY-14-0072—Final Rule, Continued Storage of Spent Nuclear Fuel (RIN 3150-AJ20) (Aug. 26, 2014) (ML14237A092); *see* "Final Rule: Continued Storage of Spent Nuclear Fuel (RIN 3150-AJ20)," Commission Paper SECY-14-0072 (July 21, 2014) (attaching

(continued . . .)

environmental impacts of continued storage of spent nuclear fuel and has addressed the issues raised in the D.C. Circuit's decision. The revised rule, in turn, codifies the environmental impacts reflected in the GEIS and reflects that these impact determinations will inform the decision-makers in individual licensing proceedings of the impacts of continued storage.[8] The NRC also addressed in the GEIS the three specific deficiencies identified by the court.[9] Because we have approved this rule today, the time is ripe to address the suspension that we imposed in CLI-12-16.

II. DISCUSSION

A. Suspension of Final Licensing Decisions

Following the court's 2012 remand, substantively identical petitions were filed in conjunction with nineteen pending reactor license applications.[10] The petitioners asked that we suspend final licensing decisions in reactor licensing cases pending the completion of our action on the remanded Waste Confidence proceeding.[11] We did so, observing that waste confidence undergirds certain licensing decisions, particularly new reactor licensing and power reactor

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the GEIS and the draft Final Rule, Continued Storage of Spent Nuclear Fuel (Continued Storage Rule)). The Commission paper and its attachments may be found at ML14177A482 (package).

[8] Continued Storage Rule at 4, 39-40; *see id.* at 74-75 (setting forth the revised section 51.23). The rule, which adopts the generic impact determinations made in the GEIS, satisfies the NRC's NEPA obligations with respect to continued storage for initial, renewed, and amended licenses for reactors, independent spent fuel storage installations (ISFSIs), construction permits, and early site permits. Further, consistent with the rule, these determinations generally may not be challenged in individual licensing proceedings. *Id.* at 19-20.

[9] Continued Storage Rule at 14. *See generally* GEIS at xxx, 1-4 (explaining that the GEIS includes an analysis of an indefinite time frame, which assumes that a repository does not become available); GEIS, App. E, "Analysis of Spent Fuel Pool Leaks"; GEIS, App. F, "Spent Fuel Pool Fires."

[10] As noted in CLI-12-16, the suspension petition was not filed in the *Indian Point* or *Limerick* matters, or in the then-pending *Victoria County* matter. CLI-12-16, 76 NRC at 68 n.10.

[11] CLI-12-16, 76 NRC at 66.

license renewal.[12] Historically, the Waste Confidence Decision represented the NRC's generic determination (and supporting generic environmental analysis) that spent nuclear fuel can be stored safely and without significant impacts for a period of time past a reactor's licensed life, but before permanent disposal. Because it made this determination generically, the NRC did not need to undertake site-specific identification of the environmental impacts associated with continued storage of spent nuclear fuel.[13] Vacatur of the Decision and Rule therefore left a gap in the NEPA analyses associated with these licensing reviews.[14]

In September 2012, we directed the Staff to develop a generic environmental impact statement to identify the environmental impacts of continued storage, address the issues raised by the court, and support an updated rule.[15] We approved publication of a proposed rule and associated draft generic environmental impact statement the next year.[16] Following a robust public comment period that included an extensive campaign of public meetings across the United States (discussed further below), the Staff has crafted a generic environmental impact

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[12] *Id.* at 66 & n.5 (citing 10 C.F.R. § 51.23(b) (2012)).

[13] Proposed Rule, Waste Confidence—Continued Storage of Spent Nuclear Fuel, 78 Fed. Reg. 56,776, 56,776 (Sept. 13, 2013) (Proposed Continued Storage Rule).

[14] *See Small Refiner Lead Phase-Down Task Force v. EPA*, 705 F.2d 506, 545 (D.C. Cir. 1983) (observing that, where the reviewing court vacates a rule without reinstating the old rule, "failure to reinstate the old rule creates a temporary regulatory vacuum"). In this case, even had the court expressly reinstated the prior version of the Waste Confidence Decision, a gap still would have been present—the court identified specific deficiencies in the Staff's analysis; the NRC was obliged to address these deficiencies. *See New York*, 681 F.3d at 478, 481-82 (holding that the NRC must include an evaluation of failure to secure permanent disposal, as well as an improved analysis of spent fuel pool leaks and spent fuel pool fires).

[15] *See* Staff Requirements—COMSECY-12-0016—Approach for Addressing Policy Issues Resulting from Court Decision to Vacate Waste Confidence Decision and Rule (Sept. 6, 2012) (ML12250A032) (SRM-COMSECY-12-0016).

[16] *See* Staff Requirements—SECY-13-0061—Proposed Rule: Waste Confidence—Continued Storage of Spent Nuclear Fuel (RIN 3150-AJ20) (Aug. 5, 2013) (ML13217A358); Proposed Continued Storage Rule, 78 Fed. Reg. at 56,776; Draft Waste Confidence Generic Environmental Impact Statement, 78 Fed. Reg. 56,621 (Sept. 13, 2013).

statement and revised rule that cure the deficiencies identified by the court. We have adopted that rule today. Upon consideration of the final Continued Storage Rule and associated GEIS, we lift the suspension on all final licensing decisions for affected applications as of the effective date of the final rule. To be sure, the results of the continued storage proceeding must be accounted for before finalizing individual licensing decisions. But once the Staff has otherwise completed its review of the affected applications and has implemented the Continued Storage Rule as appropriate for each affected application, it may make decisions regarding final license issuance.[17]

B. Pending Contentions Concerning Continued Storage

In CLI-12-16, we observed that, to the extent that the NRC addressed waste confidence on a case-by-case basis, "litigants can challenge such site-specific agency actions in our adjudicatory process."[18] Twenty-two continued storage contentions, most filed concurrently with the suspension petitions, are pending before us[19] or before the Atomic Safety and Licensing Boards.[20] All but two of these contentions are substantively similar. Echoing the court's decision, the petitioners argued in a general way that the environmental review for each

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[17] Consistent with our direction in CLI-12-16, licensing reviews and adjudications continued apace. *See* CLI-12-16, 76 NRC at 67; "Implementation of Commission Memorandum and Order CLI-12-16 Regarding Waste Confidence Decision and Rule," Commission Paper SECY-12-0132 (ML12276A054) (package) (explaining the Staff's approach for continuing licensing reviews during the pendency of the rulemaking); Continued Storage Rule at 19-20, 36-37, 39-40 (explaining how the impact determinations in the GEIS will be used in NRC environmental reviews).

[18] CLI-12-16, 76 NRC at 67 (footnote omitted).

[19] The filings before the Commission are listed in an Appendix to this decision.

[20] The filings before the Boards are listed in the Appendix to this decision, together with the Board orders implementing our direction in CLI-12-16. The continued storage issue had been raised before the Board in the *Victoria County Station* early site permit proceeding; that proceeding has since been terminated. *Exelon Nuclear Texas Holdings, LLC* (Victoria County Station Site), LBP-12-20, 76 NRC 215 (2012) (granting the motion to withdraw the application without prejudice and terminating the proceeding).

proposed facility (the environmental report, draft environmental impact statement, or final environmental impact statement, depending on the status of the application in question) does not satisfy NEPA. To cite one example:

> The [draft environmental impact statement] for the proposed Fermi 3 does not satisfy NEPA, because it does not include a discussion of the environmental impacts of spent fuel storage after cessation of operation, including the impacts of spent fuel pool leakage, spent fuel pool fires, and failing to establish a spent fuel repository, as required by the U.S. Court of Appeals in *State of New York v. NRC*, No. 11-1045 (June 8, 2012). Therefore, unless and until the NRC conducts such an analysis, no license may be issued.[21]

At bottom, the petitioners argued that, in view of the court's decision invalidating the 2010 Decision and Rule, the NRC could no longer rely on 10 C.F.R. § 51.23(b), "which relies on those findings to exempt both the agency staff and license applicants from addressing spent fuel storage impacts in individual licensing proceedings."[22]

As we acknowledged in CLI-12-16 and again earlier this year, due to the special circumstances presented by waste confidence, we directed that such contentions be held in abeyance pending our further direction.[23] As discussed in the GEIS, the NRC considered

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[21] *Intervenors' Motion for Leave to File a New Contention Concerning Temporary Storage and Ultimate Disposal of Nuclear Waste at Proposed Fermi 3 Nuclear Power Plant* (July 9, 2012), at 4.

[22] *Id.* at 4-5.

[23] *Tennessee Valley Authority* (Sequoyah Nuclear Plant, Units 1 and 2), CLI-14-3, 79 NRC __, __ (Feb. 12, 2014) (slip. op. at 3, 8-9) (indicating that further direction regarding pending contentions would be provided "concurrent with issuance of the final rule"); CLI-12-16, 76 NRC at 68-69. At the time we directed the Staff to prepare a final rule and environmental impact statement, we expressly reserved the option to conduct some environmental analyses of continued storage issues on a site-specific basis if necessary, although we cautioned the Staff that "such a step should be used only in rare circumstances in which there is an exceptional or compelling need to proceed otherwise and proceeding with the site-specific review would not delay or create inconsistencies with development of the generic [environmental impact statement]." SRM-COMSECY-12-0016 at 2 (unnumbered).

addressing the environmental impacts of continued storage in site-specific reviews.[24] As part of the analysis underpinning the GEIS, however, we concluded that the impacts of continued storage will not vary significantly across sites; the impacts of continued storage at reactor sites, or at away-from-reactor sites, can be analyzed generically.[25] Further, "the assumptions used in the analysis are sufficiently conservative to bound the impacts such that variances that may occur between sites are unlikely to result in environmental impact determinations greater than those presented in the GEIS."[26] Because these generic impact determinations have been the subject of extensive public participation in the rulemaking process, they are excluded from litigation in individual proceedings.[27]

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[24] GEIS at 1-6 to 1-9 (discussing, among other things, review of impacts on a site-specific basis, preparation of a GEIS whose findings could be used in individual licensing reviews without the binding effect of a rule, or preparation of a policy statement).

[25] Continued Storage Rule at 15-17. As the final rule acknowledges, the court of appeals endorsed a generic approach. *Id.* at 15 (citing *New York*, 681 F.3d at 480 ("[W]e see no reason that a comprehensive general analysis would be insufficient to examine on-site risks that are essentially common to all plants.")).

[26] GEIS at D-101 to D-102 (response to Comment D.2.11.6); *see also id.* at D-94 to D-109 (providing, *inter alia*, responses to comments requesting site-specific reviews instead of a generic analysis); *id.* at D-68 to D-71 (providing responses to comments expressing concerns related to particular power plants or spent fuel storage facilities).

[27] Contentions that are the subject of general rulemaking by the Commission may not be litigated in individual license proceedings. *Duke Energy Corp.* (Oconee Nuclear Station, Units 1, 2, and 3), CLI-99-11, 49 NRC 328, 345 (1999) (quoting *Potomac Electric Power Co.* (Douglas Point Nuclear Generating Station, Units 1 and 2), ALAB-218, 8 AEC 79, 85 (1974)); *see also* 10 C.F.R. §§ 2.309(f)(1)(iii), 2.335(a); GEIS at 1-7 ("Requiring the NRC to prepare site-specific discussions of generic issues, like those associated with continued storage, would result in the considerable expenditure of public, NRC, and applicant resources. Further, licensing boards could be required to hear nearly identical issues in each proceeding on these generic matters. Adopting the generic impacts of continued storage in a rule, on the other hand, allows the NRC and the participants in its licensing proceedings to focus their limited resources on site-specific issues that are unique to each licensing action.").

We therefore decline to accept for litigation those contentions pending before us.[28] The motions pending before us in the *William States Lee*, *Grand Gulf*, *Shearon Harris*, *Comanche Peak*, and *North Anna* combined license matters, and in the *South Texas* and *Grand Gulf* license renewal matters, are dismissed; those proceedings are terminated.[29]

Likewise, we direct the Atomic Safety and Licensing Boards to reject the contentions pending before them, consistent with our decision today,[30] with the exception of the two contentions pending in the *Indian Point* matter. These proposed contentions appear to include issues beyond the scope of the Continued Storage Rule.[31] To the extent that Contentions CW-SC-4 and NYS-39/RK-EC-9/CW-EC-10 raise issues resolved by the Continued Storage Rule, the Board is directed to dismiss them consistent with our opinion today. To the extent that these contentions raise other matters, the Board should assess their admissibility under our generally applicable rules of practice.[32]

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[28] As the Staff made clear in the GEIS, the Continued Storage Rule does not address the environmental impacts of spent fuel storage *during the license term*; these impacts are assessed as part of the site-specific environmental review for a proposed action. *See, e.g.*, GEIS at D-95. The site-specific environmental review may be subject to challenge, provided all other procedural requirements are satisfied.

[29] *See* the Appendix to this decision for a list of contentions pending before us. Because the proposed continued storage contentions are inadmissible, we need not, and do not, reach the other procedural issues raised by these motions.

[30] *See id*.

[31] *See Hudson River Sloop Clearwater, Inc.'s Motion for Leave to Add a New Contention Based Upon New Information and Petition to Add New Contention* (July 9, 2012) (Contention CW-SC-4); *State of New York, Riverkeeper, and Clearwater's Joint Motion for Leave to File a New Contention Concerning the On-Site Storage of Nuclear Waste at Indian Point* (July 8, 2012); *State of New York, Riverkeeper, Inc., and Hudson River Sloop Clearwater's Joint Contention NYS-39/RK-EC-9/CW-EC-10 Concerning the On-Site Storage of Nuclear Waste at Indian Point* (July 8, 2012).

[32] *See* 10 C.F.R. § 2.309(c), (f).

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One other matter merits mention. The petitioners sought "an opportunity for public comment on any generic determinations that [the Commission] may make in either an environmental assessment . . . or environmental impact statement . . . ."[33] In CLI-12-16, we committed that the public "will be afforded an opportunity to comment in advance on any generic waste confidence document that the NRC issues on remand—be it a fresh rule, a policy statement, an [environmental assessment], or an [environmental impact statement]."[34] The rulemaking record reflects that the Staff provided a variety of opportunities for public participation over the course of the rulemaking and received extensive public comment.[35] Many—if not most—of the petitioners in the captioned matters availed themselves of the opportunity to participate.[36] We are satisfied that the Staff amply fulfilled the assurances we made in CLI-12-16.

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[33] CLI-12-16, 76 NRC at 66.

[34] *Id.* at 67.

[35] The proposed rule was published for a seventy-five-day comment period on September 13, 2013; the comment period ultimately was extended until December 20, 2013. Proposed Continued Storage Rule, 78 Fed. Reg. at 56,776; Proposed Rule, Waste Confidence—Continued Storage of Spent Nuclear Fuel, 78 Fed. Reg. 66,858 (Nov. 7, 2013) (extension of comment period). During the comment period, the NRC staff held thirteen public meetings across the country. Overall, the NRC received over 33,000 comment submissions and recorded approximately 1,600 pages of public meeting transcripts. Continued Storage Rule at 52-53; GEIS at 1-12, C-1 to C-18, D-1 to D-3.

[36] *See, e.g.*, *Comments by Environmental Organizations on Draft Waste Confidence Generic Environmental Impact Statement and Proposed Waste Confidence Rule and Petition to Revise and Integrate All Safety and Environmental Regulations Related to Spent Fuel Storage and Disposal* (Dec. 20, 2013, corrected Jan. 7, 2014) (ML14030A152) (package) (transmitting comments made on behalf of 33 organizations); *Comments Submitted by the Attorneys General of the States of New York, Vermont, Connecticut, and the Commonwealth of Massachusetts, the Vermont Department of Public Service, and the Prairie Island Indian Community on the Nuclear Regulatory Commission's Draft Waste Confidence Generic Environmental Impact Statement and Proposed Rule* (Jan. 2, 2013) (ML13365A345). *See generally* GEIS at D-554 to D-602 (listing individuals who provided unique comments on the draft GEIS and proposed rule).

III. CONCLUSION

For the reasons discussed above, and in view of our approval of the final Continued Storage Rule and associated GEIS, we *lift* the suspension on all final licensing decisions for affected applications as of the effective date of the final rule. Further, the proposed "continued storage" contentions referenced herein are inadmissible, and *we decline to accept them* for litigation. As such, we *dismiss* the petitions pending before us in *William States Lee*, *Grand Gulf*, *Shearon Harris*, *Comanche Peak*, *North Anna*, and *South Texas* and *terminate* those proceedings. We *direct* the Atomic Safety and Licensing Boards, with the exception of the *Indian Point* Board, to likewise dismiss the contentions pending before them. Finally, we *direct* the *Indian Point* Board to dismiss the "continued storage" contentions pending before it; to the extent that the Board finds that these contentions raise issues outside the scope of the Continued Storage Rule, the Board should assess the admissibility of these contentions under the applicable rules of practice.

IT IS SO ORDERED.

For the Commission

NRC SEAL

/RA/

____
Annette L. Vietti-Cook
Secretary of the Commission

Dated at Rockville, Maryland,
this 26th day of August, 2014

APPENDIX

CONTENTIONS PENDING BEFORE THE COMMISSION

1. *Motion to Reopen the Record for William States Lee III Units 1 and 2* (July 9, 2012), together with *Intervenors' Motion for Leave to File a New Contention Concerning Temporary Storage and Ultimate Disposal of Nuclear Waste at William States Lee III Units 1 and 2* (July 9, 2012).

2. *Beyond Nuclear Motion for Leave to File a New Contention Concerning Temporary Storage and Ultimate Disposal of Nuclear Waste at Grand Gulf Unit 1* (July 9, 2012).

3. *Beyond Nuclear Motion for Leave to File a New Contention Concerning Temporary Storage and Ultimate Disposal of Nuclear Waste at Grand Gulf Unit 3* (July 9, 2012).

4. *Intervenors' Motion for Leave to File a New Contention Concerning Temporary Storage and Ultimate Disposal of Nuclear Waste at Comanche Peak Nuclear Power Plant* (July 9, 2012).

5. *NC WARN's Motion to Reopen the Record and Admit Contention Concerning Temporary Storage and Ultimate Disposal of Nuclear Waste at the Shearon Harris Nuclear Power Plant* (July 9, 2012).

6. *Petition for Intervention to File a New Contention Concerning Temporary Storage and Ultimate Disposal of Nuclear Waste at STP Units 1 & 2* (July 9, 2012).

7. *Motion to Reopen the Record for North Anna Unit 3* (July 9, 2012), filed with *Intervenors' Motion for Leave to File a New Contention Concerning Temporary Storage and Ultimate Disposal of Nuclear Waste at North Anna Unit 3* (July 9, 2012).

CONTENTIONS PENDING BEFORE THE ATOMIC SAFETY AND LICENSING BOARDS

1. *Intervenors' Motion for Leave to File a New Contention Concerning Temporary Storage and Ultimate Disposal of Nuclear Waste at Proposed Fermi 3 Nuclear Power Plant* (July 9, 2012); Order (Holding New Contention in Abeyance) (Aug. 29, 2012) (unpublished).

2. *Intervenors' Motion for Leave to File a New Contention Concerning Temporary Storage and Ultimate Disposal of Nuclear Waste at Davis-Besse Nuclear Power Station* (July 9, 2012); Order (Suspending Procedural Date Related to Proposed Waste Confidence Contention) (Aug. 8, 2012) (unpublished).

3. *Intervenors' Motion for Leave to File a New Contention Concerning Temporary Storage and Ultimate Disposal of Nuclear Waste at Turkey Point Nuclear Power Plant* (July 9, 2012) (two motions, one filed by Southern Alliance for Clean Energy, National Parks Conservation Association, Dan Kipnis, and Mark Oncavage, and the other by Citizens Allied for Safe Energy, Inc.); Order (Suspending Deadlines for Submission of Reply Briefs Related to Proposed Waste Confidence Contention) (Aug. 9, 2012) (unpublished).

4. *Intervenors' Motion for Leave to File a New Contention Concerning Temporary Storage and Ultimate Disposal of Nuclear Waste at Seabrook Station, Unit 1* (July 9, 2012); Order (Holding Intervenors' Motion for Leave to File a New Contention in Abeyance) (Aug. 15, 2012) (unpublished).

5. *San Luis Obispo Mothers for Peace Motion for Leave to File a New Contention Concerning Temporary Storage and Ultimate Disposal of Spent Reactor Fuel at Diablo Canyon Nuclear Power Plant* (July 9, 2012); Order (Holding Proposed New Contention in Abeyance) (Aug. 16, 2012) (unpublished).

6. *Intervenors' Motion for Leave to File a New Contention Concerning Temporary Storage and Ultimate Disposal of Spent Reactor Fuel at Levy Nuclear Power Plant* (July 9, 2012); Order (Holding Proposed New Contention in Abeyance) (Aug. 16, 2012) (unpublished).

7. *Intervenors' Motion for Leave to File a New Contention Concerning Temporary Storage and Ultimate Disposal of Nuclear Waste at South Texas Units 3 & 4* (July 9, 2012).

8. *Intervenors' Motion for Leave to File a New Contention Concerning Temporary Storage and Ultimate Disposal of Nuclear Waste at Bellefonte* (July 9, 2012); Memorandum and Order (Suspending Date for Submission of Reply Pleading) (Aug. 8, 2012) (unpublished).

9. *Southern Alliance for Clean Energy's Motion for Leave to File a New Contention Concerning Temporary Storage and Ultimate Disposal of Spent Reactor Fuel at Watts Bar Unit 2* (July 9, 2012); Order (Holding Waste Confidence Contention in Abeyance) (Aug. 9, 2012) (unpublished).

10. *Intervenor's Motion for Leave to File a New Contention Concerning Temporary Storage and Ultimate Disposal of Nuclear Waste at Callaway Nuclear Power Plant* (July 9, 2012); Memorandum and Order (Suspending Date for Submission of Reply Pleading) (Aug. 8, 2012) (unpublished).

11. *Hudson River Sloop Clearwater, Inc.'s Motion for Leave to Add a New Contention Based Upon New Information and Petition to Add New Contention* (July 9, 2012); *State of New York, Riverkeeper, and Clearwater's Joint Motion for Leave to File a New Contention Concerning the On-Site Storage of Nuclear Waste at Indian Point*, filed with *State of New York, Riverkeeper, Inc., and Hudson River Sloop Clearwater's Joint Contention NYS-39/RK-EC-9/CW-EC-10 Concerning the On-Site Storage of Nuclear Waste at Indian Point* (July 8, 2012); Order (Holding Contentions NYS-39/RK-EC-9/CW-EC-10 and CW-SC-4 in Abeyance) (Aug. 8, 2012) (unpublished).

12. *NRDC's Waste Confidence Contention* (July 9, 2012); Order (Suspending Procedural Date Related to Proposed Waste Confidence Contention) (Aug. 8, 2012) (unpublished) (suspending briefing in the *Limerick* license renewal proceeding).

13. *Prairie Island Indian Community's Request for Hearing and Petition to Intervene in License Renewal Proceeding for the Prairie Island Independent Spent Fuel Storage Installation* (Aug. 24, 2012), at 23-26 (Contention 1); LBP-12-24, 76 NRC at 510-11 (2012) (holding Contention 1 in abeyance); *Prairie Island Indian Community Motion to Admit New and Amended Contentions after Issuance of NRC's Draft Environmental Assessment* (Dec. 12, 2013); Memorandum and Order (Ruling on Motion to Admit New and Amended Contentions) (Apr. 30, 2014), at 5-7 (unpublished) (holding an amended Contention 1, challenging the draft environmental impact statement, in abeyance).

14. *Petition for Leave to Intervene and Request for Hearing by the Blue Ridge Environmental Defense League, Bellefonte Efficiency and Sustainability Team, and Mothers Against Tennessee River Radiation* (May 6, 2013), at 12-14 (Contention B in the *Sequoyah* license

renewal proceeding); LBP-13-8, 78 NRC 1, 15-16 (2013) (holding Contention B in abeyance), *interlocutory appeal denied*, CLI-14-3, 79 NRC __ (Feb. 12, 2014) (slip op.).

NUREG-0974
Supplement

Final Environmental Statement

related to the operation of Limerick Generating Station, Units 1 and 2

Docket Nos. 50-352 and 50-353

Philadelphia Electric Company

U.S. Nuclear Regulatory Commission

Office of Nuclear Reactor Regulation

August 1989

ABSTRACT

In April 1984 the staff of the Nuclear Regulatory Commission issued its Final Environmental Statement (NUREG-0974) related to the operation of Limerick Generating Station, Units 1 and 2 (Docket Nos. 50-352 and 50-353), located on the Schuylkill River, near Pottstown, in Limerick Township, Montgomery and Chester Counties, Pennsylvania.

The NRC has prepared this supplement to NUREG-0974 to present its evaluation of the alternative of facility operation with the installation of further severe accident mitigation design features. The NRC staff has discovered no substantial changes in the proposed action as previously evaluated in the Final Environmental Statement that are relevant to environmental concerns nor significant new circumstances or information relevant to environmental concerns and bearing on the licensing of Limerick Generating Station, Units 1 and 2.

SUMMARY AND CONCLUSIONS

In February 1989, the U. S. Court of Appeals for the Third Circuit ruled that NRC failed to consider a "reasonable set" of Severe Accident Mitigation Design Alternatives (SAMDAs) in the Final Environmental Statement (FES) for the Limerick Generating Station (NUREG-0974, April 1984). The NRC staff has completed consideration of a reasonable set of severe accident mitigation design alternatives. The staff has discovered no substantial changes in the proposed action as previously evaluated in the FES that are relevant to environmental concerns nor significant new circumstances or information relevant to environmental concerns and bearing on the licensing of Limerick Generating Station, Units 1 and 2.

In assessing the risk reduction potential, the value of each SAMDA was initially scoped based on risk information reported in the original Limerick Generating Station Probabilistic Risk Assessment and Severe Accident Risk Assessment and reviewed by the staff in the 1983-1984 timeframe (NUREG-1068, August 1984). Modifications were made to this information base to account for the effect of two plant improvements identified in NUREG-1068 and subsequently implemented by PECo. The risk reduction scoping estimates were compared to the estimated costs associated with each SAMDA. Based on a screening criterion of $1000 per averted person-rem, the comparison indicated that some candidate SAMDAs warranted further evaluation.

The staff then further evaluated each of the SAMDAs, considering the qualitative effect of several plant improvements made at Limerick since the time of the staff review reported in NUREG-1068. Key plant improvements include the implementation of: procedures for battery power load shedding, MSIV air supply improvements, BWR Owners' Group Emergency Procedure Guidelines, Rev. 3 (and parts of Rev. 4), the hardened containment vent line, and procedures for the use of diesel-driven fire protection system pumps for core injection. The staff also gave consideration to the results of a recent update to the Limerick PRA described in an April 25, 1989 ACRS subcommittee meeting, a June 23, 1989 utility submittal concerning SAMDAs, and a July 27, 1989 meeting with the staff concerning the SAMDA submittal. That study calculated values of CDF and offsite dose which were about four times lower than the staff's. While the staff has not reviewed these results in sufficient detail to confirm the quantitative results, the staff believes that these plant features would reduce the CDF and offsite doses. As a result, the averted offsite dose from candidate SAMDAs could be appreciably less than estimated by the staff.

The staff also considered uncertainty in the cost and effectiveness of candidate SAMDAs. For instance, the ATWS vent analyzed by the utility uses an existing 18 inch containment penetration which would be capable of removing 10 percent of full power. There are existing analyses which predict ATWS power levels as high as 30 percent for some scenarios. The staff identified operational disadvantages for some of the candidate SAMDAs (Table 4).

Of the seven SAMDAs which passed the screening cost/benefit test, the staff has identified two which have been implemented at Limerick. These are the Decay Heat Sized Vent Without Filter (3.C.) and the Low Pressure Reactor Makeup Capability (6.) The staff has not quantified the effectiveness of these SAMDAs in reducing risk. However, the staff believes that these features will result in an appreciable net decrease in CDF and risk.

In summary, the risks and environmental impacts of severe accidents at Limerick are acceptably low. We have found no new information that would call into question the FES conclusion that, "the risks of early fatality from potential accidents at the site are small in comparison with risks of early fatality from other human activities in a comparably sized population, and the accident risk will not add significantly to population exposure and cancer risks. Accident risks from Limerick are expected to be a small fraction of the risks the general public incurs from other sources. Further, the best estimate calculations show that the risks of potential reactor accidents at Limerick are within the range of such risks from other nuclear power plants," (NUREG-0974, Page 5-126).

Furthermore, while the screening cost/benefit analysis performed above indicates that several candidate SAMDAs might be cost effective based on a criterion of $1000 per person-rem averted, a more recent utility PRA presents lower risk estimates which indicate that SAMDAs are not justified. While the staff has not verified the utility estimates, the staff is convinced that risk is now lower for Limerick than the estimates used in our cost/benefit study. Moreover, there are uncertainties about the costs, effectiveness, and/or operational disadvantages of some SAMDAs. In light of these considerations, the staff has no clear basis at this time for concluding that modifications to the plant are justified for the purpose of further mitigating severe accident risks.

In the longer term, these same severe accident issues are currently being pursued by the NRC in a systematic way for all utilities through the Severe Accident Program described in SECY-88-147, "Integration Plan for Closure of Severe Accident Issues" (Reference 7). The plan includes provisions for an Individual Plant Examination (IPE) for each operating reactor, a Containment Performance Improvement (CPI) program, and an Accident Management (AM) program. These programs will produce a more complete picture of the risks of operating plants and the benefits of potential design improvements, including SAMDAs. The staff believes that the severe accident program is the proper vehicle for further review of severe accidents at nuclear power plants, including Limerick.

For example, the Containment Performance Improvement (CPI) program is in the process of performing an integrated assessment of generic containment improvements for Mark II plants. The assessment entails a broad perspective of all Mark II plants, including their vulnerabilities and potential improvements. A set of SAMDAs is being considered which deals with the overall issue of containment performance and fission product control, using the most current understanding of source term behavior.

This supplement has made use of the risk insights and cost estimates from that program for the purpose of performing our screening assessment of SAMDAs. However, further work on SAMDAs for nuclear power plants including Limerick should continue within the CPI program. To do otherwise would duplicate effort, and would not result in a consistent resolution for Mark II plants.

In addition, many of the candidate SAMDAs (2., 5.B., 6., and 7.) fall into the category of Accident Management. The severe accident program is currently developing, in concert with the industry, an analytical "framework" which utilities will use for the purpose of identifying and implementing accident management strategies. The identification process will include a balanced assessment of risk contributors, a systematic evaluation of candidate strategies, an evaluation of downsides and an assessment of plant specific problems associated with implementation. The implementation process will include consideration of instrumentation needs, training (including periodic exercises), consideration of decision making processes, and associated information requirements (such as computer codes to follow accident progression). The staff believes that accident management strategies should be implemented in an integrated fashion in the context of the NRC/industry framework.

Finally, the IPE, which consists of a full evaluation of the accident sequences which lead to core melt, will be performed by the licensee and reviewed by the staff. This process will produce an up-to-date picture of plant vulnerabilities for each plant individually, and will produce a pool of information concerning generically applicable insights. The IPE process is thus the most complete and efficient way of resolving the uncertainties discussed above associated with the core damage frequency for nuclear power plants including Limerick.

Most significantly, the three efforts described above (as well as several other related activities), will, as discussed in SECY-88-147, be brought to closure in an integrated fashion to assure a balanced resolution of severe accident issues.

FOREWORD

In February 1989, the U. S. Court of Appeals for the Third Circuit ruled that the NRC failed to consider a "reasonable set" of Severe Accident Mitigation Design Alternatives (SAMDAs) in the Final Environmental Statement (FES) for the Limerick Generating Station (NUREG-0974, April 1984). The NRC staff has completed consideration of a reasonable set of severe accident mitigation design alternatives. The staff has discovered no substantial changes in the proposed action as previously evaluated in the FES that are relevant to environmental concerns nor significant new circumstances or information relevant to environmental concerns and bearing on the licensing of Limerick Generating Station, Units 1 and 2.

Copies of this supplement are available for inspection at the NRC Public Document Room, 2120 L Street N.W., Washington, D.C. and at the Local Public Document Room at the Pottstown Public Library, 500 High Street, Pottstown, Pennsylvania 19464.

Gene Y. Suh is the NRC Project Manager for the evaluation presented in this supplement. He may be contacted by telephone at (301) 492-1426 or by mail at the following address:

U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Washington, DC 20555

LIST OF CONTRIBUTORS

The following personnel of the U.S. Nuclear Regulatory Commission participated in the preparation of the supplement to the Final Environmental Statement:

R. J. Barrett	Chief, Risk Applications Branch; Ph.D. (Nuclear Physics) 1972; 17 years experience.
R. L. Palla, Jr.	Senior Reliability and Risk Analyst; M.S., B.S. (Mechanical Engineering) 1981, 1975; 13 years experience.
E. S. Chelliah	Reliability and Risk Analyst; M.S. (Nuclear Engineering) 1972, (Electrical Engineering) 1975; 15 years experience.
S. E. Feld	Senior Industrial Economist; Ph.D. (Resource Economics) 1973; 16 years experience.
W. B. Hardin	Senior Reactor Systems Engineer; Ph.D., M.S. (Mechanical Engineering) 1987, 1965; 24 years experience.
J. N. Ridgely	Senior Reliability and Risk Analyst/Engineer; B.S. (Nuclear Science) 1972; 17 years experience.
G. Y. Suh	Project Manager; M.S. (Mechanical Engineering) 1981; 8 years experience.

ABBREVIATIONS

ACRS	Advisory Committee on Reactor Safeguards
ADS	automatic depressurization system
AM	Accident Management
ATWS	anticipated transient without scram
CDF	core damage frequency
CPI	Containment Performance Improvement Program
FES	Final Environmental Statement
IPE	Individual Plant Examination
MVSS	multi-venturi scrubber system
PECo	Philadelphia Electric Company
PRA	probabilistic risk assessment
RDA	R & D Associates
RWCU	reactor water cleanup system
SAMDA	severe accident mitigation design alternative
SARA	severe accident risk assessment

Supplement To NUREG-0974
"Final Environmental Statement Related to the Operation of
Limerick Generating Station, Units 1 and 2"

NRC Staff Evaluation of Severe Accident
Mitigation Design Alternatives for Limerick

Summary and Conclusions

In February 1989, the U. S. Court of Appeals for the Third Circuit ruled that NRC failed to consider a "reasonable set" of Severe Accident Mitigation Design Alternatives (SAMDAs) in the Final Environmental Statement (FES) for the Limerick Generating Station (NUREG-0974, April 1984). The NRC staff has completed consideration of a reasonable set of severe accident mitigation design alternatives (SAMDAs). The staff has discovered no substantial changes in the proposed action as previously evaluated in the FES that are relevant to environmental concerns nor significant new circumstances or information relevant to environmental concerns and bearing on the licensing of Limerick Generating Station, Units 1 and 2.

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For example, the Containment Performance Improvement (CPI) program is in the process of performing an integrated assessment of generic containment improvements for Mark II plants. The assessment entails a broad perspective of all Mark II plants, including their vulnerabilities and potential improvements. A set of SAMDAs is being considered which deals with the overall issue of containment performance and fission product control, using the most current understanding of source term behavior.

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In addition, many of the candidate SAMDAs (2., 5.B., 6., and 7.) fall into the category of Accident Management. The severe accident program is currently developing, in concert with the industry, an analytical "framework" which utilities will use for the purpose of identifying and implementing an optimum set of accident management strategies. The identification process will include a balanced assessment of risk contributors, a systematic evaluation of candidate strategies, an evaluation of downsides and an assessment of plant specific problems associated with implementation. The implementation process will include consideration of instrumentation needs, training (including periodic exercises), consideration of decision making processes, and associated information requirements (such as computer codes to follow accident progression). The staff believes that accident management strategies should be implemented in an integrated fashion in the context of the NRC/industry framework.

Finally, the IPE, which consists of a full evaluation of the accident sequences which lead to core melt, will be performed by the licensee and reviewed by the staff. This process will produce an up-to-date picture of plant vulnerabilities for each plant individually, and will produce a pool of information concerning generically applicable insights. The IPE process is thus the most complete and efficient way of resolving the uncertainties discussed above associated with the core damage frequency for nuclear power plants including Limerick.

Most significantly, the three efforts described above (as well as several other related activities), will, as discussed in SECY-88-147, be brought to closure in an integrated fashion to assure a balanced resolution of severe accident issues.

Estimate of Risk for Limerick

An estimate of the core damage frequency associated with operation of Limerick was developed by the staff based on the review of the original Limerick Generating Station Severe Accident Risk Assessment (LGS-SARA, 1983) as documented in NUREG-1068 (1984). Since the staff review, Philadelphia Electric Company (PECo) has made numerous modifications to plant hardware and procedures. These are described by the utility in References 1-3. Two of the modifications identified made by PECo were in response to insights/recommendations identified in NUREG-1068. These involve improvements to Automatic Depressurization System (ADS) initiation logic following the potential loss of high pressure coolant sources, and improvements to achieve an alternate method of room cooling for high pressure injection systems during loss of offsite power events. These improvements were estimated in NUREG-1068 to reduce core damage frequency from internal events by about a factor of 2.5 if implemented. The staff believes that PECo has satisfactorily implemented the plant improvements involving ADS logic and room cooling and accordingly has applied this reduction factor in establishing a baseline core damage frequency (CDF) and offsite dose estimate for Limerick. The original and modified values for CDF are presented in Table 1 by accident class. A description of the accident classes is also provided. These frequency estimates are for internally-initiated events and fire- and flood-initiated events, but do not include seismically-initiated events for reasons discussed in NUREG-1068, pages C 41-42. For comparison, the results of a recent (June 1989) update to the Limerick PRA are also provided in Table 1.

The Final Environmental Statement for Limerick, NUREG-0974, provides estimates of societal risks from severe accidents initiated by internal events and external events. These risk estimates were based on core damage frequency estimates, containment performance, source terms, and an offsite consequence analysis appropriate at that time. For purposes of evaluating SAMDAs, the staff requested its contractor, Brookhaven National Laboratory (BNL), to requantify the risk estimates to reflect the implementation of the two plant modifications identified in NUREG-1068 described above. The new risk estimates reflect only the changes in accident class frequencies. The containment performance, source terms, and offsite consequence analysis remain the same as given in the FES. The modified estimates are provided in Table 2 for selected risk measures, along with the values previously reported in NUREG-0974.

The risk associated with all significant containment failure modes considered for Limerick is provided in Table 3. This provides some insight into the risk reduction potential of SAMDAs which influence a particular containment challenge or failure mode. These insights were considered by the staff in developing a set of candidate SAMDAs, recognizing that the analyses in the risk assessment include many assumptions and uncertainties which can skew the results (NUREG-0974, pages 5-108 to 5-115).

In considering the risk estimates, it is important to note that the core damage frequency estimates on which the risk reduction estimates are based do not reflect many plant improvements made since the staff's review of the original Limerick PRA. Core damage frequency estimates from the licensee's current Limerick PRA would indicate that these improvements have reduced risk.

Development of a Set of SAMDAs

In order to develop a reasonable set of SAMDAs for consideration for Limerick, the staff reviewed the 1985 report of R&D Associates (Reference 4) and the more recent work performed in support of the Containment Performance Improvement Program. Based on this review, the staff assembled a set of candidate SAMDAs. Each SAMDA and its intended function is summarized briefly below. A qualitative assessment of the relative advantages and disadvantages of the SAMDAs is presented in Table 4.

1. Dedicated Suppression Pool Cooling

An independent dedicated system could be installed for transferring heat from the suppression pool to the spray pond. PECo evaluated this alternative assuming a diesel driven 3,200 gpm pump and heat exchanger without dependence on the Station's present AC electrical power or other systems. The diesel would be cooled with water tapped off the spray pond suction line. This system can mitigate accident sequences where containment failure by overpressure occurs prior to core degradation for Class 2 sequences, such as in the TW sequence. Also some benefit may be obtained in Class 1 and 3 sequences if overtemperature failures can be avoided. It is not clear that an independent power system is needed to obtain the risk reduction associated with this SAMDA. Thus, the staff considered an alternative means of performing this function as SAMDA #2.

2. Alternate Means of Decay Heat Removal

Existing pumps, piping, and heat exchangers in the reactor water cleanup (RWCU) or other installed system may be used to remove decay heat energy. Use of the RWCU system could prevent core degradation, for Class 2 sequences, such as the TW sequence, where the reactor scrams and normal AC power is available. This means of heat removal has been identified and analyzed by the licensee of another Mark II plant and appears to be a viable alternative to containment venting. While the feasibility for Limerick has not been addressed by the staff, this option has been included here on the basis that it might prove feasible after further study.

3. Improved Venting Capability

Three cases were considered; these differed in terms of the system flow capacity (sized for ATWS versus decay heat power levels), and whether the system included a filter external to the containment.

A. ATWS-Sized Vent (without filter)

This SAMDA involves routing a large (3' to 5' diameter) hardened wetwell vent line to an elevated release point. The system would be passive and would operate without dependence on the station's present AC electrical power or other systems. A 70 psig rupture disk would be installed to minimize the likelihood of inadvertent opening. This vent could prevent containment failure, and thereby prevent core melt for accident sequences where the overpressurization is produced by Class 4 ATWSs.

B. Decay Heat-Sized Vent With Filter

This SAMDA involves routing a small hardened wetwell vent line to a filter located outside containment. The system would be capable of preventing containment overpressure for those sequences in which the steam generation rates are less than the system flow capacity, but would be ineffective for ATWS and containment bypass sequences. The system would operate without dependence on the station's present support systems. The filter would be similar in design to the Multi-Venturi Scrubber System (MVSS) and would remove essentially all particulates. This system can mitigate the consequences of all slow to moderate overpressure containment failures.

C. Decay Heat-Sized Vent Without Filter

This SAMDA entails a small hardened wetwell vent line. The system would be capable of preventing containment over-pressure, thereby averting core damage, for those sequences in which the steam generation rates are less than the vent flow capacity, but would be ineffective for ATWS and containment bypass sequences. The system would be remote-manually operated from the main control room and would not be dependent on the station's present AC electrical power system. Releases would be scrubbed by the suppression pool provided the pool is not bypassed.

4. Core Debris Control

Core debris control involves, conceptually, a hardware modification that would serve to achieve a coolable debris bed and long-term decay heat removal. Two debris control systems were evaluated by PECo: a rubble bed device and a cooled dry crucible device. The rubble bed device consists of a floodable rubble bed in the lower pedestal pool area of the wetwell. The in-pedestal drywell floor would be modified with one foot diameter holes to allow the corium to flow onto the thoria plate covered rubble bed in the lower pedestal area. A stainless steel liner would protect the pedestal concrete from excessive decomposition. The rubble bed would be kept dry until the corium had penetrated into the rubble bed, thus minimizing the potential for steam explosion. The cooled dry crucible device is a truncated 70 foot long cone which has a forced cooled water jacket to remove the decay heat. The cone starts at the basemat and extends under the current plant foundation. One foot diameter holes are drilled into the in-pedestal floor to allow the corium to flow into the cone. These designs may prevent overpressure drywell failure by limiting core-concrete interactions for Class 1 and 3 sequences, but would not prevent containment failure and subsequent core melt for Class 2 and 4 sequences. Given the expected disruption of existing structures and equipment due to installation of this SAMDA, it may not be a feasible option.

5. Drywell Overpressure/Overtemperature Protection

Two options that could help mitigate drywell failure were considered: an enhanced drywell spray system, and drywell head flooding.

A. Enhanced Drywell Spray System

An enhanced drywell spray system would recirculate suppression pool water through a heat exchanger and to the drywell sprays. PECo modelled this option as an extension to the dedicated suppression pool cooling system, discussed in Item 1 above. However, we have used cost estimates consistent with a simpler design discussed in

Reference 5. The suppression pool cooling system would prevent containment overpressure failure and core melt for Class 2 sequences. Operation of sprays will cool the drywell atmosphere and the core debris during Class 1 and 3 accidents and minimize the threat from overtemperature. However, unless the sprays terminate core-concrete interactions, the non-condensibles released from the concrete will still cause the containment to eventually fail by overpressure. In either case, the sprays would reduce the airborne fission product concentration and thus, lower the source term.

B. Drywell Head Flooding

Intentional post-accident flooding of the area above the drywell head would cool the drywell head seal and provide fission product scrubbing in the event of drywell leakage. In Limerick, this area is serviced by the standby gas treatment system (SGTS) which is normally plugged with a blind flange during refueling. To implement this SAMDA this flange must be left in place during normal plant operation. It is expected that flooding of this area must be initiated early in the accident scenario and would prevent the over-temperature failure of the drywell head flange seals.

6. Makeup to Reactor Using Low Pressure Diesel-Driven Pump

The diesel-driven low pressure reactor makeup water pump would be an existing or new pump(s) which can provide sufficient flow to the reactor vessel when the reactor is at low pressure. If there has been no core degradation, core melt could be prevented. If core melt has commenced, this flow would prevent additional fuel degradation for the intact portion of the core and may prevent or delay bottom head failure from the corium on the bottom head. This does not reduce the risk for ATWS sequences.

7. Enhanced Reactor Depressurization Capability

This SAMDA involves enhancement of the existing reactor depressurization capability to provide additional backup power (and nitrogen if needed) to operate the safety relief valves (SRVs), either individually or as part of the manually initiated automatic depressurization system (ADS). Depressur-izing the reactor would permit low pressure injection, and would convert high pressure melt ejection sequences to low pressure sequences, thereby reducing the potential for early containment failure. This SAMDA was evaluated assuming it would be implemented in combination with other SAMDAs, as discussed below.

A. In Conjunction with Decay Heat-Sized Hardened Filtered Venting (Item 3.B)

If core debris is ejected from the reactor vessel under pressure, then it is possible to fail containment during the blowdown and bypass the filtered vent. With the reactor depressurized, the challenges to containment from early over-pressure are significantly reduced, thereby increasing the effectiveness of the filtered vent.

B. In Conjunction with Core Debris Control (Item 4)

Unless the core debris control device includes some means of collecting or diverting the debris into the device, it would not be effective for accidents in which the reactor fails at high pressure. Reactor depressurization would increase the effectiveness of the core debris control device by assuring that debris is released into the device.

C. In Conjunction with Enhanced Drywell Sprays (Item 5.A)

With the reactor depressurized, the corium would tend to exit the reactor vessel in a more coherent mass and the time to containment failure would be delayed. This would increase the effectiveness of the sprays in scrubbing the aerosols and cooling the debris.

D. In Conjunction with Drywell Head Flooding (Item 5.B)

With the reactor depressurized, early containment challenges would be reduced and the time to containment failure would be delayed. This would increase the likelihood of drywell head failure/leakage as a containment failure mode, and would enhance the risk reduction potential of drywell head flooding.

E. In conjunction with reactor vessel makeup (Item 6)

Reactor depressurization would permit the use of the diesel-driven pump(s) discussed in Item 6 for injection into the reactor. This would prevent core damage for some sequences that otherwise would lead to core melt and reactor vessel failure at high pressure.

8. Reactor Building Decontamination Factor Improvement

This SAMDA involves modifications to the fire protection and/or standby gas treatment system hardware/procedures to enhance the fission product removal capabilities of the reactor building. The fire protection system consists of diesel and motor driven pumps which discharge into compartments or areas of the plant. Some of the plant areas have complete spray coverage, other areas have partial or no spray coverage. The plant would be retrofitted to have complete spray coverage. The capacity of the fire pumps would need to be increased (either by capacity or number of pumps) to ensure continuous spraying of the entire reactor building. Such a capability would provide scrubbing of fission products, given that containment fails.

The risk reduction potential of each of these candidate SAMDAs was estimated by the staff as described below. An additional SAMDA analyzed by R&D Associates in Reference 4 is Vacuum Breaker enhancements. The staff did not give further consideration to this system because our assessment is that is does not contribute appreciably to the reduction of risk. Similarly, the staff did not give further consideration to the hydrogen recombiner SAMDA, because the Limerick containment atmosphere is inerted as a defense against hydrogen burns.

Risk Reduction Potential of Candidate SAMDAs

In assessing the risk reduction potential, the value of each SAMDA was initially scoped based on the core damage frequency estimates reported in NUREG-1068, modified to reflect the improvements to ADS initiation logic and improvements to room cooling discussed therein. The modified core damage frequency estimates are reported in Table 1. The corresponding risk estimates (person-rem per reactor-year) within 50 miles of the plant for each containment failure mode are listed in Table 3. As noted above, these risk reduction estimates do not account for some features which have been added to the Limerick plant since completion of the LGS-SARA study.

Estimates of the risk reduction potential of each SAMDA were developed in consultation with the staff's contractor, Brookhaven National Laboratory (BNL). The estimated reductions, in terms of person-rem and early fatalities per reactor year are presented in Table 5. Details of the assessment for each SAMDA are presented in Appendix A.

Cost Impacts of Limerick Severe Accident Mitigation Design Alternatives

The cost impacts of the various SAMDA mitigation systems have been investigated by the staff. To fully integrate any one of these proposed systems into the Limerick Station, costs on the order of millions to tens of millions of dollars are likely to be incurred.

Relatively large costs are to be anticipated whenever physical modifications are imposed on operating or existing nuclear power reactors. This is because labor productivity is severely constrained due to problems with congestion, access, and security requirements. Also, retrofits on existing power reactors frequently require the removal and/or replacement of existing systems due to access considerations or the new system's interdependency with existing equipment and control panels. In addition, the introduction of a new system will trigger a whole series of related requirements such as incremental training, procedural changes, and licensing requirements. Finally, the retrofit could impose significant replacement energy cost penalties on the licensee and its customers if it results in incremental downtime or if it postponed the date of initial full power operation for Unit 2. These are all legitimate costs that require consideration in a comprehensive cost estimate.

Cost analyses for most of the modifications under consideration have been developed elsewhere.[4,5] The approach taken by the staff was to evaluate these estimates in order to arrive at a representative cost for each mitigation system. It should be recognized that only gross approximations of the costs of specific mitigation systems are possible at this time. Large uncertainties exist because detailed designs are not available and there is limited experience with construction and licensing problems that could surface with this type of work. Nevertheless, the staff views the results of this review as adequate given the uncertainties surrounding these underlying cost estimates, and the level of precision necessary given the greater uncertainty inherent on the benefit side, with which these impacts were compared.

Table 6 depicts the cost estimates available from R & D Associates (RDA),[4] and Bechtel Power Corp.[5] whose report was prepared for the Philadelphia Electric Company (PECo). It should be noted that RDA's report provides cost results on a component basis and in several instances the staff has summed the component costs to produce systems comparable with those costed by PECo (Bechtel report).

Where aggregation of this nature occurs, it is noted in Table 6. Also, the RDA report provides different cost estimates based on reactor status (A - reactor in design stage, B - reactor under construction, and C - operating reactor). Cost estimates for operating reactors (case C), were judged most consistent with the current status of the Limerick Station and are adopted in Table 6. When comparable systems are costed by PECo and RDA, PECo's estimates are consistently higher, in most instances by an order of magnitude. Smaller cost differences are observed for the ATWS vent option (factor of 2), and for the gravel bed venting and filtering system (factor of 4).

The final column of Table 6 contains the staff's estimate for each mitigation system. These costs reflect decrements and increments to the PECo and RDA estimates based on a critical assessment of the assumptions embedded in their analyses and the staff's technical judgement. A general discussion of the cost elements contributing to the staff's cost estimates is provided in Appendix B.

Cost/Benefit Comparison for Candidate SAMDAs

A comparison of the estimated costs and benefits of the various SAMDAs is presented in Table 7. For those SAMDAs that were not addressed by the licensee, the costs estimates developed as part of the NRC Containment Performance Improvements (CPI) program were used where available.[6] The risk reduction potential for each option is based on the estimates given in Table 5. The averted offsite dose (person-rem per reactor year) was used as a surrogate measure of risk and environmental impact. A screening criterion of $1000 per person rem averted was used to identify SAMDA's which warrant further evaluation.

Based on this screening analysis, a set of seven potential SAMDAs was identified for more detailed evaluation. These included:

- Alternate Means of Decay Heat Removal (Options 2. and 3.C.)
- ATWS-Sized Vent
- Enhanced Reactor Coolant System Depressurization
- Enhanced Drywell Sprays
- MVSS Filtered Containment Vent
- Low Pressure Makeup to Reactor
- Drywell Head Flooding

Evaluation

For the seven candidate SAMDAs which passed the cost/benefit screening, the staff performed a further evaluation. The evaluation accounted for a number of factors which were not considered in the screening analysis. These included: plant improvements made since the publication of NUREG-1068 which were not considered in the staff's estimates of CDF; SAMDAs which exist in the plant which were not credited in the screening analysis; uncertainties in the cost and effectiveness of candidate SAMDAs; and potential operational disadvantages of SAMDAs.

1. Alternate Means of Decay Heat Removal

   Given the cost/benefit analysis performed above, this option appears to have significant potential for risk reduction by lowering the core damage frequency due to loss-of-containment-heat-removal sequences (TW). However, a feature which is already installed in the plant, containment venting, appears to be a viable means for achieving this function. The staff has performed a preliminary assessment of the hardware and procedures associated with this capability. It is the staff's judgment that the use of the existing system and procedures could be a viable option for reducing the frequency of TW sequences, especially given the slow moving nature of these sequences (20-30 hours to core melt). The efficacy of this system and potential operational disadvantages have not been reviewed by the staff. Accordingly, the benefit that an additional heat removal system might provide would be minimal.

2. ATWS-Sized Vent

   In Class IV ATWS sequences core melt occurs as a result of containment failure. The ATWS vent is intended to reduce risk by preventing containment failure thereby lowering the ATWS core damage frequency. As shown in Table 7, this system not only passes the screening analysis based on averted offsite dose, but it could also reduce the principal source of early fatalities. This is the only candidate SAMDA which substantially reduces early fatalities.

   A closer look at this system, however, raises questions about its effectiveness. First, a large fraction of the risk reduction attributed to this option in Table 5 is from Class II (TW) sequences. As noted above, the staff believes that the existing containment vent appears capable of effectively dealing with this class of sequences. Thus, the risk reduction benefit of the ATWS vent would be confined to Class IV ATWS sequences (an averted risk of 18 rather than 88 person rem per reactor year). The licensee estimates an averted risk of 27 person rem per reactor year.

   An additional source of uncertainty is the basis for the utility's proposal to use an existing 18 inch purge line penetration, based on the assumption that ATWS power would be 10% of full power. Depending on the circumstances of the event, and the assumptions used in the analysis, some existing studies predict ATWS power to be considerably higher than 10 percent. This would require a new large containment penetration and would, therefore, considerably increase the cost of this SAMDA.

3. Enhanced Reactor Coolant System Depressurization

Class I and Class III sequences consist of transients (and ATWS) in which the core melts with the containment intact. The radiological consequences of those sequences can be mitigated significantly if early containment failure can be avoided. For instance, a delay of several hours in the time to containment failure can result in a significant reduction of the fission product inventory in the containment atmosphere, as a result of natural processes such as aerosol deposition and operation of active systems such as drywell sprays.

An important uncertainty about early containment failure for Limerick is the possibility of vessel failure at high pressure due to unavailability of the Automatic Depressurization System (ADS). Despite the ADS improvements at Limerick since publication of the LGS-SARA study, the risk estimates used for the screening analysis indicate a high likelihood of reactor pressure vessel failure at high pressure versus low pressure.

A more recent assessment of core damage frequency performed by the licensee concludes that (1) the overall frequency of Class I and Class II sequences is considerably lower than the staff estimates and (2) the fraction of high pressure sequences is much lower than indicated in the FES. If this conclusion is correct, further improvements to assure reactor depressurization would have a minor impact on risk reduction. The staff has not reviewed the licensee analysis in sufficient detail to verify these quantitative estimates.

4. Enhanced Drywell Sprays

Drywell sprays can be effective in delaying containment failure and reducing the radiological releases for Class I and Class III sequences in which the containment does not fail early. In combination with the depressurization of the RCS, enhancements to containment sprays appear to have considerable risk reduction potential (Table 5) and pass the screening analysis (Table 7). However, the perceived risk reduction benefits from enhanced sprays result from mitigation of Class I and Class III sequences. As noted above, the licensee's estimates of risk from Class I and Class III sequences are considerably lower than those used by the staff in our screening analysis.

5. Filtered Containment Vent

The MVSS filtered vent appears to have significant potential for risk reduction (Table 5) for Class I and Class III sequences and warrants further evaluation based on cost/benefit ratio (Table 7). However, as noted above, the licensee's estimates of Class I CDF are considerably lower than the staff's. Furthermore, if the existing containment vent is effective in mitigating Class II sequences, the perceived benefit of MVSS would be further reduced.

6. Low Pressure Makeup To Reactor

This SAMDA appears to have risk reduction potential for those Class I accident sequences in which core melt would result from a failure of low pressure injection.

There is a significant potential disadvantage of this type of SAMDA. If the piping and hardware associated with this system is not designed to withstand reactor system pressure, the possibility exists of creating a LOCA outside of containment in the event that the RCS returned to high pressure after the SAMDA was connected.

The staff is aware that Limerick has already implemented a SAMDA of this type, using the existing diesel-driven fire suppression pump and piping for injection into the RWCU. The staff has not reviewed this existing capability in detail.

7. Drywell Head Flooding

Examination of the table of costs, benefits and cost-effectiveness ratios for Limerick indicates support for this SAMDA option. However, the scoping analysis needs further refinement in order to be in a better position to determine whether this option is worthwhile. The potential benefit envisioned for this SAMDA is directed toward reducing the risks from Class I and III accidents. The averted offsite risk estimated for this option in table 7 is approximately 50 person-rem. The utility has performed an analysis with substantially lower core damage frequency and risk-reduction benefits based on recent modifications made to the plant. Although the staff has not verified the quantitative risk estimates it is reasonable to expect that the plant modifications would reduce offsite risk. Also, cost estimates are very uncertain due to unavailability of detailed design information on modifying the drywell head configuration and on corresponding cost estimates. Furthermore, this SAMDA does not appear to preclude the possibility of other failures during accident progression that would lead to source terms for radioactivity released to the environment equivalent to those from the unmitigated case.

<u>Summary and Conclusions</u>

The NRC staff has completed consideration of a reasonable set of severe accident mitigation design alternatives (SAMDAs). The staff has discovered no substantial changes in the proposed action as previously evaluated in the FES that are relevant to environmental concerns nor significant new circumstances or infor-mation relevant to environmental concerns and bearing on the licensing of Limerick Generating Station, Units 1 and 2.

In assessing the risk reduction potential, the value of each SAMDA was initially scoped based on risk information reported in the original Limerick Generating Station Severe Accident Risk Assessment (LGS-SARA, 1983) and reviewed by the staff in the 1983-1984 timeframe (NUREG-1068, August 1984).

Modifications were made to this information base to account for the effect of two plant improvements identified in NUREG-1068 and subsequently implemented by PECo. The risk reduction scoping estimates were compared to the estimated costs associated with each SAMDA. Based on a screening criterion of $1000 per averted person-rem, the comparison indicated that some candidate SAMDAs warranted further evaluation.

The staff then further evaluated each of the SAMDAs, considering the qualitative effect of several plant improvements made at Limerick since the time of the staff review of the LGS-SARA. Key plant improvements include the implementation of: procedures for battery power load shedding, MSIV air supply improvements, BWR Owners' Group Emergency Procedure Guidelines, Rev. 3 (and parts of Rev. 4), the hardened containment vent line, and procedures for the use of diesel-driven fire spray pumps for core injection. The staff also gave consideration to the results of a recent update to the Limerick PRA described in an April 25, 1989 ACRS subcommittee meeting, a June 23, 19[illegible] utility submittal concerning SAMDAs, and a July 27, 1989 meeting with the staff concerning the SAMDA submittal. That study calculated values of CDF and offsite dose which were about four times lower than the staff's. While the staff has not reviewed these results in sufficient detail to confirm the quantitative results, the staff believes that these plant features would reduce the CDF and offsite doses. As a result, the averted offsite dose from candidate SAMDAs could be appreciably less than estimated by the staff.

The staff also considered uncertainty in the cost and effectiveness of candidate SAMDAs. For instance, the ATWS vent analyzed by the utility uses an existing 18 inch containment penetration which would be capable of removing 10 percent of full power. There are existing analyses which predict ATWS power levels as high as 30 percent for some scenarios. The staff identified operational disadvantages for some of the candidate SAMDAs (Table 4).

Of the seven SAMDAs which passed the screening cost/benefit test, the staff has identified two which have been implemented at Limerick. These are the Decay Heat Sized Vent Without Filter (3.C.) and the Low Pressure Reactor Makeup Capability (6.) The staff has not quantified the effectiveness of these SAMDAs in reducing risk. However, the staff believes that these features will result in an appreciable net decrease in CDF and risk.

In summary, the risks and environmental impacts of severe accidents at Limerick are acceptably low. We have found no new information that would call into question the FES conclusion that, "the risks of early fatality from potential accidents at the site are small in comparison with risks of early fatality from other human activities in a comparably sized population, and the accident risk will not add significantly to population exposure and cancer risks. Accident risks from Limerick are expected to be a small fraction of the risks the general public incurs from other sources. Further, the best estimate calculations show that the risks of potential reactor accidents at Limerick are within the range of such risks from other nuclear power plants," (NUREG-0974, Page 5-126).

Furthermore, while the screening cost/benefit analysis performed above indicates that several candidate SAMDAs might be cost effective, based on a criterion of $1000 per person-rem averted a more recent utility PRA presents lower risk estimates which indicate that SAMDAs are not justified. While the staff has not verified the utility estimates, the staff is convinced that risk is now lower for Limerick than the estimates used in our cost/benefit study. Moreover, there are uncertainties about the costs, effectiveness, and/or operational disadvantages of some SAMDAs. In light of these considerations, the staff has no clear basis at this time for concluding that modifications to the plant are justified for the purpose of further mitigating severe accident risks.

In the longer term, these same severe accident issues are currently being pursued by the NRC in a systematic way for all utilities through the Severe Accident Program described in SECY-88-147, "Integration Plan for Closure of Severe Accident Issues" (Reference 7). The plan includes provisions for an Individual Plant Examination (IPE) for each operating reactor, a Containment Performance Improvement (CPI) program, and an Accident Management (AM) program. These programs will produce a more complete picture of the risks of operating plants and the benefits of potential design improvements, including SAMDAs. The staff believes that the severe accident program is the proper vehicle for further review of severe accidents at nuclear power plants, including Limerick. For example, the Containment Performance Improvement (CPI) program is in the process of performing an integrated assessment of generic containment improvements for Mark II plants. The assessment entails a broad perspective of all Mark II plants, including their vulnerabilities and potential improvements. A set of SAMDAs is being considered which deals with the overall issue of containment performance and fission product control, using the most current understanding of source term behavior.

This supplement has made use of the risk insights and cost estimates from that program for the purpose of performing our screening assessment of SAMDAs. However, further work on SAMDAs for nuclear power plants including Limerick should continue within the CPI program. To do otherwise would duplicate effort, and would not result in a consistent resolution for Mark II plants.

In addition, many of the candidate SAMDAs (2., 5.B., 6., and 7.) fall into the category of Accident Management. The severe accident program is currently developing, in concert with the industry, an analytical "framework" which utilities will use for the purpose of identifying and implementing an optimum set of accident management strategies. The identification process will include a balanced assessment of risk contributors, a systematic evaluation of candidate strategies, an evaluation of downsides and an assessment of plant specific problems associated with implementation. The implementation process will include consideration of instrumentation needs, training (including periodic exercises), consideration of decision making processes, and associated information requirements (such as computer codes to follow accident progression). The staff believes that accident management strategies should be implemented in an integrated fashion in the context of the NRC/industry framework.

Finally, the IPE, which consists of a full evaluation of the accident sequences which lead to core melt, will be performed by the licensee and reviewed by the staff. This process will produce an up-to-date picture of plant vulnerabilities for each plant individually, and will produce a pool of information concerning generically applicable insights. The IPE process is thus the most complete and efficient way of resolving the uncertainties discussed above associated with the core damage frequency for nuclear power plants including Limerick.

Most significantly, the three efforts described above (as well as several other related activities), will, as discussed in SECY-88-147, be brought to closure in an integrated fashion to assure a balanced resolution of severe accident issues.

References

1. Presentation by Philadelphia Electric Company to the Advisory Committee on Reactor Safety in the Matter of Limerick 2 Operating License, April 25, 1989.

2. Letter from G. A. Hunger, Philadelphia Electric Company to the NRC, Subject: Limerick Generating Station, Units 1 and 2, Response to Request for Additional Information Regarding Consideration of Severe Accident Mitigation Design Alternatives, June 23, 1989.

3. Presentation by Philadelphia Electric Company to the NRC Staff, July 27, 1989.

4. NUREG/CR-4025, "Design and Feasibility of Accident Mitigation Systems for Light Water Reactors," R & D Associates, August 1985.

5. "Cost Estimate for Severe Accident Mitigation Design Alternatives -- Limerick Generating Station for Philadelphia Electric Company," Bechtel Power Corporation, June 22, 1989.

6. "A Preliminary Assessment of BWR Mark II Containment Challenges, Failure Modes, and Potential Improvements," Draft NRC Report, August 4, 1989.

7. SECY-88-147, "Integration Plan for Closure of Severe Accident Issue," May 25, 1988.

TABLE 1 - ESTIMATES OF CORE DAMAGE FREQUENCY FOR LIMERICK
(EXCLUDING SEISMICALLY-INITIATED EVENTS)

ACCIDENT CLASS[1]	FREQUENCY (PER REACTOR-YEAR) ORIGINAL (NUREG-1068)	MODIFIED[2]	June 1989 PRA UPDATE
I	8.0 E-5	3.4 E-5	8.8 E-6
II	4.1 E-6	4.1 E-6	1.7 E-7
III	3.3 E-6	3.3 E-6	2.7 E-7
IV	3.2 E-7	3.2 E-7	1.1 E-6
S	2.7 E-8	2.7 E-8	1.0 E-8
TOTAL	8.8E-5	4.2 E-5	1.0 E-5

[1] Accident Class Definitions

CLASS 1 (or I)	Transients or LOCAs involving loss of coolant makeup to the core. Core melts in an intact containment.
CLASS 2 (or II)	Transient or LOCA involving loss of long term heat removal. Long term core melts in a failed or open containment.
CLASS 3 (or III)	Transients with failure to scram with failure of all injection. Rapid core melt in an intact containment.
CLASS 4 (or IV)	Transient with failure to scram and failure to shutdown. Rapid core melt in a failed or open containment.
CLASS S	Core melt due to reactor pressure vessel failure with early containment failure.

[2] Modified to reflect ADS and room cooling enhancements identified in NUREG-1068.

TABLE 2 - RISK ESTIMATES FOR LIMERICK UNIT 2
(EXCLUDING SEISMICALLY-INITIATED EVENTS)

CONSEQUENCE TYPE	ESTIMATED RISK WITHIN ENTIRE REGION, PER REACTOR YEAR: FES (EXCLUDING SEISMIC)	MODIFIED[1] STAFF ESTIMATES
Early fatalities with supportive medical treatment (persons)	2(-4)	1.9(-4)
Latent Cancer fatalities (excluding thyroid) (persons)	5(-2)	3.2(-2)
Total person-rems	1(3)	5.4(2)
Land area for long-term interdiction (m^2)	N/A[2]	6.3(2)

[1] Based on modified accident class frequencies in Table 1 (excludes seismically-initiated events).

[2] Not Available

TABLE 3 - CONTRIBUTION TO RISK BY CONTAINMENT FAILURE MODE

CONTAINMENT FAILURE MODE	ESTIMATED RISK (PERSON-REM/REACTOR-YEAR)[1] Entire Region	50 Mile Region
Overpressure due to failure of decay heat removal - core melts into failed containment (Class II)	114	80
Overpressure due to ATWS - core melts into failed containment (Class IV)	25	18
Transient leads to core melt followed by drywell failure (Class I and III)	129	90
Transient leads to core melt followed by wetwell failure (Class I and III)	46	32
Transient leads to core melt - containment leakage exceeds standby gas treatment system capacity (Class I and III)	198	139
Other	15	11
TOTAL	527	370

[1] Based on modified accident class frequencies in Table 1.

TABLE 4 QUALITATIVE ASSESSMENT OF THE RELATIVE ADVANTAGES AND DISADVANTAGES OF SAMDAS

	Potential Improvement	Advantages	Disadvantages
1.	Dedicated Suppression Pool Cooling	° Helps to maintain suppression pool subcooled ° Reduces overpressure challenge from Class II sequences ° Reduces pressurization rate for ATWS	° Very expensive
2.	Alternate Means of Decay Heat Removal (e.g., use of RWCU system)	° Helps to maintain pool subcooled ° Reduces overpressure challenge for Class III sequences ° Reduces pressurization rate from ATWS ° Less expensive than dedicated pool cooling system	° Less reliable than dedicated system due to reliance on shared components
3A.	ATWS-Sized Vent	° Reduces overpressure failures for ATWS and Class II sequences ° Preemptive venting reduces base pressure prior to core damage	° Suppression pool bypass would result in unscrubbed release ° Can lead to inadvertent releases
3B.	Decay Heat-Sized Vent with Filter	° Reduces overpressure failures for transients with scram ° Delays ATWS ° Preemptive venting reduces base pressure prior to core damage ° Helps to assure all releases will be scrubbed ° Unaffected by suppression pool bypass	° Can lead to inadvertent releases of noble gases

	Potential Improvement	Advantages	Disadvantages
3C.	Decay Heat-Sized Vent without Filter	° Reduces overpressure failures for transients with scram ° Delays ATWS ° Preemptive venting reduces base pressure prior to core damage ° Less expensive than filtered vent	° Suppression pool bypass would result in unscrubbed release ° Can lead to inadvertent releases
4.	Core Debris Control (Conceptual)	° Helps to maintain core debris coolable ° Helps to eliminate containment challenges following reactor vessel failure	° May not be effective if reactor pressure vessel fails at high pressure ° Very expensive
	Adding in-pedestal downcomers and debris barrier	° Increases likelihood of quenching the core ex-vessel ° Reduces importance of containment sprays and venting	° Increases the likelihood of steam explosion/spikes ° Increases the probability of suppression pool bypass ° Requires re-analysis of containment pressure suppression capability and seismic design ° Expensive
	Strengthening ex-pedestal downcomers	° Decreases the probability of suppression pool bypass	° Does not reduce erosion of the drywell floor ° Requires re-analysis of containment pressure suppression capability and seismic design ° Expensive
5A.	Enhanced Drywell Spray System	° Reduces containment overpressure from condensibles ° Reduces drywell overtemperature failure ° Scrubbing of fission products ° Reduce core-concrete interactions	° None identified

	Potential Improvement	Advantages	Disadvantages
5B.	Drywell Head Flooding	° Mitigates drywell head seal overtemperature failure ° Drywell head leakage would be scrubbed by overlaying water pool	° Must be initiated early in the accident
6.	Makeup to Reactor Using Low Pressure Diesel-Driven Pump	° Helps to prevent core melt in low pressure transients with scram ° Some cooling and scrubbing of ex-vessel debris ° Independent of RHR ° Relatively low cost, if fire system pumps are used	° Requires reactor at low pressure for injection ° Potential conflict for concurrent fire, if fire system used ° Requires many operator actions
7.	Enhanced Reactor Depressurization Capability	° Can prevent high pressure core melt transients ° Reduces containment challenges from high pressure melt ejection ° Relatively low cost	° None identified
8.	Reactor Building Decontamination Factor Improvement	° Scrubbing of fission products ° Much of the hardware already in place	° Existing hardware provide limited spray coverage ° May provide a greater benefit as an alternate containment spray or RPV injection system ° Increased probability of hydrogen fumes

TABLE 5 STAFF ESTIMATES OF RISK REDUCTION BENEFITS FOR SAMDAS BASED ON MODIFIED NUREG-1068 ACCIDENT FREQUENCIES

MITIGATION FEATURE	EVALUATED BY PECO?	REDUCTION IN PERSON-REM/RY[1] CLASS I	CLASS II	CLASS III	CLASS IV	TOTAL	REDUCTION IN EARLY FATALITIES/RY
1. DEDICATED SUPPRESSION POOL COOLING	YES	0/193[1]	80/80	0/79	0/18	80/370	
2. ALTERNATE MEANS OF DECAY HEAT REMOVAL (e.g. RWCU SYSTEM)	NO	0	80	0	0	80	
3. IMPROVED VENTING CAPABILITY (HARDENED, PASSIVE)							
A. ATWS-SIZED VENT	YES	0	70	0	18	88	2×10^{-4}
B. DECAY HEAT-SIZED VENT W/FILTER	YES	106	70	39	0	215	
C. DECAY HEAT-SIZED VENT W/O FILTER	NO	0	70	0	0	70	
4. CORE DEBRIS CONTROL	YES	20	0	0	0	20	
5. DRYWELL OVERPRESSURE/OVER-TEMPERATURE PROTECTION							
A. DRYWELL SPRAYS	YES	71	80	27	0	178	
B. DRYWELL HEAD FLOODING	NO	46	0	4	0	50	
6. MAKEUP TO REACTOR USING LOW PRESSURE DIESEL-DRIVEN PUMP	NO	20	80[3]	0	0	100	

[1] Numbers to the right of the "slash" represent the current value of offsite dose for that accident class, before installation of SAMDAs.

MITIGATION FEATURE	EVALUATED BY PECO?	REDUCTION IN PERSON-REM/RY[1] CLASS I	CLASS II	CLASS III	CLASS IV	TOTAL	REDUCTION IN EARLY FATALITIES/RY
7. ENHANCED REACTOR DEPRESSURIZATION CAPABILITY	NO						
A. IN CONJUNCTION WITH 3B		193	70	39	0	302	Footnote 2
B. IN CONJUNCTION WITH 4		193	0	0	0	193	Footnote 2
C. IN CONJUNCTION WITH 5A		129	80	27	0	236	Footnote 2
D. IN CONJUNCTION WITH 5B		84	0	4	0	88	Footnote 2
E. IN CONJUNCTION WITH 6		193	80	0	0	273	Footnote 2
8. REACTOR BUILDING DF IMPROVEMENT	NO	46	0	4	0	50	

1 [VALUE OF REDUCTION]/[TOTAL FOR CLASS], STAFF ESTIMATES BASED ON LGS-SARA (1983) MODIFIED TO REFLECT ADS AND ROOM COOLING ENHANCEMENTS IDENTIFIED IN NUREG-1068. VALUES PRESENTED ARE FOR THE 50-MILE REGION.

2 THE UPPER BOUND IN NUREG-1068, WHICH ASSUMED CONTAINMENT FAILURE AT VESSEL BREACH FOR CLASS I EVENTS, WILL BE REDUCED.

3 ASSUMES THAT CORE INJECTION CAN BE MAINTAINED AFTER CONTAINMENT FAILURE.

TABLE 6 PER REACTOR COSTS FOR SAMDAS*
(Millions of 1990 Dollars)

	RDA	PECo	NRC[a]
I. DEDICATED SUPPRESSION POOL COOLING (SAMDA 1.)			
I.1 Dedicated Suppression Pool Cooling		25.6	20.9
I.2 Dedicated Surface Sited Heat Removal System	2.8		19.4
I.3 Dedicated Underground Heat Removal System	2.5		19.0
II. DRYWELL SPRAY (SAMDA 5.A.)			
II.1 Enhanced Drywell Spray System (new spray headers)[b]		46.5	37.3
II.2 Enhanced Drywell Spray System (existing spray headers)[b]		27.0	21.4
II.3 External Drywell Spray System[c]	3.7		35.9
II.4 Internal Drywell Spray System[c]	3.3		35.2
III. CORE DEBRIS CONTROL (SAMDA 4.)			
III.1 Rubble Bed Core Retention Device		38.4	35.5
III.2 Central Basemat Core Retention System	3.4		33.3
III.3 Dry Crucible Core Retention Device		118.8	108.8
III.4 Dry Crucible[d]	18.7		116.1
III.5 Core Distribution on Diaphragm Floor	3.3		9.2
IV. ATWS-SIZED VENT (SAMDA 3.A.)			
IV.1 ATWS Clean Steam Vent		3.9	2.6
IV.2 Clean Steam Venting to Stack	1.7		2.7
V. DECAY HEAT SIZED VENT WITH FILTER (SAMDA 3.B.)			
V.1 Gravel Bed Filter		11.3	9.2
V.2 Venting and Filtered System	2.8		5.9

Table 6 (Con't)

		RDA	PECo	NRC[a]
V.3	Multi-Venturi Scrubber System		5.7	4.0
V.4	Hardened Wet Well Vent		3.1	2.0
V.5	Combination Venting System	4.2		9.0
V.6	Large Chilled Filter System	2.9		6.7

Footnotes

* Systems that are grouped together are viewed as reasonably comparable (e.g., VI and V2.)

a. NRC estimates were derived based on adjustments to PECo and RDA estimates. PECo estimates were revised downward in the following two areas:
1. all AFUDC was disallowed;
2. engineering cost was recalculated based on 25% of direct construction cost.

RDA estimates were revised upward based on the following adjustments:
1. RDA options I.2, I.3, III.2, and III.4 are assumed to incur replacement energy cost penalties. Costs are based on number of days assumed for comparable systems costed by PECo and daily cost of $500,000 based on NUREG/CR-4012, Vol. 2. RDA items II.3 and II.4 also include replacement costs because they include option I.2 (see footnote c). For all these options, this is the dominant NRC adjustment;
2. engineering cost was recalculated based on 25% of direct construction cost;
3. cost allowance was made for the present worth of 40 years of operation and maintenance expenses;
4. cost allowance was made for regulatory/licensing, and procedural activities;
5. cost allowance was made for training;
6. labor installation cost was increased to reflect lower labor productivity for completed and operating reactors, and learning curve effects;
7. total cost is adjusted to account for general inflation between 1983-4 and 1990; and
8. RDA's contingency factor of 1.25 is applied to the recalculated total cost.

b. These systems include costs of system I.1

c. These systems include costs of system I.2

d. This system includes cost of system I.2

TABLE 7
COMPARISON OF COSTS AND BENEFITS OF SAMDAs FOR LIMERICK

Design Alternative	Estimated Cost (Millions of 1990 Dollars)	Averted Risk (Person-rem per Reactor-Year	Dollars per Person-Rem Averted[1]
1. Dedicated Suppression Pool Cooling	21	80	6600
2. Alternate Means of Decay Heat Removal	Minimal[2]	80	300
3. Improved Venting Capability			
A. ATWS-Sized Vent	3	88	850
B. Decay Heat-Sized Vent with Filter	4[3]	215	500
C. Decay Heat-Sized Vent without Filter	2	70	700
4. Core Debris Control	35	20	44000
5. Drywell Overpressure/ Overtemperature Protection			
A. Drywell Sprays	3[5]	178	400
B. Drywell Head Flooding	Minimal[2]	50	500
6. Makeup to Reactor Using Low Pressure Diesel-Driven Pump	Minimal[2]	100	250
7. Enhanced Reactor Depressurization Capability	2[5]		
A. In Conjunction with #3B	6	302	500
B. In Conjunction with #4	37	193	4800
C. In Conjunction with #5A	5	236	500
D. In Conjunction with #5B	Minimal[2]	88	300
E. In Conjunction with #6	3	273	300
8. Reactor Building Decontamination Factor Improvement	3[6]	50	1500

[1] Estimated assuming a 40 year plant life.
[2] Detailed cost estimates not available but expected to be minimal. SAMDA would involve minor modifications to hardware, procedures, and training. For purposes of estimating the cost/benefit ratio, a cost of 1 million dollars was assumed.
[3] Cost for a multi-venturi scrubber system (MVSS)
[4] Not available.
[5] Reference 6.
[6] This modification was assumed to be similar in cost to option 5.A.

APPENDIX A: RISK REDUCTION BENEFITS FOR CANDIDATE SAMDAS

The risk reduction benefits[1] for the various candidate SAMDAs are based on the information in Tables 1, 2, and 3. The tables present total person-rem/reactor-year, land area for long-term interdiction and early fatality estimates. These risk estimates are based on accident frequency estimates that resulted from the BNL review (NUREG/CR-3028) of the Limerick PRA but which also take into account the NRC staff's recommendations given in NUREG-1068. The NRC recommendations have been implemented at Limerick and result in a 2.5 reduction in the Class 1 accident frequency estimates relative to the numbers given in NUREG/CR-3028.

1. <u>Enhanced Suppression Pool Cooling</u>

This SAMDA is designed to maintain suppression pool subcooling. The main potential benefit is to prevent the overpressure challenge for Class 2 accident sequences. The assumption is that the SAMDA would be designed for decay heat levels and would not therefore be effective for mitigating Class 4 accident sequences. In addition maintaining suppression pool subcooling does not mitigate the containment challenges for Class 1 and 3 accidents so that this SAMDA is only effective for Class 2 accidents.

Potential benefit: 80 person-rem/reactor-year

2. <u>Alternative RHR System</u>

This SAMDA will provide the same potential benefit as described above.

3. <u>Improved Venting Capability</u>

3A. <u>ATWS Sized Vent</u>

This would be a "clean" vent system sized for mitigating Class 4 ATWS accidents. The vent would be opened prior to core damage in order to prevent structural failure of the containment. The main potential benefit is, therefore, to prevent containment failure and hence core damage for Class 4 accidents. However, the vent would also be helpful for preventing containment failure and core melt for Class 2 accidents. The vent could not be very effective for mitigating Class 1 and 3 accidents without some form of filtering. Even if the vent was taken from the wetwell air space suppression pool bypass mechanisms could still result in a significant fission product release (principally from core/concrete interactions and revolatilizations from the reactor vessel). Therefore no mitigation of Class 1 and 3 accidents was assumed for this vent.

Potential benefit:

Class 1 (No mitigation) =	--
Class 2 (Factor of 10 reduction) =	70
Class 3 (No mitigation) =	--
Class 4 (100% mitigation) =	18
TOTAL	88 person-rem/year

[1] The risk reduction estimates in this appendix have been rounded in some cases. These approximations have no appreciable impact on the outcome of the cost benefit analysis.

3B. Decay Heat Sized Vent with Filter

This SAMDA would provide some mitigation of Class 1, 2, and 3 accidents but not Class 4 ATWS events. However, some fraction of Class 1 accidents and the majority of Class 3 accidents are predicted to have the reactor vessel at high pressure during core meltdown. If the core debris is ejected from the reactor vessel under pressure then it is possible for the containment to fail during the blowdown. Because of uncertainty in containment performance during high pressure core meltdown accidents, the vent is assumed to be only 50% effective for mitigating these events.

Potential benefit:

Class 1 high pressure (50% mitigation)	87
Class 1 low pressure (100% mitigation)	19
Class 2 (Factor of 10)	70
Class 3 high (50% mitigation)	39
Class 4 (no mitigation)	--
TOTAL	215 person-rem/reactor-year

3C. Decay Heat Sized Vent Without Filter

This vent would be effective for mitigating only Class 2 accidents. It would not be effective for Class 4 ATWS events or for Class 1 and 3 accidents (because of suppression pool bypass).

Potential benefit:

Class 1 (No mitigation) =	--
Class 2 (Factor of 10) =	70
Class 3 (No mitigation) =	--
Class 4 (No mitigation) =	--
TOTAL	70 person-rem/reactor-year

4. Core Debris Control

This SAMDA would be designed to prevent core/concrete interactions and remove decay heat from the core debris. The SAMDA would therefore be effective for mitigating containment challenges associated in the high pressures and temperatures caused by core/concrete interactions (i.e., Class 1 and 3 accidents only). However, unless the SAMDA includes some form of collection device (or way of directing the core into the SAMDA) it would not be effective for core meltdown accidents with the reactor vessel at high pressure. Thus the SAMDA is assumed to be effective for mitigating only those fraction of Class 1 accidents that are at low pressure during core meltdown.

Potential benefit:

Class 1 high pressure (No mitigation)	--
Class 1 low pressure (100% mitigation)	20
Class 2 (No mitigation)	--
Class 3 high (No mitigation)	--
Class 4 (No mitigation)	--
TOTAL	20 person-rem/year

5. Drywell Overpressure/Overtemperature Protection

5A. Enhanced Drywell Spray System

Ensuring spray operation during Class 1 and 3 accidents has the potential to cool the drywell atmosphere and the core debris and thus minimize the threat from overtemperature. However, unless the sprays terminate core/concrete interactions, the non-condensibles released form the concrete will still cause the containment to eventually fail because of overpressure. However, even if the containment fails, the sprays would reduce the airborn fission product concentration and thus lower the source term. A DF of 3 was assumed for the sprays if the containment eventually fails. Again because of uncertainty associated with high pressure core meltdown the sprays are assumed to mitigate only 50% of the high pressure accident sequences.

The enhanced spray system would be designed to remove the decay heat so that it could potentially mitigate Class 2 sequences. However, it could not prevent containment failure and core melt for Class 4 ATWS events.

Potential Benefit:

Class 1 high pressure (50% mitigation with DF-3) =	59
Class 1 low pressure (100% mitigation with DF-3) =	13
Class 2 (100% mitigation) =	80
Class 3 high pressure (50% mitigation with DF-3) =	26
Class 4 (no mitigation) =	--
TOTAL	178 person-rem/reactor-year

5B. Drywell Head Flooding

This modification requires flooding of the drywell head. It could potentially mitigate those accidents that result in leakage through the drywell head (refer to Table 1).

Potential Benefit:

Class 1 (high pressure) leakage =	113 person-rem/reactor-year
Class 1 (low pressure) leakage =	13 person-rem/reactor-year
Class 3 (high pressure) leakage =	13 person-rem/reactor-year

Because of uncertainty in containment performance for high pressure core melt accidents a 50% effectiveness is again assumed. Also a pool DF of only 3 was assumed for assessing the effectiveness of this SAMDA.

Potential Benefit:

Class 1 high pressure (50% mitigation, DF-3) =	38	
Class 1 low pressure (DF-3) =	8	
Class 3 high pressure (50% mitigation, DF-3) =	4	
TOTAL	50	person-rem/year

6. Enhanced Reactor Vessel Depressurization

Enhanced reactor vessel depressurization will have very little impact on the plant risk estimates unless used in conjunction with other SAMDAs. This is because even with the reactor vessel depressurized the containment is predicted to fail early (within 3 hours) so that there is little attenuation of the source term during this time period using WASH-1400 methods.

However, some of the SAMDAs considered above that were assumed to be only effective for 50% of the high pressure accidents will be more effective when coupled with depressurization. For the purpose of this analysis, all Class 1 sequences were assumed to be at low pressure, but Class 3 sequences were assumed to be high pressure events.

6A. In Conjunction with 3B

Potential Benefit:

Class 1 all low pressure (100% mitigation) =	193	
Class 2 (Factor of 10) =	70	
Class 3 high pressure (50% mitigation) =	39	
Class 4 (No mitigation) =	--	
TOTAL	302	person-rem/reactor-year

6B. In Conjunction with 5A

Potential Benefit:

Class 1 all low pressure (DF-3) =	129	
Class 2 (100% mitigation) =	80	
Class 3 high pressure (50%, DF-3) =	27	
Class 4 (No mitigation) =	--	
TOTAL	236	person-rem/reactor-year

6C. In Conjunction with 5B

Potential Benefit:

Class 1 all low pressure (DF-3) =	84	
Class 3 high pressure (50%, DF-3) =	4	
TOTAL	88	person-rem/reactor-year

6D. In Conjunction with 4

Potential Benefit:

Class 1 all low pressure =	193	
Class 3 high pressure (no mitigation)	--	
TOTAL	193	person-rem/reactor-year

7. Diesel-Driven Low Pressure Reactor Makeup Water System

This SAMDA can potentially prevent core damage for those accident sequences in which the reactor vessel is depressurized and all other ways of injecting water have been lost. This SAMDA is therefore potentially of benefit for some Class 1 and Class 2 sequences. It will be of benefit for Class 2 sequences provided it can continue to operate after the pool becomes saturated and the containment fails.

Potential Benefit:

Class 1 high pressure (no mitigation) =	--	
Class 1 low pressure (100% mitigation) =	20	
Class 2 (100% mitigation) =	80	
Class 3 (no mitigation) =	--	
Class 4 (no mitigation) =	---	
TOTAL	100	person-rem/reactor-year

8. Alternate Low Pressure Reactor Makeup Water System

This SAMDA is similar to SAMDA 7 but has the additional capability of depressurizing some of the Class 1 accident sequences so that core damage can be prevented for a larger fraction of this accident class. The potential benefit is 193 and 80 person-rem per reactor year from Class 1 and Class 2 sequences, respectively.

9. Secondary Containment Improvement in DF

This SAMDA would be effective for those accidents that result in leakage. Mitigation of these failure modes by drywell head flooding was addressed in SAMDA 5.B. and in SAMDA 6C (with enhanced reactor vessel depressurization). A DF of 3 was assumed for the flooding SAMDA. A similar benefit would be expected from an improved secondary containment DF.

TABLE 1
Person-rem/year Within 50 Miles As a Function of
Accident Class and Failure Mode
Assuming FES Results with Modified Class 1 Frequency

Accident Class	Overpress/Overtemp Failure: Drywell	Overpress/Overtemp Failure: Wetwell Airspace	Overpress/Overtemp Failure: Wetwell Pool	H Burn	Leakage: With SGTS	Leakage: Without SGTS	Total
Class 1 (High Pressure)	52	2	Neg[1]	4	2	113	174
Class 1 (Low Pressure)	6	Neg	Neg	1	Neg	13	19
Class 2	40	36	4	Neg	NCM[2]	NCM	80
Class 3	33	30	3	Neg	Neg	13	79
Class 4	9	8	1	Neg	Zero	Zero	18
Total	140	76	8	5	2	139	370

1. Negligible

2. No Core Melt

TABLE 2
Land Area for Long-Term Interdiction (m^2/year)
As a Function of Accident Class and Failure Mode
Assuming FES Results with Modified Class 1 Frequency

Accident	Overpress/Overtemp Failure			H Burn	Leakage		Total
Class	Drywell	Wetwell Airspace	Wetwell Pool		With SGTS	Without SGTS	
Class 1 (High Pressure)	7	Neg	Neg	6	Neg	243	256
Class 1 (Low Pressure)	1	Neg	Neg	1	Neg	27	29
Class 2	95	85	10	Neg	NCM	NCM	190
Class 3	47	43	5	1	Neg	26	122
Class 4	17	15	3	Neg	Zero	Zero	35
Total	167	143	18	8	--	296	632

TABLE 3
Early Fatalities (per year) As a Function of
Accident Class and Failure Mode
Assuming FES Results with Modified Class 1 Frequency

Accident Class	Overpress/Overtemp Failure Drywell	Overpress/Overtemp Failure Wetwell Airspace	Overpress/Overtemp Failure Wetwell Pool	H Burn	Leakage With SGTS	Leakage Without SGTS	Total
Class 1* (High Pressure)	Zero*	Zero*	Zero*	Neg	Zero	Neg	Neg
Class 1 (Low Pressure)	Zero	Zero	Zero	Neg	Zero	Neg	Neg
Class 2	Zero	Zero	Zero	Neg	NCM	NCM	Zero
Class 3*	Zero*	Zero*	Zero*	Neg	Zero	Neg	Neg
Class 4	1(-4)	7(-5)	1(-5)	Neg	Zero	Zero	1.8(-4)
Total	1(-4)	7(-5)	1(-5)	Neg	Neg	Neg	1.9(-4)

* The base case results in NUREG/CR-3028 did not calculate any early fatalities for Class 1 and Class 3 accidents because of the assumed warning time (4 hours) before fission product release. It was noted in NUREG-1068 that for high pressure core meltdown accidents it is possible for the containment to fail at the time the core debris penetrates the reactor vessel. If this were to occur then the warning time for evacuation would be shorter than assumed in NUREG/CR-3028 and some early fatalities would be predicted for Class 1 and 3 sequences.

APPENDIX B - STAFF ESTIMATES OF COST OF SAMDAs FOR LIMERICK

This Appendix provides a general discussion of the cost elements contributing to the staff's estimates of the costs of SAMDAs for Limerick.

1. General Inflation

The RDA results[1] were prepared in early 1984 (1983-1984 dollars) whereas the PECo estimates[2] were developed in mid 1989 (1989 dollars). Assuming implementation of a mitigation system is approved, work would likely commence in 1990 or beyond. Costs should be expressed in 1990 dollars. For PECo's estimates the impact is negligible. However, RDA's estimates should be adjusted upward by 25 percent based on actual and projected changes in the GNP Implicit Price Deflator between 1984 and 1990.

2. Replacement Energy Costs

Replacement energy cost penalties are potentially a dominant cost factor for backfits to existing power reactors. In NUREG/CR-4012[3] the staff estimates incremental costs on the order of $500,000 for each day one of the Limerick units is out of service in the 1990 timeframe.

The RDA study notes that replacement energy costs have not been factored into their analysis although for several of the modifications the authors do acknowledge the need for plant downtime.

The PECo study assumes that for each mitigation system a portion of the construction activity will require the reactor to be shut down.

However, in most instances the downtime is projected as 13 weeks in duration and is assumed to be accommodated during normally scheduled outages. However, for three of these options, incremental outages of about 1, 2, and 5 months are projected and for these options replacement energy costs are included in their cost estimate. For these options, this cost element is the major contributor to the cost differential observed between PECo and RDA. In the staff's view, PECo's inclusion of replacement energy costs under these select circumstances is reasonable, particularly since most downtime has been assumed to be accommodated within scheduled outages.

Select adjustments to RDA system costs were made in the staff's cost estimates. The systems impacted and bases are indicated in the notes to Table 1. Essentially, the staff adopted the incremental downtime reported by PECo but applied the NRC daily replacement energy cost penalty of $500,000 vs PECo's own estimate of $850,000 per day. Nevertheless, for these select systems, the addition of replacement energy costs constituted the dominant adjustment to the RDA cost estimates.

PECo estimates that any one of the modifications will require a construction period of from about 1 to 2 years. The staff cautions that if Limerick 2 operationis delayed pending installation of one of these mitigation systems, replacement energy cost penalties on the order of hundreds of millions of dollars would be incurred.

*Enhanced Drywell Spray System, Water-Cooled Rubble Bed, Dry Crucible.

3. Labor Installation Costs

NRC's generic cost methodology recognizes a dramatic fall off in labor productivity when the work environment shifts from a new construction environment to a completed or operating reactor.[4,5,6] Worker productivity is affected by access and handling constraints, congestion and interference, radiation environments, manageability considerations, removal activities, and security constraints. For example, an outage activity performed in containment at an operating reactor, which best characterizes a good deal of the work proposed here, requires over three times the manpower requirements of comparable work in a new construction environment, based on NRC generic cost estimating assumptions.[7]

The staff's review of the RDA report suggests that their costs have not been adjusted adequately to account for this. The cost differences for reactors in the design stage (Case A) vs. operating reactors (Case C) are minimal, and since costs under Case C allow for "...radiation protection, draining of equipment, etc."[8] it is likely that no adjustment has been made for lower labor productivity. The PECo report, on the other hand, acknowledges the inclusion of labor productivity adjustments[9] and clearly, its labor cost category is consistently significantly higher than RDA's.

PECo's higher labor cost estimates are also consistent with NRC's inclusion of learning curve factors in its generic cost methodology.[10] If it is the first or second time industry will be performing these activities, which appears likely for much of the work proposed here, labor costs are estimated to be 2.5 to 3.6 times higher than for activities that have been performed by industry 3 or more times. For these reasons the higher labor costs embedded in PECo's estimates appear more reasonable. Consequently, the labor installation cost component for the RDA systems was adjusted upward by a factor of 6 to account for NRC generic cost labor productivity and learning curve effects.

4. Engineering

The NRC's generic cost estimate for engineering effort for complex modifications to operating reactors consists of a 25 percent cost factor to be applied to the direct construction cost.[11] Wide variability in this cost factor is acknowledged. For example, a much larger engineering cost factor is to be expected for relatively minor structural/system changes where engineering analysis is required. Alternatively, large modifications involving primarily off-the-shelf items are likely to require a minimal amount of engineering as a percentage of the direct cost.

Both RDA and PECo include engineering effort in their overall cost estimates. RDA assumes engineering constitutes 12 percent of the direct labor and material costs.[12] PECo's engineering cost is significantly higher. For the more expensive mitigation systems, PECo's "engineering" cost category typically ranges in the mid to high 30 percent range as a percentage of direct costs. For the less expensive options, the engineering effort typically approaches and exceeds 100 percent of the direct construction cost. Additional engineering effort associated with the PECo Nuclear Engineering Department and Field Engineering are included in their overall estimates. These engineering efforts are embedded in their "station/owner" cost category.

The staff's cost estimate modifies both RDA's and PECo's engineering cost based on a 25 percent cost factor applied to the direct construction cost.

5. Regulatory and Procedural Costs

In the staff's view, the RDA study attempts to quantify only the most direct costs associated with the proposed mitigation systems. In reality, physical modifications of this nature are likely to necessitate numerous regulatory/licensing and procedural requirements. For example, the issuance of new technical specifications, rewriting of procedures and training manuals, training sessions for operators and supervisors, issuance of detailed documentation and analytical reports, and extensive interfaces with the NRC are all likely to materialize if one of these mitigation systems is adopted. The RDA report does not include any costs for these activities. PECo captures most of these costs under its "regulatory" cost category. These regulatory costs range from about 1 percent to 5 percent of the total cost for the various options under consideration, and were based on 25 percent of PECo and Bechtel engineering and home office costs.[13] In absolute dollars these regulatory costs range from about $0.15 million to $1 million per reactor. The PECo estimates included additional cost allowances for training related activities that in some instances exceed $0.5 million. In the staff's view an allowance for these factors is not unreasonable and are an appropriate addition to a comprehensive cost estimate. The staff's cost estimates modified RDA's costs by incorporating allowances for regulatory/licensing and procedural requirements. An estimate of $0.5 million was derived from NRC's generic cost estimating[14] methodology and was incorporated in RDA's overall cost calculation unless PECo identified lower costs for a comparable system. In those circumstances, PECo's lower estimates for regulatory and training requirements were adopted by the staff.

QA/QC, O&M, Land, Profit, Insurance

The RDA study includes no allowance for QA/QC, O&M costs, land costs, profit (assuming contractors perform part or all of the work), or liability insurance. The RDA authors, in recognition of comments that their estimates were unrealistically low performed a sensitivity analysis on one of their baseline estimates. Adding allowances for just land costs and QA/QC caused their baseline cost to increase by a factor of 1.75.[15] In the staff's view, most of these factors are either already accounted for by the staff's earlier adjustments [e.g., engineering factor of 25% includes an allowance for QA/QC], or are sunk costs that are not incremental to the mitigation system [e.g., land]. However, O&M costs are a legitimate cost of all physical modifications. For example, maintenance, cleaning, testing, and inspection of the new hardware will be required over its assumed 40 year life. The present worth cost of this stream of expenditure is included in the PECo estimates. An allowance of either $50,000 or $100,000 has been added to the RDA estimates.

6. AFUDC

Allowance for funds used during construction captures the interest paid on monies expended during the life of the project. PECo's estimates include this item which typically constitutes between 8 percent and 14 percent of the total cost, and for two of the mitigation systems analyzed exceeds $10 million of the total cost.

The staff recognizes that AFUDC is a real cost to the utility, but disallows it for value-impact analysis purposes. In a value impact context all future costs are subject to present worth considerations and discounting. PECo's inclusion of AFUDC acknowledges that the monies will be expended over time, but these same cost streams have not been discounted in the PECo analysis. Assuming PECo's cost of money is reasonably commensurate with the discount rate would minimize the importance of the distinction between AFUDC and present worth considerations.

References for Appendix B

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4. NUREG/CR-4627, Revision 1, "Generic Cost Estimates -- Abstracts from Generic Studies for use in Preparing Regulatory Impact Analyses," Science and Engineering Associates, February 1989.

5. NUREG/CR-5138, "Validation of Generic Cost Estimates for Construction-Related Activities at Nuclear Power Plants," Science and Engineering Associates, May 1988.

6. NUREG/CR-4546, "Labor Productivity Adjustment Factor," Science and Engineering Associates, March 1986.

7. NUREG/CR-5138, pp. 8, 14.

8. RDA, P. 2-10.

9. Bechtel, P. 36.

10. NUREG/CR-5138, pp. 17-19.

11. NUREG/CR-4921, "Engineering and Quality Assurance Cost Factors Associated with Nuclear Plant Modification," United Engineers and Constructors, April 1987.

12. RDA, p. 2-10.

13. Bechtel, p. 36.

14. NUREG/CR-4627, Rev. 1.

15. RDA, pp. A-20 to A-22.

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In April 1984 the staff of the Nuclear Regulatory Commission issued its Final Environmental Statement (NUREG-0974) related to the operation of Limerick Generating Station, Units 1 and 2 (Docket Nos. 50-352 and 50-353), located on the Schuylkill River, near Pottstown, in Limerick Township, Montgomery and Chester Counties, Pennsylvania.

The NRC has prepared this supplement to NUREG-0974 to present its evaluation of the alternative of facility operation with the installation of further severe accident mitigation design features. The NRC staff has discovered no substantial changes in the proposed action as previously evaluated in the Final Environmental Statement that are relevant to environmental concerns nor significant new circumstances or information relevant to environmental concerns and bearing on the licensing of Limerick Generating Station, Units 1 and 2.

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Generic Environmental Impact Statement for License Renewal of Nuclear Plants

Main Report

Final Report

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U.S. Nuclear Regulatory Commission
Washington, DC 20555–0001

ABSTRACT

The Nuclear Regulatory Commission (NRC) anticipates that it will receive applications for renewal of the operating licenses of a significant portion of existing nuclear power plants. This Generic Environmental Impact Statement (GEIS) examines the possible environmental impacts that could occur as a result of renewing licenses of individual nuclear power plants under 10 CFR 54. The GEIS, to the extent possible, establishes the bounds and significance of these potential impacts. The analyses in the GEIS encompass all operating light-water reactors. For each type of environmental impact the GEIS attempts to establish generic findings covering as many plants as possible. While plant and site-specific information is used in developing the generic findings, the NRC does not intend for the GEIS to be a compilation of individual plant environmental impact statements.

This GEIS has three principal objectives: (1) to provide an understanding of the types and severity of environmental impacts that may occur as a result of license renewal of nuclear power plants under 10 CFR Part 54, (2) to identify and assess those impacts that are expected to be generic to license renewal, and (3) to support a rulemaking (10 CFR Part 51) to define the number and scope of issues that need to be addressed by the applicants in plant-by-plant license renewal proceedings. To accomplish these objectives, the GEIS makes maximum use of environmental and safety documentation from original licensing proceedings and information from state and federal regulatory agencies, the nuclear utility industry, the open literature, and professional contacts.

CONTENTS

CONTENTS

5. Environmental Impacts of Postulated Accidents

5.1 INTRODUCTION

This section discusses each aspect of postulated accidents that is normally treated in the final environmental statements (FESs) for the operation of nuclear power plants. Methodologies that estimate future risks at each existing nuclear power plant site in the United States are developed in Section 5.3.3, considering an additional 20-year period of operation beyond the current license term.

The characteristics of nuclear power plant accidents are discussed (Section 5.2.1) to acquaint the reader with (1) the sources of radiation from postulated accidents, (2) the potential pathways of radiation to the environment, and (3) the possible health effects of exposure to such accidental releases. Historical experience and observed impacts of nuclear power plant accidents are discussed next (Section 5.2.2), followed by a description of the various measures taken in the design and operation of a power plant to reduce the likelihood or consequences of an accident (Section 5.2.3).

The impacts of accident risks during a license renewal period are discussed in Section 5.3. A brief discussion of the primary concern arising from extending the operational life of nuclear power plants is provided (Section 5.3.1). This concern centers on the effects that plant aging and increasing population can have on the probability and consequences of accidents. Calculation of the estimated environmental impacts and risks due to postulated accidents during the license extension period is discussed in Sections 5.3.2 and 5.3.3. Consequences of design-basis and severe accidents are reviewed. The potential pathways for radiation release examined are (1) direct release to the atmosphere, (2) fallout on open bodies of water, and (3) groundwater. Existing severe accident analyses were reviewed and used to predict consequences at all sites. The potential economic impacts of accidents during the renewal period were also reviewed (Section 5.3.4). To maintain a perspective on the results of this analysis, a discussion of the uncertainties associated with the types of consequence analyses used in this evaluation is provided (Section 5.3.5). Finally, a discussion is given on the role of severe accident mitigation design alternatives (SAMDAs) in the license renewal process (Section 5.4).

5.2 PLANT ACCIDENTS

5.2.1 General Characteristics of Accidents

The term "accident" refers to any unintentional event outside the normal plant operational envelope that results in a release or the potential for release of radioactive materials into the environment. Generally, the U.S. Nuclear Regulatory Commission (NRC) categorizes accidents as "design basis" (i.e., the plant is designed specifically to accommodate these) or "severe" (i.e., those involving multiple failures of equipment or function and, therefore, whose likelihood is generally lower than design-basis accidents but where consequences may be higher), for which plants are analyzed to determine their response. The predominant focus in environmental assessments is on events that can lead to releases substantially in excess of permissible limits for normal operation. Normal release limits are specified in the NRC's regulations (10 CFR Part 20 and 10 CFR Part 50, Appendix I).

Many features combine to minimize the risk of accidents at nuclear power plants. These features include high-quality reactivity control and reactor cooling systems and containment and backup safety systems to respond to equipment failure. The incorporation of safety into design, construction, and operation is to a very large extent devoted to minimizing the possibility of the release of radioactive materials from their normal places of confinement within the plant. Descriptions of these safety features are provided in each licensee's final safety analysis report (FSAR) and in the NRC's safety evaluation report.

The plant design, including the types and number of safety systems, takes into consideration the specific locations of radioactive materials within the plant; their amounts; their nuclear, physical, and chemical properties; and their potential for transport into the environment and for creating health hazards.

5.2.1.1 Fission Product Characteristics

By far the largest inventory of radioactive material in a nuclear power plant is produced as a by-product of the fission process and is located in the uranium oxide fuel pellets in the reactor core in the form of fission products. During periodic refueling shutdowns, the assemblies containing these fuel pellets are transferred to a spent-fuel storage pool; the second largest inventory of radioactive material is located in this storage area. Much smaller inventories of radioactive materials are also normally present in the water that circulates in the reactor coolant system and in the systems used to process gaseous and liquid radioactive wastes in the plant.

Radioactive materials in power plants exist in a variety of physical and chemical forms. Their potential for dispersal into the environment depends not only on mechanical forces that might physically transport them, but also on their inherent properties, particularly their volatility. The majority of these materials exist as nonvolatile solids over a wide range of temperatures. Some, however, are relatively volatile solids, and a few are gaseous at normal temperatures and pressures. These characteristics have a significant bearing on the assessment of the environmental radiological impacts of accidents.

The gaseous materials include radioactive forms of the chemically inert noble gases krypton and xenon. These two gases have the highest potential for release into the atmosphere. If a reactor accident involving degradation of the fuel cladding were to occur, the release of substantial quantities of these radioactive gases from the fuel into the reactor cooling system would be virtually certain. Such accidents are low-frequency, but credible, events. For this reason, the safety analysis of each nuclear power plant incorporates a hypothetical design-basis accident that postulates the release of the entire contained inventory of radioactive noble gases from the fuel in the reactor into the containment structure. If the noble gases were further released to the environment as a result of failure to maintain the containment boundary, the hazard to individuals from these noble gases would arise predominantly through the external gamma radiation from the airborne plume.

The reactor containment structure and containment support systems are designed to minimize the possibility of this type of release.

Radioactive forms of iodine are produced in substantial quantities in the fuel by the fission process, and in some chemical forms they may be quite volatile. For these reasons, iodine has traditionally been regarded as having a relatively high potential for release from the fuel into the containment during certain design-basis accidents. Because iodine concentrates in the thyroid gland, the release of radioiodines to the atmosphere is controlled by containment and by the use of special systems (i.e., filters) designed to retain the iodine.

The chemical forms in which the fission product radioiodines are found are generally solid materials at room temperatures; hence, they have a strong tendency to condense (or "plate out") on cooler surfaces. In addition, most of the iodine compounds are quite soluble in, or are chemically reactive with, water. Although these properties do not prevent the release of radioiodines from degraded fuel, they would act to inhibit release from the containment structure that has large internal surface areas and may contain large quantities of water as a result of an accident. The same properties affect the behavior of radioiodines that may "escape" into the atmosphere. Thus, if it rains during a release, or if there is moisture on exposed surfaces (for example, dew), the radioiodines will show a strong tendency to be absorbed by the moisture.

Other radioactive materials formed during the operation of a nuclear power plant are less volatile and have a much smaller tendency to escape from degraded fuel unless the temperature of the fuel becomes very high. Such materials tend to condense quite rapidly when they are transported to a lower temperature region or to dissolve in water when it is present. This mechanism can result in production of very small particles that can be carried some distance by a moving stream of gas or air. If such particulate materials are dispersed into the atmosphere as a result of containment failure, they tend to be carried downwind and deposited on surfaces by gravitational settling (fallout) or by precipitation (washout or rainout), where they will become "contamination" hazards in the environment.

All of these radioactive materials exhibit the property of radioactive decay with half-life periods ranging from fractions of a second to many days or years. Many of the radioactive materials decay through a sequence of decay processes, and all eventually become stable (nonradioactive). The radiation emitted during these decay processes renders the radioactive materials hazardous.

5.2.1.2 Meteorological Considerations

Two separate analyses of accident sequences are performed during the licensing process for a nuclear power plant. The first analysis is the determination of the consequences for design-basis accidents and is performed for the NRC's safety evaluation report. This analysis is performed to ensure that the doses to any individual at the exclusion area boundary over a period of 2 hours, or at the outer boundary of the low population zone (LPZ) during the entire period of plume passage, will not exceed the siting dose guidelines of 25 rem to the whole body or 300 rem to the thyroid, pursuant to 10 CFR Part 100. This analysis is used to examine site suitability (10 CFR Part 100) and the mitigative capability of certain plant safety features (10 CFR Part 50). The atmospheric dispersion model for this evaluation, as described in the NRC Regulatory Guide 1.145, uses on-site meteorological data (typically, a multiyear record) considered representative of the site and vicinity to calculate relative dilutions that will be exceeded no more than 0.5 percent of the time in any one sector (22.5°) and no more than 5 percent of the time for all sectors (360°) at the exclusion area boundary and LPZ. These dilution factors, because they provide little plume spread, ensure site-specific calculated doses that could be exceeded only 5 percent of the time.

The second analysis of accident consequences is generally found in the environmental documentation for the most recently licensed nuclear plants and considers a spectrum of releases, including those for severe accidents. Actual meteorological conditions from a representative 1-year period of record of on-site data are used in this environmental analysis. A detailed description of the atmospheric dispersion model used to estimate the environmental impacts of such accidents is contained in NUREG-75/014 (formerly WASH-1400), Appendix VI.

5.2.1.3 Exposure Pathways

The radiation exposure (hazard) to individuals is determined by the individual's proximity to the radioactive materials; the duration, intensity, and type (external versus internal) of exposure; and factors that act to shield the individual from the radiation. Many of the pathways for radiation and the transport of radioactive materials that lead to radiation exposure hazards to humans are the same for accidental as for "normal" releases. These pathways are depicted in Figure 5.1. Two additional possible pathways that could be significant for accident releases are not shown in Figure 5.1. One of these pathways is the fallout of radioactivity onto open water or onto land with runoff into open water bodies. The second pathway would be unique to an accident involving temperatures high enough to cause melting of the reactor core and subsequent penetration of the reactor vessel and underlying base mat by the molten core debris. Such an occurrence would create the potential for the release of radioactive material into the hydrosphere via groundwater beneath the plant. These pathways may lead to external exposure to radiation and also to internal exposure if radioactive material is contacted, inhaled, or ingested from contaminated food or water.

It is characteristic of all these pathways that during the transport of radioactive material by wind or water, the material tends to spread and disperse—like a plume of smoke from a smokestack—becoming less concentrated in larger volumes of air or water. The result of these natural processes is to lessen the intensity of exposure to individuals downwind or downstream of the point of release, but the processes also tend to increase the number who may be exposed. For a release into the atmosphere, the degree to which dispersion reduces the concentration in the plume at any downwind point is governed by the turbulence characteristics of the atmosphere, which vary considerably with time and from place to place. This fact, taken in conjunction with the variability of wind direction and the presence or absence of precipitation, means that accident consequences depend largely upon the

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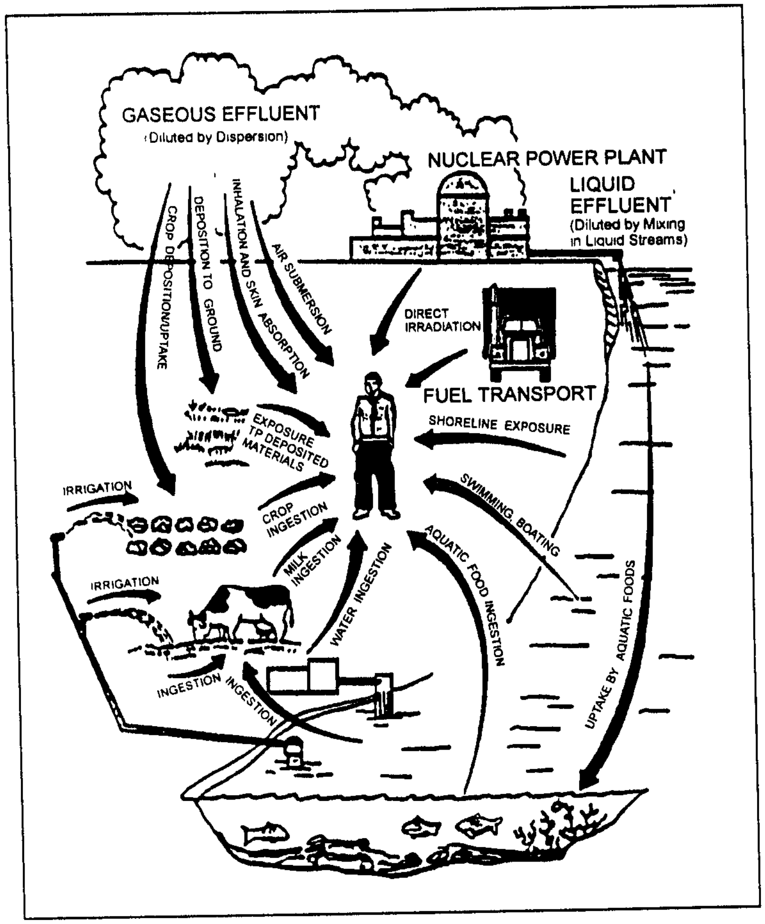

Figure 5.1 Potential exposure pathways to individuals.

weather conditions existing at the time of the accident.

5.2.1.4 Adverse Health Effects

The cause-and-effect relationships between radiation exposure and adverse health effects are quite complex. Whole-body radiation exposure resulting in a dose greater than about 25 rem over a short period of time (hours) is necessary before any physiological effects to an individual are clinically detectable[1] shortly thereafter. Doses about 10 to 20 times larger, also received over a relatively short period of time (hours to a few days), can be expected to cause some fatalities. At the severe (but extremely low probability) end of the accident spectrum, very high exposures of these magnitudes are theoretically possible for persons in proximity to the plant if measures are not or cannot be taken to provide protection, such as by sheltering or evacuation.

Lower levels of exposures may constitute a longer-term health risk. The effects of such exposures may include randomly occurring cancer in the exposed population and genetic changes in future generations after exposure of a prospective parent. Relating a given health effect to a known exposure to radiation is most often not possible because of the many other possible causes for such effects. For this reason, it is necessary to assess radiation-induced cancer effects on a statistical basis.

Occurrences of cancer in the exposed population may begin to develop only after a lapse of 2 to 15 years (latent period) from the time of exposure and continue over a period of over 40 years (plateau period). However, in the case of exposure of fetuses (in utero), occurrences of cancer may begin to develop at birth (no latent period) and end at age 10 (that is, the plateau period is 10 years). The occurrence of cancer itself is not necessarily indicative of a fatality because the ratio of mortality to incidence of cancer depends upon the cancer type and advances in medical treatment.

The estimates of health consequences used for latent fatalities in this document are the same estimators used in the development of the revised 10 CFR 20 regulations. A discussion is provided in Sections 3.8 and 4.6, and a more detailed discussion is provided in Section E.4, which details the recent developments in radiation risk estimation that lead to the health-consequence risk estimates in this section. The discussion in Section E.4 includes background information about epidemiology as well as health-effects information compiled by the United Nations Scientific Committee on the Effects of Atomic Radiation, by the National Academy of Sciences (reports of Advisory Committees on the Biological Effects of Ionizing Radiation—BEIR-I, BEIR-III, BEIR-V), and by the International Commission on Radiological Protection. The risk estimates for fatal cancers are considered to be nominally 500 per million person-rem, consistent with the risk factors described earlier (Section 3.8.1.3 and Appendix E.4). In addition, approximately 100 genetic disorders per million person-rem are projected for the succeeding generations.

5.2.1.5 Avoiding Adverse Health Effects

Radiation hazards in the environment disappear by the natural process of radioactive decay. Where the decay process is a slow one, however, and where the material becomes relatively fixed in its location as an environmental contaminant (such as in soil), the hazard can continue to exist for a long period of time—months, years, or even decades. Thus, a possible environmental societal reaction to severe accidents is avoidance of the potential health hazards by restrictions on the use of the contaminated property or contaminated foodstuffs, milk, and drinking water.

5.2.2 Accident Experience and Observed Impacts

A limited number of accidents have been recorded in the experience data of the world's nuclear programs. The United States, Great Britain, and the Soviet Union have all experienced accidents of varying magnitudes and consequences. The following paragraphs will discuss first the United States experience, followed by the British and then the Soviet accident experience.

As of September 1990, 112 commercial nuclear power reactor units were licensed for operation in the United States (Table 2.1) with power-generating capacities ranging from 72 to 1270 MW(e).

The combined experience with these operating units represents approximately 1300 reactor-years (RYs) of operation over an elapsed time of about 28 years. [An additional 6 plants, with individual generating capacities of up to 1314 MW(e), are expected to receive an operating license within the next 10 years.] Several of these facilities have experienced accidents (ORNL 1980; NUREG-0651; Thompson and Beckerley 1964), some of which have resulted in small releases of radioactive material to the environment. None is known to have caused any radiation injury or fatality to any member of the public, nor any significant contamination of the environment. Although the experience base with light-water reactors (LWRs) having containments such as those licensed in the United States is not large enough to permit reliable statistical prediction of accident probabilities, it does, however, suggest that significant environmental impacts caused by accidents are not at all likely to occur over time periods of a few decades.

Melting or severe degradation of reactor fuel has occurred in only one U.S.-licensed commercial LWR—during the accident at Three Mile Island Unit 2 (TMI-2) on March 28, 1979. It has been estimated that about 2.5 million Ci of noble gases (about 0.9 percent of the core inventory) and 15 Ci of radioiodine (about 0.00003 percent of the core inventory) were released to the environment at TMI-2 (NUREG/CR-1250).[2] No other radioactive fission products were released in measurable quantities. It has been estimated that the maximum cumulative off-site radiation dose to an individual was less than 100 mrem (NUREG/CR-1250; *President's Commission* 1979). The total population exposure has been estimated to be in the range from about 1000 to 5000 person-rem. (This range is discussed on page 2 of NUREG-0558.) This exposure could statistically produce between zero and one additional fatal cancer over the lifetime of the exposed population of approximately 2 million in the site area. The same population receives about 240,000 person-rem each year from natural background radiation, and approximately a half million cancers are expected to develop in this group over the lifetime of the population (NUREG/CR-1250; *President's Commission* 1979), primarily from causes other than radiation. Trace quantities (barely above the limit of detectability, below allowable limits, and less than that from fallout due to nuclear tests) of radioiodine were found in a few samples of milk produced in the area. No other food or water supplies were affected.

Accidents at U.S. nuclear power plants have also caused occupational injuries and a few occupational fatalities, but these were not due to radiation exposure. Individual worker exposures have ranged up to about 4 rem as a direct consequence of reactor accidents (although there have been higher exposures to individual workers as a result of other unusual occurrences). However, the collective worker exposure levels (person-rem) from accidents are a small fraction of the exposures experienced during routine operation; during the 1982–1986 time period, routine exposures ranged from 23 to 2880 person-rem/year in pressurized-water reactors (PWR) and 84 to 4080 person-rem/year in boiling-water reactors (BWR) per RY (NUREG-0713).

Accidents have also occurred at other nuclear facilities in the United States and in other countries (ORNL 1980; Bertini 1980). Reactor fuel melted in at least seven of these accidents: Fermi 1 (Lagoona Beach, Michigan), St. Laurent (France), NRX Reactor (Chalk River, Canada), Experimental Breeder Reactor 1 (Idaho), Heat Transfer Reactor Experiment Facility (Idaho), Westinghouse Reactor (Waltz Mills, Pennsylvania), and Oak Ridge Research Reactor (Tennessee). Because of inherent differences in design, construction, operation, and purpose of these other facilities, their accident record has only indirect relevance to current nuclear power plants. The most relevant accident was the one in 1966 at Enrico Fermi Atomic Power Plant Unit 1. Fermi Unit 1 was a sodium-cooled fast breeder demonstration reactor designed to generate 61 MW(e). The damages were repaired and the reactor reached full power 4 years after the accident. It operated successfully and completed its mission in 1973. The Fermi accident did not release any measurable radioactivity to the environment.

A reactor accident in 1957 at Windscale, England (renamed Seascale), released a significant quantity of radioiodine, approximately 20,000 Ci, to the environment and minor quantities of ^{137}Cs, ^{89}Sr, and ^{90}Sr (Eisenbud 1987) and ^{240}Po (Crick and Linsley 1983). This reactor, which was not operated to generate electricity, used a graphite core design and circulated air rather than water to cool the uranium fuel. During a special operation to heat the large amount of graphite in this reactor (an operation normal for this graphite-moderated reactor), the fuel overheated and radioiodine and noble gases were released directly to the atmosphere from a 123-m (405-ft) stack. Milk produced in a 518-km^2 (200-mile^2) area around the facility was impounded for up to 44 days. The United Kingdom National Radiological Protection Board (1957) estimates that the releases may have caused as many as 260 cases of thyroid cancer, about 13 of them fatal, and as many as 7 deaths from other cancers or hereditary diseases. This kind of accident cannot occur in a water-moderated and -cooled reactor like those in the U.S. nuclear power program.

On April 26, 1986, a major accident occurred at reactor 4 of the Chernobyl Nuclear Power Station in the Soviet Union. This reactor differs substantially from LWRs licensed to operate in the United States. The initiating event, a reactivity insertion, was recognized as a potential problem early in U.S. power reactor design; consequently, licensed U.S. power reactors are designed to prevent or accommodate occurrences of reactivity insertions. A major difference in safety between the U.S. designs and Chernobyl is that the Chernobyl reactor did not have a containment similar to those found on U.S. reactors. Also, the Chernobyl plant, which used graphite as a neutron moderator rather than water as with U.S. designs, had a positive power coefficient for the off-normal plant conditions that were present at the time of the accident. Thus, the accident has only indirect relevance to LWRs. The release of radioactive material from the accident was initially reported by the Soviets to be about 100 million Ci of fission products, but (except for the noble gases) that estimate included only material deposited within the European part of the Soviet Union. As a result of the accident, radionuclides were deposited throughout the Northern Hemisphere.

Of the almost 3 billion people in the Northern Hemisphere receiving Chernobyl radiation, about 800 million people account for 97 percent of the total risk increment. The remaining 3 percent of the dose commitment in Asia and North America represents a minuscule risk increment. Outside of the 30-km (19-mile) zone surrounding Chernobyl, the incremental increase in fatal cancer risk is a fraction of a percent and is not likely ever to be detected epidemiologically (DOE/ER-0332; Goldman 1987).

5.2.3 Mitigation of Accident Consequences

5.2.3.1 Design Features

All U.S. power reactors contain system features designed to prevent accidental release of radioactive fission products from the fuel and to lessen the consequences should such a release occur. Many of the design and operating specifications of these features are derived from the analysis of postulated events known as design-basis accidents. These accident-preventing and -mitigating system features are collectively referred to as "engineered safety features." Safety injection systems are incorporated to provide cooling water to the reactor core during a loss-of- coolant accident to prevent or minimize fuel damage. Heat-removal capability is provided inside the containment to prevent containment failure from overpressure. Long-term decay heat removal systems are also provided to remove decay heat from the core. All the mechanical systems mentioned above are supplied with emergency power from on-site diesel generators in the event that normal off-site station power is interrupted.

Containment structures are used as a mitigating system to provide a nearly leaktight barrier to minimize the escape of fission products to the environment in the event of a fission product release inside containment. These structures are designed to withstand the internal pressure and temperature associated with design-basis accidents.

The fuel-handling structures also have accident-mitigating systems. Spent fuel is handled and stored under water, which would tend to greatly reduce the amount of radioactive material released to the building environment in the event of fuel failure. A safety-grade exhaust air ventilation subsystem contains both charcoal and high-efficiency particulate filters. The ventilation systems are also designed to keep the area around the spent-fuel pool below the prevailing barometric pressure during fuel-handling operations to minimize the outleakage through building openings. Upon detection of high radiation, exhaust air is routed through the filter units, and radioactive iodine and particulate fission products which escaped from the spent fuel pool would be removed from the flow stream before exhausting to the atmosphere.

Much more extensive discussions of the safety features and characteristics of a particular plant may be found in the FSAR for that plant. In addition, the implementation of the lessons learned from the TMI-2 accident—in the form of improvements in design, procedures, and operator training—has significantly reduced the likelihood of a degraded-core accident that could result in large releases of fission products to the containment. These TMI-2-related requirements are specified in NUREG-0737.

5.2.3.2 Site Features

The NRC's site criteria, found in 10 CFR Part 100, require that every power reactor site have certain characteristics that tend to reduce the risk and potential impact of accidents. First, the site must have an exclusion area around the reactor. A typical exclusion area radius is about 0.8 km (0.5 mile). No residents are allowed in the exclusion area. Public transportation routes and other public activities are allowed within the exclusion area, but these routes and activities must be demonstrated to be controllable in the event of an emergency. Second, beyond and surrounding the exclusion area is an LPZ. A typical LPZ radius is about 5 km (3 miles). Within this zone, the licensee must ensure that there is a reasonable probability that appropriate protective measures could be taken on behalf of the residents and other members of the public in the event of a serious accident. Third, 10 CFR Part 100 requires that the distance from the reactor to the nearest boundary of a densely populated area containing more than 25,000 residents be at least one and one-third times the distance from the reactor to the outer bound of the LPZ.

5.2.3.3 Emergency Preparedness

Each licensee is required to establish emergency preparedness plans to be implemented in the event of an accident, including protective action measures for the public. The NRC, as well as other federal and state regulatory agencies, review the subject plans to ensure that the condition of on- and off-site emergency preparedness provides reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency. Among the standards that must be met by these plans are provisions for two emergency planning zones (EPZs). A plume exposure pathway EPZ (requiring preplanned evacuation procedures) of about 16 km (10 miles) in radius and an ingestion exposure pathway EPZ (where interdiction of foodstuffs is planned) of about 80 km (50 miles) in radius are required. Other standards include appropriate ranges of protective actions for each of these zones; provisions for dissemination to the public of basic emergency planning information; provisions for rapid notification of the public during a serious reactor emergency; and methods, systems, and equipment for assessing and monitoring actual or potential off-site consequences in the event of a radiological emergency condition.

5.3 ACCIDENT RISK AND IMPACT ASSESSMENT FOR LICENSE RENEWAL PERIOD

5.3.1 Regulatory Interface Between License Renewal and Accident Impacts

In general, the safety and environmental issues associated with license renewal fall into two general categories: (1) effects of aging on the physical plant itself and the associated impact of these effects on accident frequency and radiological releases and (2) effects on accident consequences due to the changing environment in which the plant exists.

The potential effects of age on the physical plant are addressed through engineering and research programs. Potential deterioration of plant components and structures due to physical processes such as corrosion, erosion, mechanical wear, and embrittlement could result in the increased likelihood of component or structure failure. These increased failure rates, in turn, could lead to a higher frequency of accidents or more severe consequences. Therefore, control of these effects is necessary if the plant is to be assured of continuing to operate in a safe manner. As a result, NRC has developed the license renewal process within the context of the aging issue. The process will provide assurance that these age-related impacts are controlled and adequate protection of the health and safety of the public is maintained during the 20-year license renewal period. To supplement the control that the normal regulatory process has over the aging effects on the plant, the NRC requires that the renewal applicant specifically address the issue of age-related degradation by identifying, in an integrated plant assessment process, those structures and components which are susceptible to age-related degradation and whose functions are necessary to ensure that the facility's licensing basis is maintained. The licensee will further be required to demonstrate that the effects of aging will be adequately managed so that the intended functions of these structures and components will be maintained for the period of extended operation. The combined impact of these actions should be to provide high confidence that significant incremental increases in public risk will not result from aging effects related to the plant. A comprehensive discussion of the NRC rule, programs, and activities to provide this assurance is found in 55 *FR* 29043, dated July 17, 1990.

In assessing the impact on the environment from postulated accidents during the license renewal period, the assumption has been made that the license renewal process will ensure that aging effects on the plant are controlled and that the probability of any radioactive releases from accidents will not increase over the license renewal period.

The effects due to the changing environment around the plant during the license renewal period are less predictable, are generally not subject to regulatory controls, and could cause an increase in public risk as the plant continues to operate. These effects manifest themselves primarily by increasing the consequences of a given accident. For example, as the general population in the vicinity of a nuclear plant increases, the number of persons that could be affected by an accidental release also increases. Because these impacts are "noncontrollable," their potential for increasing risk as well as the magnitude of any such increase in risk must be specifically examined. Such an examination is presented in the following sections, which will discuss and assess the potential adverse impacts to the environment from postulated accidents during the license renewal period.

5.3.2 Design-Basis Accidents

Two classes of accidents are evaluated. The first class of accidents, design-basis accidents, is discussed in this section. The second, severe accidents, is discussed in Section 5.3.3. As noted previously, design-basis accidents are those that both the licensee and the NRC staff evaluate to ensure that the plant meets acceptable design and performance criteria. The environmental impacts of design-basis accidents are evaluated during the initial license process, and the ability of the plant to accommodate these accidents is demonstrated to be acceptable before issuance of the license. The results of these evaluations are found in license documentation such as FESs and FSARs. The licensee is required to maintain these acceptable design and performance criteria throughout the life of the plant, including any extended-life operation. The consequences for these events are evaluated for the hypothetical maximum exposed individual; as such, changes in the plant environment will not affect these evaluations. Because of the requirements that continuous acceptability of the consequences and aging management programs be in effect for license renewal, the environmental impacts as calculated for design-basis accidents should not differ significantly from initial licensing assessments over the life of the plant, including the license renewal period. In addition, any refurbishment necessary to prepare for license renewal would be done in a fashion consistent with the limits set for design-basis accidents and would not alter their consequences. Accordingly, the design of the plant relative to design-basis accidents during the extended license period is considered to remain acceptable and the environmental impacts of those accidents will not be examined further in this section.

5.3.3 Probabilistic Assessment of Severe Accidents

This section presents the staff's assessment of impacts of severe accidents during the license renewal period. Methodologies were developed to evaluate each of the dose pathways by which a severe accident may result in adverse environmental impacts and to estimate off-site costs of severe accidents.

Three pathways for release of radioactive material to the environment from severe accidents are evaluated in this section for each plant site for the license renewal period. These pathways are (1) air, (2) air to surface water, and (3) groundwater to surface water. For most plants, the air pathway represents the most likely pathway for significant dose to the public. The air to surface water pathway is significant for only a few sites that are close to large but confined bodies of water. The third pathway represents a less significant potential for dose because of reduction in radioactivity due to retention in the ground and greater flexibility and time to implement interdiction measures. Separate methodologies were developed for quantifying the potential consequences resulting from each pathway for each site. Economic impacts from severe accidents during the license renewal period are also described in this chapter.

Section 5.3.3.1 reviews the existing analyses available for use in this Generic Environmental Impact Statement (GEIS) study; Section 5.3.3.2 examines the effects of atmospheric releases, including vegetation pathways; Section 5.3.3.3 examines the effects from direct fallout onto open bodies of water; Section 5.3.3.4 reviews effects from releases to groundwater; and Section 5.3.3.5 examines the economic impacts of severe accidents. All analyses will adhere to a process that uses the results of existing analyses and site-specific information to conservatively predict the environmental impacts of severe accidents for each plant during the license renewal period.

5.3.3.1 Review of Existing Impact Assessments

The public risk due to nuclear power accidents has a range of values. The staff believes that current regulatory practices ensure that the basic statutory requirement, adequate protection of the public, is met (51 *FR* 28044). These risk estimates are representative of the magnitude of risk associated with current regulatory practices. Since the early 1970s, there have been increasing efforts to determine severe accident risks more precisely and on a plant-specific basis. The first comprehensive plant-specific examination of risk was the Reactor Safety

Study (RSS), published in 1975 (NUREG 75/014, formerly WASH-1400). The risk values calculated in RSS were later updated in NUREG-0773 and used in NRC FESs published after 1980. Later, more complex and more intensive plant-specific risk studies were developed, both by NRC and the industry. The most recent NRC studies of severe accident consequences are found in the NUREG-1150 analyses. To date, about 40 percent of the 118 operating plants and plants under construction have had some level of plant-specific risk analysis reviewed by NRC. This body of knowledge was used in the prediction of environmental impacts of severe accidents for all plants. Further details of these studies are provided in the following paragraphs.

FES reports since 1980 (Table 5.1) have provided assessments of impacts resulting from postulated severe accidents. Both the frequency and magnitude of the source terms ("source term" is a descriptive name for the releases of radioactive material to the environment under various accident conditions) for such assessments were usually taken from the rebaselined RSS (NUREG-0773). [These values are the result of updating the original RSS (NUREG-75/014, formerly WASH-1400) results using improved methods relative to the original WASH-1400 methodology.] Table 5.2 provides more information on the source-term data used in the FES analyses. These rebaselined source terms were then used with site-specific meteorological and demographic data to calculate off-site risk. A separate rebaselined set of source terms was provided for each of the two types of reactor designs, BWRs and PWRs. In most FES assessments, these same sets of data, without change, were used to evaluate off-site risks. Accordingly, the risk values provided in these FESs are based upon the plant designs analyzed in WASH-1400. As such, they do not represent plant-specific analyses for the FES plants but are sufficient to illustrate the general magnitude and types of risks that may occur from reactor accidents. There were some exceptions in that several studies included some further modification of the rebaselined RSS frequency estimates to better account for plant-specific design differences from the RSS plants. When available, other studies used plant-specific information on severe accident risks [such as probabilistic risk assessments (PRAs)]. Once the source-term data were established, all plants used the Calculation of Reactor Accident Consequences (CRAC) code to determine environmental consequences. Site-specific information regarding meteorology, population, and evacuation was used. Assumptions regarding exposure pathway, exposure limits, and plume behavior remained largely unchanged for all analyses.

The NUREG-1150 study is an NRC-sponsored risk examination of five U.S. nuclear power plants.[3] These analyses used state-of-the-art technology in evaluation of source-term release frequency, source-term characteristics, and consequence evaluation. Efforts were made to explore uncertainties in accident frequency, containment behavior, and radioactive material release and transport so that from this distribution of results, mean values of risk could be determined. Source terms and frequencies specific to the plant were determined. Advanced computer codes were used. For example, the MELCOR Accident Consequence Code System (MACCS) computer code for consequence evaluation was used instead of CRAC.

Table 5.1 Available risk analyses associated with final environmental statements

Plant	NSSS[a] vendor	Plant size [MW(e)]	Containment type	NUREG document number	NUREG date
Beaver Valley 2	W	836	Subatmospheric	1094	9-85
Braidwood 1, 2	W	1120	Large dry	1026	6-84
Byron 1, 2	W	1120	Large dry	0848	4-82
Callaway 1	W	1171	Large dry	0813	1-82
Catawba 1, 2	W	1145	Ice condenser	0921	1-83
Clinton 1	GE	933	Mark III	0854	5-82
Comanche Peak 1, 2	W	1150	Large dry	0775	9-81
Fermi 2	GE	1093	Mark I	0769	8-81
Grand Gulf 1, 2	GE	1250	Mark III	0777	9-81
Shearon Harris 1, 2	W	900	Large dry	0972	10-83
Hope Creek	GE	1067	Mark I	1074	6-84
Indian Point 2, 3	W	873/965	Large dry	*b*	*b*
Limerick 1, 2	GE	1055	Mark II	0974	12-83
Millstone 3	W	1154	Subatmospheric	1064	12-84
Nine Mile Point 2	GE	1091	Mark II	1085	5-85
Palo Verde 1, 2, 3	CE	1270	Large dry	0841	2-82
Perry 1, 2	GE	1191	Mark III	0884	8-82
River Bend	GE	936	Mark III	1073	1-85
San Onofre 2, 3	CE	1070/1080	Large dry	0490	4-81
Seabrook 1, 2	W	1198	Large dry	0895	12-82
South Texas 1, 2	W	1250/1251	Large dry	1171	8-86
St. Lucie 2	CE	830	Large dry	0842	4-82
Summer 1	W	900	Large dry	0719	5-81
Susquehanna 1, 2	GE	1050	Mark II	0564	6-81
Vogtle 1, 2	W	1101	Large dry	1087	3-85
Waterford 3	CE	1104	Large dry	0779	9-81
Wolf Creek 1	W	1170	Large dry	0878	6-82
WNP-2[c]	GE	1100	Mark II	0812	12-81

[a]NSSS = nuclear steam supply system, W = Westinghouse, GE = General Electric, CE = Combustion Engineering.
[b]Indian Point 2 and 3 consequence information was obtained from Atomic Safety and Licensing Board testimony.
[c]WNP-2 = Washington Nuclear Project 2.

Table 5.2 Source term information used for final environmental statement severe accident analyses

Plant	Source term used	Comments
Beaver Valley 2	Rebaselined Reactor Safety Study (RSS)	Pressurized-water reactor (PWR) source terms and frequencies from NUREG-0773 used
Braidwood 1, 2	Rebaselined RSS modified	PWR source terms and frequencies from NUREG-0773 modified for specific Braidwood design features
Byron 1, 2	Rebaselined RSS	Same as Beaver Valley
Callaway 1	Rebaselined RSS	Same as Beaver Valley
Catawba 1, 2	Rebaselined RSS	Same as Beaver Valley
Clinton 1	Rebaselined RSS	Boiling-water reactor (BWR) source terms and frequencies from NUREG-0773 used
Comanche Peak 1, 2	Rebaselined RSS	Same as Beaver Valley
Fermi 2	Rebaselined RSS	Same as Clinton
Grand Gulf 1, 2	Rebaselined RSS	Same as Clinton
Shearon Harris 1, 2	Rebaselined RSS	Same as Beaver Valley
Hope Creek	Rebaselined RSS	Same as Clinton
Indian Point 2, 3	Plant specific	
Limerick 1, 2	Rebaselined RSS (modified)	BWR source terms and frequencies from NUREG-0733 modified for specific Limerick design features. External events also included
Millstone 3	Plant-specific probabilistic risk analysis (PRA)	Source terms and frequencies from plant specific PRA used
Nine Mile Point 2	Limerick PRA (modified)	Source terms and frequencies from Limerick PRA modified for specific Nine Mile Point Unit 2 design features
Palo Verde 1, 2, 3	Rebaselined RSS	Same as Beaver Valley
Perry 1, 2	Rebaselined RSS	Same as Clinton

See footnote at end of table.

Table 5.2 (continued)

Plant	Source term used	Comments
River Bend	Grand Gulf RSS Methodologies Applications Program (MAP)	Source terms and frequencies from Grand Gulf RSS MAP (NUREG/CR-1659) with no modification
San Onofre 2, 3	Rebaselined RSS	Same as Beaver Valley
Seabrook 1, 2	Rebaselined RSS	Same as Beaver Valley
South Texas 1, 2	Rebaselined RSS (modified)	PWR source terms and frequencies from NUREG-0773 modified for specific South Texas design features
St. Lucie 2	Rebaselined RSS	Same as Beaver Valley
Summer 1	Rebaselined RSS	Same as Beaver Valley
Susquehanna 1, 2	Rebaselined RSS	Same as Clinton
Vogtle 1, 2	Rebaselined RSS (modified)	PWR source terms and frequencies from NUREG-0773 modified for specific Vogtle design features
Waterford 3	Rebaselined RSS	Same as Beaver Valley
Wolf Creek 1, 2	Rebaselined RSS	Same as Beaver Valley
WNP-2[a]	Rebaselined RSS	Same as Clinton

[a]Washington Nuclear Project 2.

The industry-sponsored risk assessments (e.g., Oconee 3, Seabrook, and Millstone 3) are similar in that efforts are made to reduce the degree of conservatism and to use the best information available. For these studies, source-term levels and frequencies specific to the plant are calculated.

Finally, studies exist that provide a detailed assessment of the risk due to specific types of accidents. For example, two such studies are NUREG-0440, which is a generic study of the radiological risks that could result from a severe accident that releases significant contamination into the groundwater, and NUREG-0769 (Addendum 1), which estimates the risks from direct contamination of the Great Lakes due to fallout from a severe accident at the Enrico Fermi 2 power plant. These two as well as other specific risk studies are used in this GEIS to provide a projection of risk during the license renewal period.

Severe accidents initiated by external phenomena such as tornadoes, floods, earthquakes, fires, and sabotage have not traditionally been discussed in quantitative terms in FESs. With the exception of sabotage, the NRC staff has, however, reviewed or performed detailed probabilistic assessments of external events for Zion Units 1 and 2, Indian Point Units 2 and 3, Limerick Units 1 and 2, Surry Unit 1, Peach Bottom Unit 2, and Millstone Unit 3. In most cases, the external event risks were determined to be comparable to internal event risks. However, for Zion and Limerick, the licensee's PRAs indicated that external events could be significant contributors to risk. For the Indian Point units, NRC staff evaluations also indicated that external events could significantly contribute to severe accident risk. The most recent NRC analysis of external events has been the NUREG-1150 external events assessment for Surry Unit 1 and Peach Bottom Unit 1. This analysis examined a broad range of external events and found that they could range from negligible to significant contributors to risk when compared with internal initiators. It should be noted, however, that in cases where external event risk was shown to be a significant contributor to the overall risk, the majority of the estimated risk arose from large beyond design basis earthquakes; but in all cases, the total risk (internal and external) is still small.

NRC's earthquake design standards have been conservatively developed to ensure protection of the public health and safety from earthquakes whose magnitudes are well above the most likely earthquake magnitude when considering the collective earthquakes history for specific plant sites in the United States. Therefore, earthquakes exceeding NRC seismic design standards are extremely unlikely. However, in the unlikely event of such an earthquake, there would be substantial damage to older residential structures, commercial structures, and high-hazard facilities such as dams whose seismic design standards are below nuclear seismic design standards. The societal impact due to the non-nuclear losses alone from an earthquake larger than the design basis of a nuclear plant, including property damage, injuries, and fatalities, would be major. The technology for assessing losses from such large earthquakes is a developing one, and there are several ongoing studies of this technology, including work at the United States Geological Survey. Presently there is no agreed-upon method for performing such assessments, although a recent report of the National Academy of Sciences suggests some broad guidelines (NAS 1989). The NRC has not developed a method for assessing the societal losses from large earthquakes such that the reactor contribution to accident consequences can be quantitatively compared with the non-nuclear losses. However, as supported by at least one study (Lee et al. 1979), the commission expects that the reactor accident contribution to the losses from large beyond design basis earthquakes would be small relative to the non-nuclear losses. While this in itself does not mean the reactor consequences from such an earthquake would be small, the commission concludes that even with potentially high consequences from a beyond design basis earthquake, the extremely low probability of such earthquake yields a small risk from beyond design basis earthquakes at existing nuclear power plants.

With regard to sabotage, quantitative estimates of risk from sabotage are not made in external event analyses because such estimates are beyond the current state of the art for performing risk assessments. The commission has long used deterministic criteria to establish a set of regulatory requirements for the physical protection of nuclear power plants from the threat of sabotage, 10 CFR Part 73, "Physical Protection of Plants and Materials", delineates these regulatory requirements. In addition, as a result of the World Trade Center bombing, the Commission amended 10 CFR Part 73 to provide protection against malevolent use of vehicles, including land vehicle bombs. This amendment requires licenses to establish vehicle control measures, including vehicle barrier systems to protect against vehicular sabotage. The regulatory requirements under 10 CFR part 73 provide reasonable assurance that the risk from sabotage is small. Although the threat of sabotage events cannot be accurately quantified, the commission believes that acts of sabotage are not reasonably expected. Nonetheless, if such events were to occur, the commission would expect that resultant core damage and radiological releases would be no worse than those expected from internally initiated events.

Based on the above, the commission concludes that the risk from sabotage and beyond design basis earthquakes at existing nuclear power plants is small and additionally, that the risks form other external events, are adequately addressed by a generic consideration of internally initiated severe accidents.

Although external events are not discussed in further detail in this chapter, it should be noted that the NRC is continuing to evaluate ways to reduce the risk from nuclear power plants from external events. For example, each licensee is performing an individual plant examination to look for plant vulnerabilities to internally and externally initiated events and considering potential improvements to reduce the frequency or consequences of such events. Additionally, as discussed in Section 5.4.1.2, as part of the review of individual license renewal applications, a site-specific consideration of alternatives to mitigate severe accidents will be performed in order to determine if improvements to further reduce severe accident risk or consequences are warranted.

5.3.3.2 Dose and Adverse Health Effects from Atmospheric Releases

5.3.3.2.1 Methodology for Predicting Future Risk

Summary of methodology

The assessment of environmental impacts due to the atmospheric release pathway are described in this section. This pathway includes the exposure of individuals directly from the passage of the cloud of radioactive material released from an accident and from material deposited on the ground, as well as the longer-term effects from other terrestrial pathways such as the ingestion of crops. Doses and the resulting health effects (early and latent fatalities) will be estimated for the middle year of relicense (MYR) population. The MYR is the estimated midpoint of the renewal period for a given plant rounded upward to the next year of available population data. Predictions of MYR risk were generated by taking the results of existing risk calculations (i.e., plant-specific estimates of early fatalities, latent fatalities, and dose) and regressing those values against a composite site-specific variable called the exposure index (EI). EI is a function of population surrounding the plant weighted by the site-specific wind direction frequency and, thus, is a site-specific parameter. Because meteorological patterns, including wind direction frequency, tend to remain constant over time, EI changes as populations change or become redistributed.

A straight-line regression of the total risk values (taken from FES analyses) for each plant listed in Table 5.1 versus the EI for that plant (at the date assumed in the FES analyses) was calculated. Average and 95 percent upper confidence bound values of total risk were estimated. Risks for individual plants for their license renewal period were then estimated from the upper confidence bound values based on MYR population data converted to MYR EI. In the prediction of risk using EI (discussed in the preceding paragraph), the assumption was made that future plant risk is primarily a function of population and wind direction. Secondary factors—such as terrain, rainfall, and wind stability—also have some effect on risk, but their impact was judged to be much smaller than the effects of population and wind direction.

Selection of appropriate existing analyses for use in regression

Currently, 118 nuclear plants are in operation or under active construction in the United States. These 118 plants represent 72 sites for the evaluation of air pathway consequences (74 sites are used for the other two pathway evaluations).[4] As noted previously, only a portion of these nuclear plants have severe accident analyses available for review.

The data selected for use in this GEIS analysis were taken from the FESs published since 1981. As discussed previously, these FES analyses are based upon source terms resulting from the RSS (NUREG-75/014, formerly WASH-1400) rebaselined in NUREG-0773. As such, these source terms (and the resulting risk and environmental impacts calculated using them) reflect the plant designs used in WASH-1400. However, this approach is considered conservative because the source terms developed in WASH-1400 generally reflect an "as found" (late 1970s) and, as such, do not reflect the improvements that have been made in nuclear industry plant design and operations since the early 1980s. Accordingly, the use of WASH-1400 source terms in the FESs may, in many cases, tend to overestimate the actual environmental consequences and risks.

Since the RSS study was completed, the NRC has implemented several industry-wide risk-reduction programs. These programs, such as station blackout (10 CFR 50.63), anticipated transient without scram (10 CFR 50.62), resolution of other generic safety issues, improvements resulting from the extensive reviews of the accident at Three Mile Island (NUREG-0737), and the individual plant examination and containment performance improvement programs, have served to lower the overall average values of nuclear plant risk relative to their values prior to the changes. Because the programs are implemented on an industry-wide basis, risk values should be smaller at all plants. No quantification of the overall risk reduction has been performed, but it is believed that the risk reduction is significant. As a result of the changes, the staff believes that the spectrum of risk for the entire nuclear industry shifted downward to lower overall risk values, and the average total risk for all nuclear plants is smaller than the risk estimated in the original RSS analyses. Thus, RSS risk estimates are more representative of the upper end of the total nuclear plant risk spectrum than the actual current risks.

The preceding discussion shows that the use of the FES risk values provides reasonable estimates of the actual average risk of the general nuclear plant population and that the use of the FES values in this analysis results in appropriate risk values in the GEIS. Where there were choices of methodology and the best method was not obvious, the staff chose the method that would lead to higher predicted values. The use of the 95 percent upper prediction confidence bounds from the regression in this analysis (discussed later) provides even greater assurance that the GEIS does not underestimate potential future environmental impacts.

As for use of detailed PRA analyses in the GEIS, particularly the NUREG-1150 studies, the plants represented in these detailed PRAs have had the benefit of considerable risk reduction feedback and improvement; consequently, their predicted risk values are not considered to be representative of the absolute values of the general plant population risk. However, these studies do provide significant risk information on the relative risks to the public as a function of distance from the plant. Because of the much more advanced computational tools available during the NUREG-1150 studies (which could better model secondary effects such as rainfall pattern), as well as more than 10 years of additional knowledge about severe accidents, the information on the distribution of risk at a specific plant, as estimated by the NUREG-1150 reports, is considered more realistic and representative of the actual environmental impacts due to the air pathway for severe accidents. The GEIS uses this relative risk information in its analysis process.

Enveloping of all plants with FES analyses

Many factors could potentially increase the consequences to the general public resulting from a severe-accident release. A comprehensive listing and description of factors that influence consequences are provided in the *PRA Procedures Guide* (NUREG/CR-2300). The purpose of this section is to use, to the extent possible, the available severe accident results (Table 5.3), in conjunction with those factors that are important to risk and that change with time to estimate the consequences of nuclear plant accidents for all plants for a time period that exceeds

Table 5.3 Comparison of general site characteristics. Italics indicate that the final environmental statement contains severe accident evaluations

Plant	MYR evaluation date[a]	MYR 50-mile population[b]	MYR 50-mile population in high-frequency wind direction	Rain[c]	Snow[c]	General terrain[d]
Arkansas 1	2030	245,476	20,471	51	5	3
Arkansas 2	2030	245,476	20,471	51	5	3
Beaver Valley 1	2030	4,039,282	1,177,194	36	46	3
Beaver Valley 2	2050	4,169,673	1,202,284	36	46	3
Bellefonte 1	2050	1,473,597	60,836	56	3	4
Bellefonte 2	2050	1,473,597	60,836	56	3	4
Big Rock Point	2030	228,199	61	31	111	2
Braidwood 1	2050	5,092,832	1,534,979	30	28	2
Braidwood 2	2050	5,092,832	1,534,979	30	28	2
Browns Ferry 1	2030	926,918	27,791	47	3	4
Browns Ferry 2	2030	926,918	27,791	47	3	4
Browns Ferry 3	2030	926,918	27,791	47	3	4
Brunswick 1	2030	304,703	7,703	51	2	1
Brunswick 2	2030	304,703	7,703	51	2	1
Byron 1	2050	1,141,541	29,618	18	34	2
Byron 2	2050	1,141,541	29,618	18	34	2
Callaway 1	2030	463,360	17,712	37	19	3
Calvert Cliffs 1	2030	3,481,008	256,881	41	21	1
Calvert Cliffs 2	2030	3,481,008	256,881	41	21	1
Catawba 1	2050	2,337,775	139,401	42	5	4
Catawba 2	2050	2,337,775	139,401	42	5	4
Clinton 1	2050	869,226	27,294	35	23	2
Comanche Peak 1	2030	1,654,378	54,431	31	3	1
Comanche Peak 2	2050	1,875,643	61,419	31	3	1
Cooper	2030	217,516	19,745	28	28	2
Crystal River 3	2030	655,382	0	42	0	1
D.C. Cook 1	2030	1,440,998	15	36	69	2
D.C. Cook 2	2030	1,440,998	15	36	69	2
Davis Besse	2030	2,169,925	20	32	37	2
Diablo Canyon 1	2050	419,046	4	32	0	6
Diablo Canyon 2	2050	419,046	4	32	0	6
Dresden 2	2030	7,453,539	143,593	33	30	2
Dresden 3	2030	7,453,539	143,593	33	30	2
Duane Arnold 1	2030	754,825	26,445	33	31	2
Farley 1	2030	488,464	21,412	54	0	1
Farley 2	2050	542,746	25,242	54	0	1

See footnotes at end of table.

Table 5.3 (continued)

Plant	MYR evaluation date[a]	MYR 50-mile population[b]	MYR 50-mile population in high-frequency wind direction	Rain[c]	Snow[c]	General terrain[d]
Fermi 2	2050	6,647,763	0	31	31	2
FitzPatrick	2030	804,876	12,128	34	88	2
Fort Calhoun 1	2030	887,478	14,526	30	32	2
Ginna	2030	1,112,686	0	33	86	2
Grand Gulf 1	2050	504,930	15,143	50	2	1
Haddam Neck (Connecticut Yankee)	2030	4,136,066	120,354	43	53	5
Hatch 1	2030	416,412	43,798	44	1	1
Hatch 2	2030	416,412	43,798	44	1	1
Hope Creek	2050	5,424,373	54,596	40	23	1
Indian Point 2[e]	2030	15,195,541	602,427	43	6	3
Indian Point 3[e]	2030	15,195,541	602,427	43	26	3
Kewanee 1	2030	733,618	0	28	45	2
La Salle 1	2050	1,366,307	61,875	35	28	2
La Salle 2	2050	1,366,307	61,875	35	28	2
Limerick 1	2050	7,615,980	794,765	59	20	1
Limerick 2	2050	7,615,980	794,765	59	20	1
Maine Yankee	2030	830,737	19,668	43	71	5
McGuire 1	2050	2,543,485	134,597	43	6	4
McGuire 2	2050	2,543,485	134,597	43	6	4
Millstone 1	2030	3,138,820	1,419	39	26	5
Millstone 2	2030	3,137,820	1,419	39	26	5
Millstone 3	2050	3,325,582	1,462	39	26	5
Monticello 1	2030	2,815,967	1,587,694	24	42	2
Nine Mile Point 1	2030	802,759	12,239	34	88	2
Nine Mile Point 2	2050	811,475	12,478	34	88	2
North Anna 1	2030	1,478,490	41,700	44	16	4
North Anna 2	2030	1,478,490	41,700	44	16	4
Oconee 1	2030	1,311,318	53,947	53	6	4
Oconee 2	2030	1,311,318	53,947	53	6	4
Oconee 3	2030	1,311,318	53,947	53	6	4
Oyster Creek 1	2030	4,561,213	929	41	16	1
Palisades	2030	1,337,910	9,582	36	69	2
Palo Verde 1	2050	1,974,946	2,700	13	0	3
Palo Verde 2	2050	1,974,946	2,700	13	0	3
Palo Verde 3	2050	1,974,946	2,700	13	0	3
Peach Bottom 2	2030	5,283,198	122,770	38	35	4
Peach Bottom 3	2030	5,283,198	122,770	38	35	4

See footnotes at end of table.

Table 5.3 (continued)

Plant	MYR evaluation date[a]	MYR 50-mile population[b]	MYR 50-mile population in high-frequency wind direction	Rain[c]	Snow[c]	General terrain[d]
Perry 1	2050	2,767,417	0	34	52	2
Pilgrim 1	2030	4,881,755	0	42	42	1
Point Beach 1	2030	700,257	13,275	24	45	2
Point Beach 2	2030	700,257	13,275	24	45	2
Prairie Island 1	2030	2,961,583	29,124	24	44	2
Prairie Island 2	2030	2,961,583	29,124	24	44	2
Quad Cities 1	2030	810,640	13,191	36	29	2
Quad Cities 2	2030	810,640	13,191	36	29	2
Rancho Seco 1	2030	2,589,992	303,556	17	0	6
River Bend	2050	1,105,994	15,770	54	0	1
Robinson 2	2030	991,450	30,941	45	2	4
Salem 1	2030	5,180,877	49,873	40	23	1
Salem 2	2050	5,372,611	54,002	40	23	1
San Onofre 1	2030	7,048,438	0	12	0	1
San Onofre 2	2050	7,764,644	0	12	0	1
San Onofre 3	2050	7,764,644	0	12	0	1
Seabrook 1	2050	4,452,452	344	43	75	5
Sequoyah 1	2030	1,208,316	205,182	58	4	3
Sequoyah 2	2050	1,334,579	226,371	58	4	3
Shearon Harris 1	2050	2,122,597	75,055	45	7	4
Shoreham	2050	5,692,690	170,058	47	34	1
South Texas 1	2050	382,195	29,850	42	0	1
South Texas 2	2050	382,195	29,850	42	0	1
St. Lucie 1	2030	1,036,446	41,401	32	0	1
St. Lucie 2	2050	1,245,868	49,375	32	0	1
Summer 1	2050	1,385,612	83,181	45	2	4
Surry 1	2030	2,506,022	36,210	45	10	1
Surry 2	2030	2,506,022	36,210	45	10	1
Susquehanna 1	2050	1,575,680	34,206	35	50	4
Susquehanna 2	2050	1,575,680	34,206	35	50	4
Three Mile Island 1	2030	2,294,045	263,028	38	37	3
Trojan 1	2030	2,822,894	116,369	42	7	6
Turkey Point 3	2030	4,156,261	93,491	54	0	1
Turkey Point 4	2030	4,156,261	93,491	54	0	1
Vermont Yankee	2030	1,709,869	58,938	43	60	5
Vogtle 1	2050	932,240	17,480	42	1	1
Vogtle 2	2050	932,240	17,480	42	1	1
Waterford 3	2050	2,778,959	45,309	54	0	1

See footnotes at end of table.

Table 5.3 (continued)

Plant	MYR evaluation date[a]	MYR 50-mile population[b]	MYR 50-mile population in high-frequency wind direction	Rain[c]	Snow[c]	General terrain[d]
Watts Bar 1	2050	1,367,537	56,133	53	9	3
Watts Bar 2	2050	1,367,537	56,133	53	9	3
WNP-2[f]	2050	405,235	23,692	5	18	3
Wolf Creek 1	2050	273,225	26,641	31	15	2
Yankee Rowe	2010	1,796,823	471,262	37	66	5
Zion 1	2030	8,199,956	0	32	58	2
Zion 2	2030	8,199,956	0	32	58	2

[a]MYR = Middle year of license renewal period rounded up to the next year for which population forecasts were available.
[b]50 miles = 80 km.
[c]Annual average in inches.
[d]Terrain categories: 1 = coastal plain, 2 = central lowlands, 3 = plateaus, 4 = parallel valleys and ridges, 5 = rolling hills to high mountains, 6 = steep mountains.
[e]Severe accident information obtained from Atomic Safety and Licensing Board testimony and not from the final environmental statement.
[f]WNP-2 = Washington Nuclear Project 2.

the time frame of existing analyses. This estimation process was completed by predicting increases or decreases in consequences as the plant lifetime is extended past the normal license period by considering the projected changes in the risk factors. The primary assumption in this analysis is that regulatory controls will ensure that the physical plant condition (i.e., the predicted probability of and radioactive releases from an accident) will be maintained at a constant level during the renewal period; therefore, the frequency and magnitude of a release will remain relatively constant. In other words, significant changes in consequences will result only from changes in the plant's external environment. The most logical approach, then, would be to incorporate the most significant environmental factors into calculations of consequences for subsequent correlation with existing analyses (which use the consequence computer codes). The two parameters selected for this analysis are population and wind direction, as discussed in the following paragraphs.

Many factors can affect the amount of radiation to which the public is exposed. The magnitude of impact varies for any individual factor and generally is very specific to a particular plant or site. If the FES risk results are to be used to predict future risk values for all plants, it should be demonstrated that the FES plants provide a reasonable envelope of the more significant risk factors for all plants. Such factors include population density, meteorology, evacuation, and interdiction. Studies have shown that some factors have a greater degree of influence than others; for example, population has a very strong influence over risk (NUREG/CR-2239, NUREG-1150). Evacuation can have a significant influence on early fatality risk but a much more limited impact on latent fatality risk. Interdiction primarily reduces latent fatality risk. While particular aspects of meteorology, such as rainfall, can have a significant impact on peak risk values, mean health effect values are relatively insensitive to meteorology. When the basic reasons for the risk influence of each factor are examined, these factors can generally be reduced to three issues: (1) the number of people exposed to the severe accident release, (2) the likelihood that any given individual receives an exposure, and (3) the amount of radiation the individual receives. Consequently, site population (which reflects the number of people potentially at risk to severe accident exposure) and wind direction frequency (which reflects the likelihood of exposure) have been chosen as the primary factors affecting risks.

Although there are other secondary factors (e.g., source term and dose response relationship) that can influence risk and were not specifically analyzed on a plant-specific basis in this GEIS, these factors were not ignored as their impact is included in the FES analyses whose results are the basis for the GEIS analyses. Consequently, their effects are indirectly considered in the prediction of future risks and are reflected within the uncertainty bounds generated by the regression of the FES risk values. To ensure that the existing FES analyses cover a range of secondary factors representative of the total population of plants, the more significant secondary factors were examined as discussed below. The secondary factors examined are as follows:

- average annual precipitation,
- residential population within a 50-mile (80-km(radius of the plant,
- population [50 miles (90 km)] in highest frequency wind direction,
- general terrain, and
- emergency planning.

Average annual precipitation. After an atmospheric release caused by a severe accident, the fallout rate of the released radionuclides is generally the result of gravitational settling and, consequently, is not a rapid process. This slow fallout allows a given release to be suspended for sufficient time to allow for some radioactive decay of the shorter-lived radionuclides, resulting in lower individual doses to the public. In addition, releases are distributed over a wide area, resulting in relatively low individual doses (although the overall total population dose is not greatly affected). However, precipitation counteracts both of these effects by washing the radionuclides out of the atmosphere and not allowing time for extensive dispersion or decay. Thus, plant sites with higher levels of annual precipitation may indicate higher levels of risk for those measures that are based on individual doses.

Residential population within a 50-mile radius of the plant. This factor is a rather understandable selection in that plant sites with larger resident populations will have a larger number of persons at risk for a given severe accident release. Population projections were made based on the 1980 census data and projected growth (decline) factors derived from the U.S. Bureau of Census evaluations. A radius of 50 miles was selected for comparison purposes because existing analyses indicate a large majority (although not all) of early health effects from a severe accident release occur within 50 miles of the plant site.

Population (50 miles) in highest-frequency wind direction. This factor highlights a "higher risk" sector of the overall population around a specific plant site. The sector is 22.5° and the population is 0 to 50 miles from the plant in that sector. Higher populations combined with higher frequency of wind in that direction may indicate higher risks in that sector.

General terrain. This factor is chosen because the dispersion behavior of the plume may be influenced by the general terrain surrounding the plant (e.g., plains versus mountains). Six terrain classifications were selected as described in footnote c to Table 5.3.

Table 5.3 shows the values for these four factors for all nuclear plant sites. As can be seen, the existing severe accident analysis as provided in those FESs containing a severe accident evaluation provides a reasonable envelope for precipitation (rainfall and snowfall), 50-mile population, and 50-mile population in the direction of highest wind frequency. All six terrain classifications are also covered by referenced FES analyses. From review of these data, it is concluded that the FES plants sufficiently envelop these factors. Likewise, any plant risk projections that are developed from the FES severe accident results will reasonably account for secondary effects from these factors if the upper confidence bounding values from the projections are used to estimate the risk from atmospheric releases for plants during their license renewal period.

Emergency planning. Even in the event of a release of radioactive material from a plant, protective actions can be taken to move or shelter members of the public in the projected path of the radioactive cloud. The success of these actions in preventing exposure of members of the public to the radioactive material is dependent upon the warning time available prior to the release and the time it takes to carry out the protective actions. In general, this latter item (the time to carry out the protective action) is mostly influenced by the size of the population around the plant. Each FES that addresses severe accidents considers the effects of site-specific emergency planning in calculating exposures and risks to the public. Since the FES plants include sites with populations that reasonably cover the range of populations at all 74 sites, a range of emergency planning is considered in the data used for the predictions of early and latent fatalities during the license renewal period. Thus, this GEIS analysis should reasonably account for the effects of emergency planning.

Projections of estimates of risk

Detailed severe accident consequence (early and latent fatalities and total dose) evaluations are not available for all plants. Therefore, a predictor for these consequences was developed using correlations based upon the calculated results from the existing FES severe accident analyses. This predictor was then used to infer the future consequence level of all individual nuclear plants. Correlations were developed using two environmental parameters that are available for all plants. This correlation process is described below.

Discussion of exposure index

Population, which changes over time, defines the number of people within a given distance from the plant. Wind direction, which is assumed not to change from year to year, helps determine what proportion of the population is at risk in a given direction, because radionuclides are carried by the wind. Therefore, an EI relationship was developed by multiplying the wind direction frequency (fraction of the time per year) for each of 16 (22.5°) compass sectors times the population in that sector for a given distance from the plant and summing all products. An example calculation for an EI value for 1990 at 10 miles (16 km) is shown in Table 5.4. The EI value, as calculated in Table 5.4, can be considered to be the expected population at risk for the year 1990 out to a distance of 10 miles from the nuclear power plant. Population varies with population growth and movement, and with the distance from any given plant. As the population changes for that plant, the EI also changes (the larger the EI, the larger the number of people at risk). Thus, EI is proportional to risk and an EI for a site for a future year can be used to predict the risk to the population around that site in that future year.

Regression of FES values

Several relationships of EI versus risk were developed by regressing total early fatality, normalized total latent fatality, and normalized total dose values on various EI values for the FES plants (see Appendix G). The EI values at 10 miles were found to best correlate with early fatalities, which is to be expected because, in the FES analyses, early fatalities tend to be clustered close to the plant. The EI values at 150 miles (241 km) were found to best correlate with latent fatalities and total dose. This finding is to be expected because the magnitudes of these risk values are largely influenced by the exposure of large populations around the plant.

Table 5.4 Example calculation for exposure index (EI) value with 1990 population at 10-mile radius from plant

Direction segment	*A* (wind frequency in given direction)	*B* (1990 population within 10 miles of Plant *X*)[a]	*C* (product)
N	0.06	100	6.0
NNE	0.06	105	6.3
NE	0.02	55	1.1
ENE	0.10	20	2.0
E	0.08	25	2.0
ESE	0.08	24	1.92
SE	0.09	75	6.75
SSE	0.10	125	12.5
S	0.06	400	24.0
SSW	0.05	275	13.75
SW	0.07	100	7.0
WSW	0.06	78	4.68
W	0.06	72	4.32
WNW	0.06	40	2.40
NW	0.02	80	1.6
NNW	0.03	78	2.34
	1.00	1652	EI = 98.66

[a]10 miles = 16 km.

Note: To calculate EI value: $A \times B = C$; EI = sum of C.

Because the magnitude of the source term is generally proportional to plant power for a given accident sequence, the FES estimates for total latent fatalities used in the latent fatality regression were first normalized to 1000 MW(t) to minimize the regression variance due to the differing plant sizes. A linear dose response function is used in the FES analyses, and because of the assumptions of downwind and crosswind spread, radioactive material is predicted to be widely dispersed. Thus, the larger the amount of radioactive material released, the larger the predicted latent fatality level (slightly reduced from strict linearity by the interdiction assumptions). Similar logic is applicable to normalization of total dose. Normalization was not used for early fatalities because of the highly nonlinear dose response function used in the FES analyses and the use of a threshold effect (that is, there is a dose level below which no early fatality is predicted). Nonetheless, early fatalities are also highly influenced by the amount of radioactive material released (i.e., plant size), and to help ensure that early fatality data from smaller plants do not distort the regression results for the larger plants, only the early fatality data for plants greater than 3025 MW(t) were used in the regression of early fatalities (Table 5.5, footnote f). The inability to correct fully for the effects of plant size and the dose–early fatality relationship leads to a higher dispersion in the regression estimates, which influences the upper confidence bound (UCB) as will be seen in subsequent sections.

Also, in several of the FES documents, two sets of early fatality values were provided, one set which assumed minimal medical support was available to aid the exposed population and a second set which assumed normal and expected levels of medical support were available. The regression used those early fatality values associated with expected medical support levels. The assumption there would be only minimal or no medical support after an accident was considered to be unrealistic. A detailed discussion of the regression analyses and UCB is provided in Appendix G.

5.3.3.2.2 Results

The data in Table 5.5 summarize the information for 28 nuclear plant sites that were used to develop the relationship between EI and consequences of severe accidents analysis for both PWRs and BWRs. Because of fundamental design differences between PWRs and BWRs, separate regression analyses were performed for each to better account for the BWR-PWR differences in plant failure modes and source terms. Accordingly, the PWR regression was used to determine the best fit relationship for PWR risk values and the BWR regression was used to determine the best fit relationship for FES BWR risk values. As can be seen in Figures 5.2–5.7, two lines (representing average and UCB values) result from the regression analyses for total early fatalities, total latent fatalities, and total dose. The 95 percent UCB (dashed line) was developed based on the scatter in the data. Two points need to be made about the UCB. First, two UCB values were calculated: one value assuming that the data points (i.e., early and latent fatalities and population dose) had a normal distribution about some mean and the second value assuming that the data points did not have a normal distribution about the mean. The larger of the two UCB values was then used in making plant risk projections. The second point to be noted is that because of the small number of data used in the regressions (18 PWR data points and 10 BWR data points), the scatter in the data (expressed as residuals)

Table 5.5 Information used for regression analyses for expected early, latent, and total dose at 28 nuclear plant sites for the license renewal period
Normalized values are obtained by converting nonnormalized values to the equivalent of a 1000-MW(t) plant

Plant	FES analysis[a] date of population	EI values[b] (10 miles)	EI values[b] (150 miles)	Expected early[c,d] fatalities (persons/reactor year)	Expected latent fatalities (persons/reactor year)		Expected total dose (person-rem/reactor year)	
					Nonnormalized[c]	Normalized[e]	Nonnormalized[c]	Normalized[e]
Beaver Valley 2	2010	9,195	958,330	0.002 [f]	0.022	0.0083	230	86.73
Braidwood 1, 2	2000	1,916	1,435,347	0.00038	0.0138	0.004	180	52.77
Byron 1, 2	2000	1,391	1,084,499	0.00026	0.016	0.0047	218	63.91
Callaway 1	2000	508	343,991	0.0001	0.0077	0.0022	126	35.34
Catawba 1, 2	2000	5,414	678,486	0.0011	0.0124	0.0036	170	49.84
Clinton 1	2000	658	1,272,955	0.000009 [f]	0.0191	0.0066	320	110.57
Comanche Peak 1, 2	2000	1,251	292,169	0.0001	0.0046	0.0014	58	17.00
Fermi 2	2000	4,165	1,112,272	0.00074	0.04	0.012	520	157.96
Grand Gulf 1, 2	2000	437	297,829	0.00006	0.0055	0.0014	100	26.09
Shearon Harris 1, 2	2010	1,415	550,951	0.00018 [f]	0.0088	0.0032	114	41.08
Hope Creek	2010	1,541	1,822,818	0.0003	0.07	0.021	1000	303.67
Indian Point 2, 3[g]	1990	18,325	2,743,032	0.0115 [h]	0.826[i]	0.299	10,400 [i]	3770.85
Limerick 1, 2	2000	10,307	2,455,497	0.00914	0.0957	0.029	1360	413.00
Millstone 3	2010	8,751	1,397,683	0.0008	0.05	0.015	1000	293.17
Nine Mile Point 2	2000	1,500	269,042	0.0004	0.023	0.007	300	90.28
Palo Verde 1, 2, 3	2000	67	194,928	0.0000021	0.00456	0.0012	67	17.63
Perry 1, 2	2000	4,465	920,212	0.000016	0.0285	0.008	470	131.32
River Bend	2000	1,485	334,565	0.0004 [f]	0.047	0.016	700	241.88
San Onofre 2, 3	2000	3,950	978,306	0.001	0.033	0.0097	380	112.09
Seabrook 1, 2	2000	4,090	448,066	0.0006	0.0075	0.0022	105	30.78
South Texas 1, 2	2010	236	461,241	0.0000007	0.0108	0.0028	250	65.79
St. Lucie 2	2000	8,739	540,442	0.00007 [f]	0.0064	0.0024	78	28.89
Summer 1	2000	647	627,969	0.00017 [f]	0.0094	0.0034	130	46.85
Susquehanna 1, 2	2000	3,760	1,995,580	0.00077	0.0227	0.0069	360	109.32
Vogtle 1, 2	2010	117	469,641	0.00001	0.024	0.007	310	90.88
Waterford 3	2000	4,745	285,560	0.00057	0.0059	0.0017	69	20.35
Wolf Creek 1	2000	311	289,260	0 [j]	0.00559	0.0016	99	29.02
WNP-2[k]	2000	108	100,055	0.00032	0.00487	0.0015	77	23.17

[a]The population estimates for the indicated year were used to evaluate the consequences to the public for the final environmental statement (FES).
[b]Exposure index (EI) values are given for FES analysis date of population (see note a).
[c]Values obtained from FES for the respective plant with the exception of Indian Point (See note g).
[d]Due to threshold dose effects, these estimates cannot be normalized (i.e., effects are not linear until an exposure threshold is reached).
[e]Normalized to 1000 MW(t) (see Appendix G).
[f]Plant thermal power < 3025 MW(t) and was not used in the regression for expected early fatalities.
[g]Expected risk values obtained from Atomic Safety and Licensing Board testimony and not from FES.
[h]Risk values for Indian Point 3 are listed.
[i]Risk values for Indian Point 2 are listed.
[j]Because values of zero have no meaning on log scales, this data point was not used in the regression for early fatalities.
[k]WNP-2 = Washington Nuclear Project 2.
Note: Multiply person-rem by 0.01 to find person-sieverts; multiply miles by 1.609 to find kilometers.

ORNL-DWG 95-1757

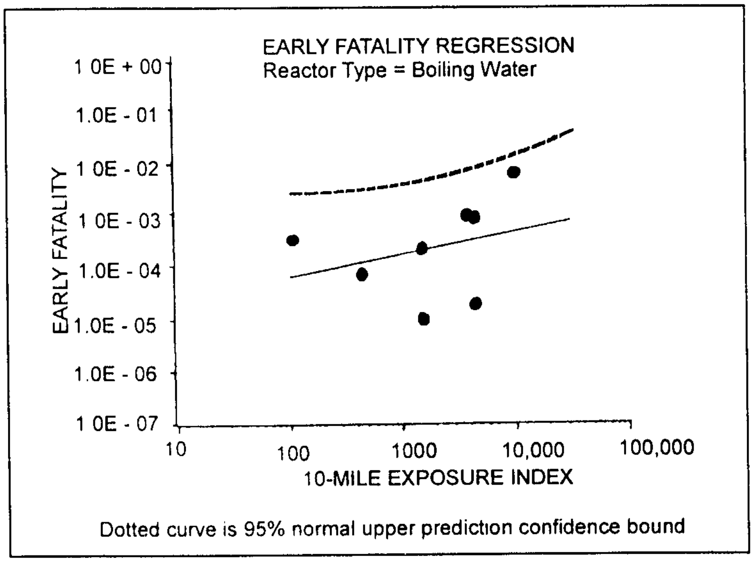

Figure 5.2 **Log plot of early fatalities (average deaths per reactor-year) for final environmental statement boiling-water reactor plants, fitted regression line (solid curve), and 95 percent normal-theory upper prediction confidence bounds (dotted curve).**

ORNL-DWG 95-1758

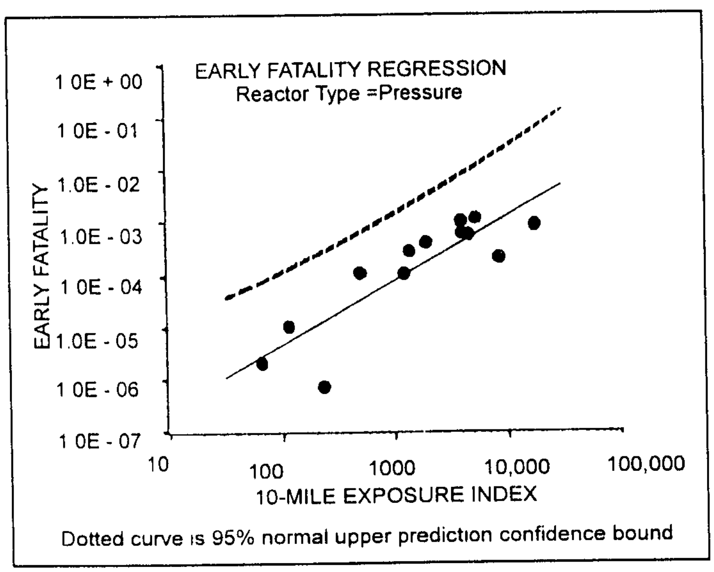

Figure 5.3 **Log plot of early fatalities (average deaths per reactor-year) for final environmental statement pressurized-water reactor plants, fitted regression line (solid curve), and 95 percent normal-theory upper prediction confidence bounds (dotted curve).**

ORNL-DWG 95-1759

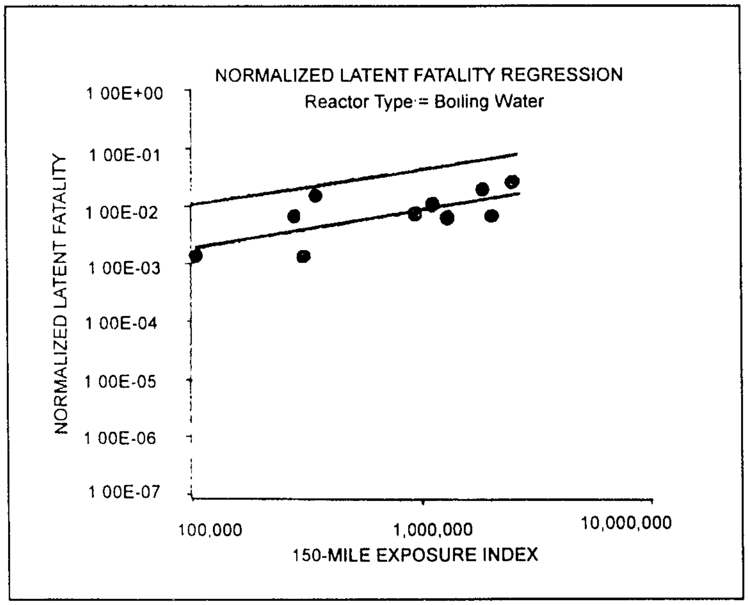

Figure 5.4 Log plot of normalized latent fatalities (average deaths per 1000 MW reactor-year) for final environmental statement boiling-water reactor plants, fitted regression line (solid curve), and 95 percent distribution-free upper prediction confidence bounds (dotted curve).

ORNL-DWG 95-1760

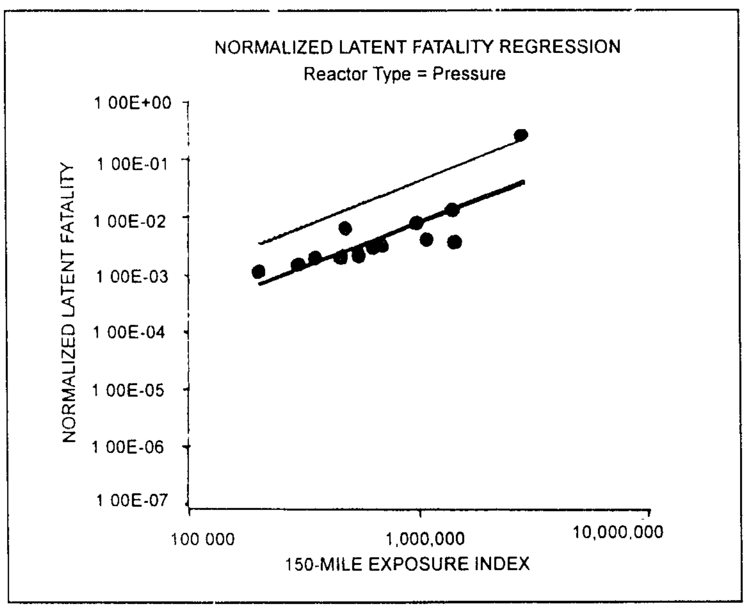

Figure 5.5 Log plot of normalized latent fatalities (average deaths per 1000 MW reactor-year) for final environmental statement pressurized-water reactor plants, fitted regression line (solid curve), and 95 percent distribution-free upper prediction confidence bounds (dotted curve).

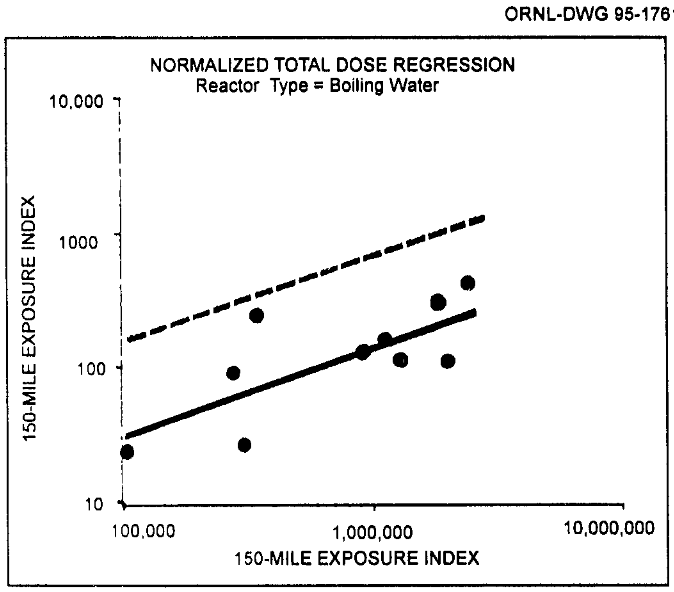

Figure 5.6 Log plot of normalized total dose (person-rem per 1000 MW reactor-year) for final environmental statement boiling-water reactor plants, fitted regression line (solid curve), and 95 percent distribution-free upper prediction confidence bounds (dotted curve).

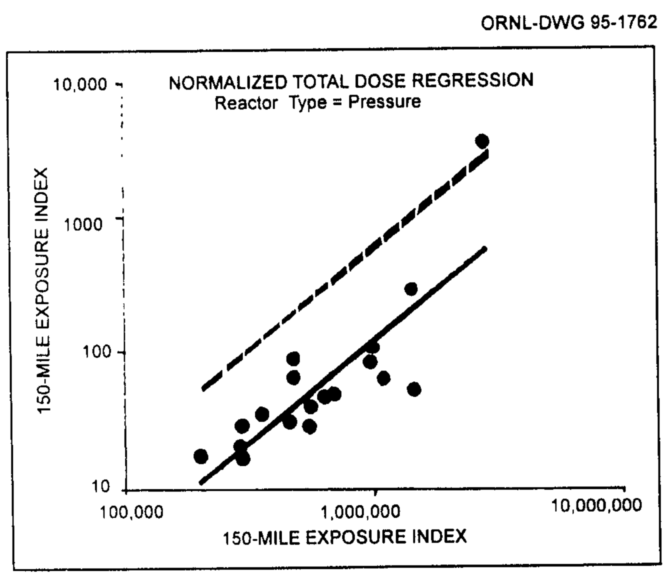

Figure 5.7 Log plot of normalized total dose (person-rem per 1000 MW reactor-year) for final environmental statement pressurized-water reactor plants, fitted regression line (solid curve), and 95 percent distribution-free upper prediction confidence bounds (dotted curve).

for all 28 data points was used in determining the UCB for both the PWR and BWR regressions.

Using the UCB results of the regression analysis, the values for total early fatalities, total latent fatalities, and total dose were then predicted for each site at their MYRs, rounded up to the nearest year for which projected population data are available (2010, 2030, 2050). The results of the UCB projections for early fatalities, latent fatalities, and total dose are shown in Table 5.6. The EI values corresponding to the MYR for each site, which were used to make these predictions, are shown in Tables 5.7 and 5.8. Data for the Millstone plant provide a good example of the process by which these projections were made. The EI at 10 miles for Millstone (an FES plant) is 9420 at its MYR (2050) (Table 5.7). An EI of 9420 results in a projected early fatality UCB of 0.025 fatalities/RY. This value is higher than that reported in the Millstone FES for the year 2010 (0.0008 fatalities/RY, as shown in Table 5.5) and represents a conservative projection of the increase in early fatalities that could occur as a result of increased population around the Millstone site. The effects on risk due to factors such as emergency planning, meteorology (other than the frequency of wind direction—e.g., rainfall), and topography were accounted for in the FES analyses of severe accidents and are consequently incorporated into the FES risk values. Any variation in risk resulting from variation of these secondary parameters among FES plants will be reflected in the UCB calculated by the regressions. As discussed in Section 5.3.3.2.1, the FES plants reasonably envelop these secondary effects. If the future risks for all plants are then estimated using the appropriate (BWR or PWR) regression and the MYR EI, the resulting UCB values are estimated future risks that are not expected to be exceeded.

It should be noted that the risk values for latent fatalities provided in the FESs were calculated using the CRAC computer code which used a linear-quadratic cancer model based on older, low-level radiation exposure data (BEIR-III). Recent evaluations of the EI methodology (see Section 5.3.3.2.3) have been conducted using MACCS, the current, state-of-the-art computer code for assessing risks associated with postulated severe reactor accidents. Unlike CRAC, MACCS uses a linear cancer model based on the newer BEIR-V report. These evaluations suggest that latent fatality values in the FESs are an order of magnitude too low. Therefore, to account for this, the latent fatality results predicted from the FES values have been multiplied by a factor of 10 to obtain the final predicted latent fatality results in this GEIS.

Total population dose for an accident during each plant's relicensing period was also estimated by regression analysis. This dose includes the contribution from direct exposure to the radioactive cloud at the time of release as well as the longer-term effects from ground contamination. Table 5.9 shows the results of this (in person-rem/RY) along with an estimate of the respective average individual dose, in rem/RY, for each plant. Average individual doses were estimated by distributing the UCB total dose estimates from the regression analysis over the population within 150 miles (240 km) of the plant. Because it is virtually certain that people beyond this 150-mile radius would receive some incrementally small dose from an accident, attributing the total dose to the population within 150 miles will provide a conservative average individual dose estimate. For perspective, the annual average background dose to an individual

Table 5.6 Predicted early and latent fatalities and dose estimates per reactor-year (RY) for all sites at their middle year of license renewal period, prior to incorporation of benchmark data

Plant	Predicted UCB total early fatalities/RY (95% UCB)[a]	Nonnormalized predicted latent total fatalities/RY (95% UCB)	Nonnormalized predicted total dose (person-rem/RY) (95% UCB)
Arkansas	3.3×10^{-3}	1.7×10^{-2}	238
Beaver Valley	2.5×10^{-2}	1.3×10^{-1}	1720
Bellefonte	4.0×10^{-3}	1.0×10^{-1}	1335
Big Rock Point	2.7×10^{-3}	3.2×10^{-3}	48
Braidwood	3.6×10^{-3}	3.3×10^{-1}	4418
Browns Ferry	4.3×10^{-3}	9.7×10^{-2}	1446
Brunswick	3.5×10^{-3}	4.7×10^{-2}	704
Byron	2.3×10^{-3}	2.2×10^{-1}	2867
Callaway	6.9×10^{-4}	3.6×10^{-2}	509
Calvert Cliffs	1.8×10^{-3}	2.3×10^{-1}	2995
Catawba	1.7×10^{-2}	1.4×10^{-1}	1880
Clinton	3.0×10^{-3}	1.8×10^{-1}	2549
Comanche Peak	2.3×10^{-3}	3.3×10^{-2}	466
Cooper	2.6×10^{-3}	6.3×10^{-2}	955
Crystal River	1.5×10^{-3}	5.0×10^{-2}	700
D. C. Cook	8.4×10^{-3}	1.8×10^{-1}	2311
Davis Besse	1.4×10^{-3}	1.5×10^{-1}	2021
Diablo Canyon	1.5×10^{-3}	2.5×10^{-2}	346
Dresden	4.6×10^{-3}	1.4×10^{-1}	1991
Duane Arnold	8.0×10^{-3}	3.7×10^{-2}	561
Farley	1.5×10^{-3}	2.4×10^{-2}	334
Fermi 2	6.8×10^{-3}	1.9×10^{-1}	2722
FitzPatrick	3.8×10^{-3}	5.0×10^{-2}	728
Fort Calhoun	1.7×10^{-3}	8.0×10^{-3}	111
Ginna	3.9×10^{-3}	1.5×10^{-2}	203
Grand Gulf	2.8×10^{-3}	9.7×10^{-2}	1441
Haddam Neck (Connecticut Yankee)	1.2×10^{-2}	2.0×10^{-1}	2618
Hatch	2.6×10^{-3}	5.7×10^{-2}	855
Hope Creek	4.1×10^{-3}	2.5×10^{-1}	3604
Indian Point	6.5×10^{-2}	7.7×10^{-1}	9727
Kewanee	8.9×10^{-4}	2.2×10^{-2}	303
La Salle	3.6×10^{-3}	2.0×10^{-1}	2898
Limerick	1.1×10^{-2}	3.1×10^{-1}	4461
Maine Yankee	1.8×10^{-3}	3.0×10^{-2}	414
McGuire	1.0×10^{-2}	1.4×10^{-1}	1806
Millstone	2.5×10^{-2}	3.1×10^{-1}	3988
Monticello	4.1×10^{-3}	5.0×10^{-2}	730
Nine Mile Point	3.8×10^{-3}	6.7×10^{-2}	996
North Anna	9.4×10^{-4}	1.1×10^{-1}	1496
Oconee	1.1×10^{-2}	1.0×10^{-1}	1311
Oyster Creek	7.4×10^{-3}	1.5×10^{-1}	2125
Palisades	4.2×10^{-3}	1.3×10^{-1}	1691

Table 5.6 (continued)

Plant	Predicted UCB total early fatalities/RY (95% UCB)[a]	Nonnormalized predicted latent total fatalities/RY (95% UCB)	Nonnormalized predicted total dose (person-rem/RY) (95% UCB)
Palo Verde	1.1×10^{-4}	2.6×10^{-2}	369
Peach Bottom	4.2×10^{-5}	2.0×10^{-1}	2950
Perry	6.9×10^{-3}	1.7×10^{-1}	2544
Pilgrim	3.7×10^{-3}	6.0×10^{-2}	873
Point Beach	2.5×10^{-3}	2.3×10^{-2}	309
Prairie Island	3.7×10^{-3}	1.7×10^{-2}	237
Quad Cities	4.5×10^{-3}	1.1×10^{-1}	1588
Rancho Seco	1.1×10^{-3}	1.3×10^{-1}	1723
River Bend	4.1×10^{-3}	8.0×10^{-2}	1168
Robinson	3.1×10^{-3}	7.0×10^{-2}	926
Salem	2.9×10^{-3}	5.0×10^{-1}	6059
San Onofre	1.1×10^{-2}	2.4×10^{-1}	3099
Seabrook	1.1×10^{-2}	6.0×10^{-2}	819
Sequoyah	6.6×10^{-3}	1.1×10^{-1}	1474
Shearon Harris	2.8×10^{-3}	7.3×10^{-2}	1001
South Texas	3.3×10^{-4}	8.0×10^{-2}	1065
Saint Lucie	3.2×10^{-2}	8.0×10^{-2}	1063
Shoreham	7.7×10^{-3}	6.3×10^{-2}	2724
Summer	1.3×10^{-3}	1.0×10^{-1}	1381
Surry	1.6×10^{-2}	9.0×10^{-2}	1200
Susquehanna	6.0×10^{-3}	2.8×10^{-1}	4010
Three Mile Island	2.8×10^{-2}	3.3×10^{-1}	4381
Trojan	3.7×10^{-2}	1.5×10^{-1}	1971
Turkey Point	6.0×10^{-2}	2.0×10^{-2}	278
Vermont Yankee	4.6×10^{-3}	9.0×10^{-2}	1314
Vogtle	1.6×10^{-4}	7.3×10^{-2}	983
WNP-2[b]	2.3×10^{-3}	4.3×10^{-2}	649
Waterford	1.4×10^{-2}	3.3×10^{-2}	477
Watts Bar	1.8×10^{-3}	1.2×10^{-1}	1540
Wolf Creek	4.7×10^{-4}	3.3×10^{-2}	466
Yankee Rowe	3.3×10^{-3}	6.7×10^{-2}	872
Zion	5.6×10^{-2}	1.8×10^{-1}	2379

[a]UCB = upper confidence bound. For description and explanation of these values, see Appendix G.
[b]WNP-2 = Washington Nuclear Project 2.
Note: Multiply person-rem by 0.01 to find person-sieverts.

Table 5.7 Middle year of license renewal period (MYR) evaluation date and 10-mile exposure index (EI) for each licensed nuclear plant in the U.S.
Values are given in descending order

Plant	MYR evaluation date[a]	EI[b] (10 miles)
Indian Point	2030	18,959
Turkey Point	2030	17,852
Zion	2030	16,913
Trojan	2030	12,556
St. Lucie	2030	11,447
Limerick	2050	10,709
Three Mile Island	2030	10,327
Beaver Valley	2050	9,535
Millstone	2050	9,420
Catawba	2050	7,219
Surry	2030	6,796
Duane Arnold	2030	6,283
Waterford	2050	6,163
Shoreham	2050	5,915
Oyster Creek	2030	5,584
Haddam Neck (Connecticut Yankee)	2030	5,476
Seabrook	2050	5,234
Oconee	2030	5,184
San Onofre	2050	5,179
Perry	2050	5,020
Fermi 2	2050	4,919
McGuire	2050	4,919
D. C. Cook	2030	4,163
Susquehanna	2050	3,976
Sequoyah	2050	3,471
Palisades	2030	2,421
Vermont Yankee	2030	2,408
Dresden	2030	2,345
Bellefonte	2050	2,317
Ginna	2030	2,291
Quad Cities	2030	2,228
Prairie Island	2030	2,188
Braidwood	2050	2,126
Browns Ferry	2030	2,019
Yankee Rowe	2010	1,998
Arkansas	2030	1,993
Peach Bottom	2030	1,972
River Bend	2050	1,857
Salem	2050	1,808

Table 5.7 (continued)

Plant	MYR evaluation date[a]	EI[b] (10 miles)
Robinson	2030	1,889
Monticello	2030	1,832
Hope Creek	2050	1,807
Shearon Harris	2050	1,773
Point Beach	2030	1,612
Nine Mile Point	2050	1,568
FitzPatrick	2030	1,532
Comanche Peak	2030	1,518
Byron	2050	1,468
Pilgrim	2030	1,435
La Salle	2050	1,307
Maine Yankee	2030	1,246
Watts Bar	2050	1,241
Calvert Cliffs	2030	1,232
Brunswick	2030	1,195
Fort Calhoun	2030	1,155
Crystal River	2030	1,064
Farley	2050	1,021
Diablo Canyon	2050	1,020
Davis-Besse	2030	979
Summer	2050	902
Rancho Seco	2030	835
Clinton	2050	760
North Anna	2030	704
Kewanee	2030	671
Grand Gulf	2050	562
Callaway	2030	541
Big Rock Point	2030	476
Cooper	2030	411
Wolf Creek	2050	381
Hatch	2030	372
South Texas	2050	278
Vogtle	2050	141
WNP-2[c]	2050	134
Palo Verde	2050	96

[a]The renewal period evaluation year is the estimated midpoint of the renewal period for that plant conservatively rounded upward to the next year of available population data (MYR). Dates of license expiration were obtained from Table 2.1. The maximum renewal period of 20 years was assumed.
[b]Value obtained by multiplying wind frequency in each of 16 compass sectors by population 0 to 10 miles (16 km) from plant in that compass sector, then summing all products.
[c]WNP-2 = Washington Nuclear Project 2.

Table 5.8 Middle year of license renewal period (MYR) evaluation date and 150-mile exposure index (EI) for each licensed nuclear plant in the U.S.
Values given in descending order.

Plant	MYR evaluation date[a]	EI[b] (150 miles)
Indian Point	2030	2,863,844
Limerick	2050	2,647,224
Susquehanna	2050	2,279,528
Shoreham	2050	2,014,947
Salem	2050	1,979,840
Oyster Creek	2030	1,970,098
Hope Creek	2050	1,955,878
Three Mile Island	2030	1,928,285
Yankee Rowe	2010	1,739,663
Haddam Neck (Connecticut Yankee)	2030	1,722,399
Braidwood	2050	1,615,088
Millstone	2050	1,510,698
Calvert Cliffs	2030	1,459,323
Peach Bottom	2030	1,453,860
Clinton	2050	1,418,383
La Salle	2050	1,396,350
Fermi 2	2050	1,287,935
Vermont Yankee	2030	1,286,085
San Onofre	2050	1,284,282
Byron	2050	1,214,624
Dresden	2030	1,193,394
Zion	2030	1,107,448
Davis-Besse	2030	1,104,797
D. C. Cook	2030	1,051,654
Palisades	2030	1,041,961
Beaver Valley	2050	1,021,547
Perry	2050	1,021,049
Rancho Seco	2030	992,605
Trojan	2030	944,628
Catawba	2050	914,688
McGuire	2050	890,305
North Anna	2030	876,587
Oconee	2030	867,675
Quad Cities	2030	854,803
Summer	2050	852,405
Surry	2030	846,246
Watts Bar	2050	798,733
Sequoyah	2050	769,140
Robinson	2030	738,770
Saint Lucie	2030	727,763

Table 5.8 (continued)

Plant	MYR evaluation date[a]	EI[b] (150 miles)
Shearon Harris	2050	688,554
Bellefonte	2050	678,549
Vogtle	2050	590,283
South Texas	2050	579,617
Crystal River	2030	573,211
Seabrook	2050	523,715
Browns Ferry	2030	491,751
Monticello	2030	487,606
Pilgrim	2030	486,154
Point Beach	2030	469,985
Kewanee	2030	440,217
River Bend	2050	432,680
Cooper	2030	428,471
Maine Yankee	2030	391,929
Grand Gulf	2050	388,245
Prairie Island	2030	375,227
Callaway	2030	373,564
Waterford	2050	370,569
Comanche Peak	2030	363,530
Wolf Creek	2050	363,380
Ginna	2030	357,773
Hatch	2030	347,873
Turkey Point	2030	345,115
Farley	2050	344,405
Duane Arnold	2030	329,426
Diablo Canyon	2050	302,887
Palo Verde	2050	290,395
Nine Mile Point	2050	273,322
FitzPatrick	2030	270,532
Arkansas	2030	265,479
Brunswick	2030	256,923
Fort Calhoun	2030	242,370
Big Rock Point	2030	136,942
WNP-2[c]	2050	132,195

[a]The renewal period evaluation year is the estimated midpoint of the renewal period for that plant conservatively rounded up to the next year of available population data (MYR). Dates of license expiration were obtained from Table 2.1. The maximum renewal period of 20 years was assumed.
[b]Value obtained by multiplying wind frequency in each of 16 compass sectors by population 0 to 150 miles (240 km) from plant in that compass sector, then summing all products.
[c]WNP-2 = Washington Nuclear Project 2.

Table 5.9 Predicted dose estimate (total and average individual) per reactor-year (RY) for all sites at their middle year of license renewal (MYR)

Plant	Predicted UCB total dose 95% UCB[a] (person-rem/RY)	150-mile MYR population (in millions)	Predicted UCB average individual dose 95% UCB[b] (person-rem/RY)
Arkansas	238	4.1	6×10^{-5}
Beaver Valley	1720	15.6	1×10^{-4}
Bellefonte	1335	12.3	1×10^{-4}
Big Rock Point	48	2.3	2×10^{-5}
Braidwood	4418	20.5	2×10^{-4}
Browns Ferry	1446	8.6	2×10^{-4}
Brunswick	704	5.2	1×10^{-4}
Byron	2867	17.8	2×10^{-4}
Callaway	509	6.6	8×10^{-5}
Calvert Cliffs	2995	20.8	1×10^{-4}
Catawba	1880	13.8	1×10^{-4}
Clinton	2549	18.6	1×10^{-4}
Comanche Peak	466	8.8	5×10^{-5}
Cooper	955	5.4	2×10^{-4}
Crystal River	700	10.6	7×10^{-5}
D.C. Cook	2311	20.1	1×10^{-4}
Davis-Besse	2021	20.6	1×10^{-4}
Diablo Canyon	346	5.7	6×10^{-5}
Dresden	1991	18.9	1×10^{-4}
Duane Arnold	561	6.0	9×10^{-5}
Farley	334	5.7	6×10^{-5}
Fermi 2	2722	21.3	1×10^{-4}
FitzPatrick	728	6.1	1×10^{-4}
Fort Calhoun	111	3.6	3×10^{-5}
Ginna	203	5.8	4×10^{-5}
Grand Gulf	1441	6.2	2×10^{-4}
Haddam Neck (Connecticut Yankee)	2618	32.4	8×10^{-5}
Hatch	855	5.8	1×10^{-4}
Hope Creek	3604	35.5	1×10^{-4}
Indian Point	9727	35.7	3×10^{-4}
Kewanee	303	7.4	4×10^{-5}
La Salle	2898	19.1	2×10^{-4}
Limerick	4461	39.3	1×10^{-4}
Maine Yankee	414	7.6	5×10^{-5}
McGuire	1806	14.3	1×10^{-4}
Millstone	3988	32.6	1×10^{-4}

See footnotes at end of table.

Table 5.9 (continued)

Plant	Predicted UCB total dose 95% UCB[a] (person-rem/RY)	150-mile MYR population (in millions)	Predicted UCB average individual dose 95% UCB[b] (person-rem/RY)
Monticello	730	5.9	1×10^{-4}
Nine Mile Point	996	6.2	2×10^{-4}
North Anna	1496	14.7	1×10^{-4}
Oconee	1311	14.1	1×10^{-4}
Oyster Creek	2125	34.0	6×10^{-5}
Palisades	1691	20.4	8×10^{-5}
Palo Verde	369	4.9	8×10^{-5}
Peach Bottom	2950	33.1	9×10^{-5}
Perry	2544	19.7	1×10^{-4}
Pilgrim	873	13.9	6×10^{-5}
Point Beach	309	7.4	4×10^{-5}
Prairie Island	237	6.5	4×10^{-5}
Quad Cities	1588	15.0	1×10^{-4}
Rancho Seco	1723	16.5	1×10^{-4}
River Bend	1168	7.9	1×10^{-4}
Robinson	926	11.9	8×10^{-5}
Salem	6059	36.1	2×10^{-4}
San Onofre	3099	23.6	1×10^{-4}
Seabrook	819	14.7	6×10^{-5}
Sequoyah	1474	12.9	1×10^{-4}
Shearon Harris	1001	11.8	8×10^{-5}
Shoreham	2724	36.0	8×10^{-5}
South Texas	1065	10.2	1×10^{-4}
Saint Lucie	1063	12.0	9×10^{-5}
Summer	1381	12.6	1×10^{-4}
Surry	1200	12.9	9×10^{-5}
Susquehanna	4010	36.0	1×10^{-4}
Three Mile Island	4381	29.3	1×10^{-4}
Trojan	1971	9.4	2×10^{-4}
Turkey Point	278	6.9	4×10^{-5}
Vermont Yankee	1314	20.9	6×10^{-5}
Vogtle	983	9.4	1×10^{-4}
WNP-2[c]	649	2.5	3×10^{-4}
Waterford	477	6.8	7×10^{-5}
Watts Bar	1540	13.4	1×10^{-4}
Wolf Creek	466	6.3	7×10^{-5}

Table 5.9 (continued)

Plant	Predicted UCB total dose 95% UCB[a] (person-rem/RY)	150-mile MYR population (in millions)	Predicted UCB average individual dose 95% UCB[b] (person-rem/RY)
Yankee Rowe	872	25.0	3×10^{-5}
Zion	2379	18.1	1×10^{-4}

[a]UCB = upper confidence bound. For description and explanation of these values see Appendix G.
[b]Obtained by dividing total fatalities by 150-mile population.
[c]WNP-2 = Washington Nuclear Project 2.
Note: Multiply person-rem by 0.01 to find person-sieverts; 150 miles = 240 km.

from all other causes, including radon, is estimated as 3×10^{-1} rem per year.

5.3.3.2.3 Benchmark Evaluations of the EI Methodology

Values for the consequences associated with nuclear power plant severe accidents have been taken from the FESs and used to establish the regressions and corresponding 95 percent UCBs presented in this chapter. As described previously, the FES values were calculated using the CRAC computer model. Using these regressions and the site-specific EI, UCB estimates for early and normalized latent fatalities and normalized total dose were obtained. As a means of assessing the performance of the EI methodology, two additional studies have been performed (Yambert and Linn 1992 and Tingle 1993). The primary goal of these studies was to demonstrate the accuracy of the EI methodology in predicting consequences associated with severe nuclear power plant accidents. In addition, insight gained from these evaluations was used to adjust values estimated using the EI regressions to reflect current, state-of-the-art calculation techniques.

The most direct means to perform this benchmarking would be to compare the outputs from CRAC used in the FESs with the output of the MACCS code, given identical inputs, for each of the FES plants. However, CRAC has undergone numerous revisions and a working version of the code used for the FES calculations is not available. Also, because the original CRAC input files for the FES plants were no longer available, detailed MACCS input files reflecting the FES plant inputs could not be created. Consequently, a direct comparison of the FES and MACCS output could not be made.

To bridge the gap between the FES values upon which the GEIS results were based and the MACCS code, CRAC2S was used to evaluate 72 hypothetical nuclear power plants. The first effort was to determine if CRAC2S would be an adequate surrogate for CRAC. Then CRAC2S and MACCS would be used to evaluate the 72 hypothetical sites and the results would be compared.

Benchmarking the CRAC2S code

A benchmark run was made using CRAC2S in order to verify its ability to satisfactorily reproduce the CRAC results found in the FESs. This was done by trying to match the input data sets for Indian Point Units 1 and 2 (Acharya and Blond n.d.). The data used in the CRAC2S main input file were identical to those used for the Indian Point CRAC main input file. However, the on-site meteorological data file used in the original Indian Point CRAC calculations was not available. In its place, meteorological data from the nearest monitoring station location, New York City, were used. The results of the benchmark found the early fatalities at Indian Point as calculated by the CRAC2S code were almost five times lower than the values calculated by CRAC. The values for latent cancers and total dose were almost identical. From these results, the staff concluded that the CRAC2S code could be used as a reasonable surrogate for CRAC in benchmarking it against the MACCS code.

Comparison of CRAC2S results to EI results for the hypothetical sites

Yambert and Linn (1992) created 72 hypothetical reactor sites. These sites were constructed by combining projected year 2030 population data for 9 existing reactor sites (5 PWR and 4 BWR) with actual meteorological data taken from 8 stations located across the U.S. The meteorological data were independent of the population data sites. Reactor locations for which population data were selected were chosen such that areas with high, medium, and low populations were represented. Similarly, the meteorological data were selected to represent a wide range of weather patterns (i.e., wet site, dry site, calm site, windy site, etc.). Values for early and normalized latent fatalities, and normalized total dose were then calculated for each of these hypothetical PWR and BWR sites using the CRAC2S computer code.[5] These values were then compared to estimates obtained by applying the EI methodology to the 72 hypothetical sites.

Comparison of the two sets of estimates showed that in all cases, the consequence values calculated using CRAC2S fell below the corresponding 95 percent UCB limit predicted using the EI methodology. In the case of early fatalities, CRAC2S calculated values for PWRs averaged about 2 to 3 times lower than expected values predicted using the fitted EI regression line. This difference was greater for hypothetical BWR sites where CRAC2S calculated values averaged an order of magnitude less than the corresponding expected values from the EI regression. In addition, for a hypothetical site with a very low EI value (less than 100), the CRAC2S predictions were 4 orders of magnitude lower than the EI regression line. This large variability was attributed to the sensitivity of the CRAC2S code results to the number of persons located near the site, particularly in the 0 to 2 mile radius from the facility. The CRAC2S values for both normalized latent fatalities and normalized total dose were nearly identical to the EI fitted regression line for BWRs and were slightly below the regression line for PWRs.

The preceding paragraphs showed that the CRAC code can be adequately represented by the CRAC2S code and that the EI methodology (which is derived from values calculated by the CRAC code) predicts higher or equal consequences for all combinations of population and meteorology compared with the CRAC2S results. The final step was to compare the CRAC2S computations with the latest consequence code to determine if the CRAC2S values, and by inference, the EI methodology values, conservatively overpredict consequences when compared to the state-of-the-art consequence models and computation techniques.

A study was conducted at Brookhaven National Laboratory (Tingle 1993) which compared predictions made by the CRAC2S code to those of the MACCS code. MACCS is the consequence code currently supported by NRC for estimating consequences associated with severe reactor accidents. The Brookhaven study used MACCS to analyze the 72 hypothetical reactor sites (Yambert and Linn 1992).

Early fatality values calculated using MACCS for PWR sites were about a factor of 2 higher than those calculated by CRAC2S. For BWR sites the MACCS values were about a factor of 10 to 20 higher. Consequently, CRAC2S underpredicted MACCS early fatality values by a factor of 2 for PWR sites and a factor of 10 to 20 for BWR sites. However, the EI regression values overpredict the values for early fatality estimates from the CRAC2S code (which are based on CRAC analyses performed for the plants' FES) by factors of 3 for PWRs and 10 for BWRs. These results show that the early fatalities values estimated using the most advanced consequence computer code, MACCS, can be adequately predicted using the fitted EI regression methodology and are well within the 95 percent UCB determined by the EI regression. Consequently, the early fatality regression values shown in Table 5.10 are conservative estimates of this potential impact.

The values for total dose calculated by MACCS and CRAC2S were nearly identical, differing by no more than a factor of 2. This was the same result in comparing the CRAC2S and EI regression values. Thus, the EI regression can be used as an adequate predictor of population total dose due to a severe accident release.

For latent fatalities, the study showed some significant differences between the values predicted by the two codes. MACCS estimates for latent fatalities were consistently factors of 5–15 higher than estimates from the CRAC2S code. Since the CRAC2S values for latent fatalities were very close to the expected EI regression values, the EI regressions underestimate the current best estimates for latent fatalities by approximately a factor of 10. In order to enable the EI methodology to be an adequately conservative predictor of latent fatalities, this information was incorporated by taking the 95 percent UCB values as estimated from the EI regressions and increasing the values by a factor of 10. It is these increased values which are used in the GEIS. The adjusted latent fatality estimates are shown in Table 5.11.

5.3.3.2.4 Conclusion

As can be seen from the data in Tables 5.10 and 5.11, the risk of early and latent fatalities from individual nuclear power plants is small. It represents only a small fraction of the risk to which the public is exposed from other sources. Even if the predicted early and latent fatalities from all 118 plants were considered (that is, the risk to the population of the United States from all 118 nuclear power plants), this would only result in a predicted risk of approximately one additional early fatality per year and approximately 30 additional latent fatalities per year, which is still a small fraction of the approximately 100,000 early and 500,000 latent cancer fatalities per year from other sources.

Table 5.10 Predicted early fatality estimates per reactor-year (RY) for all sites at their middle year of license renewal

Plant	Predicted UCB total early fatalities/RY (95% UCB)[a]
Arkansas	3.3×10^{-3}
Beaver Valley	2.5×10^{-2}
Bellefonte	4.0×10^{-3}
Big Rock Point	2.7×10^{-3}
Braidwood	3.6×10^{-3}
Browns Ferry	4.3×10^{-3}
Brunswick	3.5×10^{-3}
Byron	2.3×10^{-3}
Callaway	6.9×10^{-4}
Calvert Cliffs	1.8×10^{-3}
Catawba	1.7×10^{-2}
Clinton	3.0×10^{-3}
Comanche Peak	2.3×10^{-3}
Cooper	2.6×10^{-3}
Crystal River	1.5×10^{-3}
D. C. Cook	8.4×10^{-3}
Davis-Besse	1.4×10^{-3}
Diablo Canyon	1.5×10^{-3}
Dresden	4.6×10^{-3}
Duane Arnold	8.0×10^{-3}
Farley	1.5×10^{-3}
Fermi 2	6.8×10^{-3}
FitzPatrick	3.8×10^{-3}
Fort Calhoun	1.7×10^{-3}
Ginna	3.9×10^{-3}
Grand Gulf	2.8×10^{-3}
Haddam Neck	1.2×10^{-2}
Hatch	2.6×10^{-3}
Hope Creek	4.1×10^{-3}
Indian Point	6.5×10^{-2}
Kewanee	8.9×10^{-4}
La Salle	3.6×10^{-3}
Limerick	1.1×10^{-2}
Maine Yankee	1.8×10^{-3}
McGuire	1.0×10^{-2}
Millstone	2.5×10^{-2}
Monticello	4.1×10^{-3}
Nine Mile Point	3.8×10^{-3}

See footnotes at end of table.

Table 5.10 (continued)

Plant	Predicted UCB total early fatalities/RY (95% UCB)[a]
North Anna	9.4×10^{-4}
Oconee	1.1×10^{-2}
Oyster Creek	7.4×10^{-3}
Palisades	4.2×10^{-3}
Palo Verde	1.1×10^{-4}
Peach Bottom	4.2×10^{-3}
Perry	6.9×10^{-3}
Pilgrim	3.7×10^{-3}
Point Beach	2.5×10^{-3}
Prairie Island	3.7×10^{-3}
Quad Cities	4.5×10^{-3}
Rancho Seco	1.1×10^{-3}
River Bend	4.1×10^{-3}
Robinson	3.1×10^{-3}
Salem	2.9×10^{-3}
San Onofre	1.1×10^{-2}
Seabrook	1.1×10^{-2}
Sequoyah	6.6×10^{-3}
Shearon Harris	2.8×10^{-3}
Shoreham	3.3×10^{-3}
South Texas	3.2×10^{-3}
Saint Lucie	7.7×10^{-2}
Summer	1.3×10^{-4}
Surry	1.6×10^{-2}
Susquehanna	6.0×10^{-3}
Three Mile Island	2.8×10^{-2}
Trojan	3.7×10^{-2}
Turkey Point	6.0×10^{-2}
Vermont Yankee	4.6×10^{-3}
Vogtle	1.6×10^{-4}
WNP-2[b]	2.3×10^{-3}
Waterford	1.4×10^{-2}
Watts Bar	1.8×10^{-3}
Wolf Creek	4.7×10^{-4}
Yankee Rowe	3.3×10^{-3}
Zion	5.6×10^{-2}

[a]UCB = upper confidence bound. For description and explanation of these values, see Appendix G.
[b]WNP-2 = Washington Nuclear Project 2.

Table 5.11 Predicted latent fatality estimates per reactor-year (RY) for all sites at their middle year of license renewal (MYR)

Plant	Nonnormalized predicted UCB total latent fatalities/RY (95% UCB)[a]
Arkansas	1.7×10^{-1}
Beaver Valley	1.3×10^{0}
Bellefonte	1.0×10^{0}
Big Rock Point	3.2×10^{-2}
Braidwood	3.3×10^{0}
Browns Ferry	9.7×10^{-1}
Brunswick	4.7×10^{-1}
Byron	2.2×10^{0}
Callaway	3.6×10^{-1}
Calvert Cliffs	2.3×10^{0}
Catawba	1.4×10^{0}
Clinton	1.8×10^{0}
Comanche Peak	3.3×10^{-1}
Cooper	6.3×10^{-1}
Crystal River	5.0×10^{-1}
D. C. Cook	1.8×10^{0}
Davis-Besse	1.5×10^{0}
Diablo Canyon	2.5×10^{-1}
Dresden	1.4×10^{0}
Duane Arnold	3.7×10^{-1}
Farley	2.4×10^{-1}
Fermi 2	1.9×10^{0}
FitzPatrick	5.0×10^{-1}
Fort Calhoun	8.0×10^{-2}
Ginna	1.5×10^{-1}
Grand Gulf	9.7×10^{-1}
Haddam Neck (Connecticut Yankee)	2.0×10^{0}
Hatch	5.7×10^{-1}
Hope Creek	2.5×10^{0}
Indian Point	7.7×10^{0}
Kewanee	2.2×10^{-1}
La Salle	2.0×10^{0}
Limerick	3.1×10^{0}
Maine Yankee	3.0×10^{-1}
McGuire	1.4×10^{0}
Millstone	3.1×10^{0}

See footnotes at end of table.

Table 5.11 (continued)

Plant	Nonnormalized predicted UCB total latent fatalities/RY (95% UCB)[a]
Monticello	5.0×10^{-1}
Nine Mile Point	6.7×10^{-1}
North Anna	1.1×10^{0}
Oconee	1.0×10^{0}
Oyster Creek	1.5×10^{0}
Palisades	1.3×10^{0}
Palo Verde	2.6×10^{-1}
Peach Bottom	2.0×10^{0}
Perry	1.7×10^{0}
Pilgrim	6.0×10^{-1}
	2.3×10^{-1}
Point Beach	
Prairie Island	1.7×10^{-1}
Quad Cities	1.1×10^{0}
Rancho Seco	1.3×10^{0}
River Bend	8.0×10^{-1}
Robinson	7.0×10^{-1}
Salem	5.0×10^{0}
San Onofre	2.4×10^{0}
Seabrook	6.0×10^{-1}
Sequoyah	1.1×10^{0}
Shearon Harris	7.3×10^{-1}
Shoreham	8.0×10^{-1}
South Texas	8.0×10^{-1}
St. Lucie	6.3×10^{-1}
Summer	1.0×10^{0}
Surry	9.0×10^{-1}
Susquehanna	2.8×10^{0}
Three Mile Island	3.3×10^{0}
Trojan	1.5×10^{0}
Turkey Point	2.0×10^{-1}
Vermont Yankee	9.0×10^{-1}
Vogtle	7.3×10^{-1}
WNP-2[b]	4.3×10^{-1}
Waterford	3.3×10^{-1}
Watts Bar	1.2×10^{0}
Wolf Creek	3.3×10^{-1}
Yankee Rowe	6.7×10^{-1}
Zion	1.8×10^{0}

[a]UCB = upper confidence bound. For description and explanation of these values, see Appendix G.
[b]WNP-2 = Washington Nuclear Project 2.

In addition, the prediction technique used was designed to overestimate the risk from reactor accidents. Table 5.12 illustrates this point by comparing—for the five NUREG-1150 plants—the early and latent risk values obtained from Tables 5.10 and 5.11 versus those from the NUREG-1150 analyses. In all cases the NUREG-1150 analyses predict lower risk values (one to five orders of magnitude) than the GEIS prediction technique. Although some of the difference can be attributed to the fact that the NUREG-1150 results incorporated plant modifications discovered and corrected as a result of the NUREG-1150 analyses, some can also be attributed to the conservatism of the prediction technique used versus the more recent detailed analyses used for NUREG-1150.

Table 5.12 Comparison of predicted early and latent fatality estimates to NUREG-1150 findings

	Early fatalities		Latent fatalities	
Plant	Table 5.10	NUREG-1150	Table 5.11	NUREG-1150
Grand Gulf	2.8×10^{-3}/RY	1×10^{-8}/RY	9.7×10^{-1}/RY	9×10^{-4}/RY
Peach Bottom	4.2×10^{-3}/RY	3×10^{-8}/RY	2.0×10^{0}/RY	4×10^{-3}/RY
Sequoyah	6.6×10^{-3}/RY	3×10^{-5}/RY	1.1×10^{0}/RY	1×10^{-2}/RY
Surry	1.6×10^{-2}/RY	2×10^{-6}/RY	9.0×10^{-1}/RY	5×10^{-3}/RY
Zion	5.6×10^{-2}/RY	3×10^{-5}/RY	1.8×10^{0}/RY	8×10^{-3}/RY

Note: RY = reactor-year.

5.3.3.3 Dose and Adverse Health Effects from Fallout onto Open Bodies of Water

5.3.3.3.1 Methodology

Following a severe accident, a radiation hazard may exist from the deposition of airborne, radioactive fallout onto open bodies of water. Depending on the type of water body, this hazard may lead to internal exposure from the ingestion of contaminated water or from consuming contaminated aquatic fauna. External exposure may result from swimming in the contaminated water or from recreational activities on the shoreline. The extent of the hazard is largely determined by the proximity of individuals to the reactor, the areal extent of contamination, and the ability for interdiction to reduce the exposure hazard. The risk from this exposure at plants sited on all types of water bodies is compared with that of the Fermi plant, located on Lake Erie, for which an analysis has been completed for an uninterdicted dose (NUREG-0769, Addendum 1). The potential risk is also discussed for a dose with interdiction.

This section examines such radiation exposure risk at nuclear power reactors in the event of a severe reactor accident in which radioactive contaminants are released into the atmosphere and subsequently deposited onto open bodies of water. The drinking-water pathway is treated separately from the aquatic food, swimming, and shoreline pathways. The latter three pathways are addressed collectively, and the rationale for selecting only the aquatic food pathway for analysis is presented. In the case of the drinking-water pathway, environmental parameters at representative sites are compared with such parameters at the Enrico Fermi Atomic Power Plant, Unit 2, to arrive at some indication of comparative, uninterdicted hazard.

For the aquatic food pathway, the methodology in the Fermi analysis was used with site-specific data to arrive at a comparative population dose. The Fermi analysis applied the completely mixed lake model bottom sedimentation, so that sedimentation processes are accounted for in the residence times. Population dose estimates for both the drinking-water and aquatic food pathways are compared with estimates from the atmospheric pathway. Analysis of the drinking-water pathway precedes that of the aquatic food pathway.

For the drinking-water pathway, sites adjacent to bodies of fresh water that can be used as a source of drinking water are considered. One estuarine site, which is not used as a source of drinking water, is examined for comparison purposes only. Direct deposition onto the surface water is the only pathway evaluated. The contamination of surface water bodies by the land erosion of atmospherically deposited radionuclides is not considered. One study concludes that risk from such a pathway is small compared with that of the atmospheric and terrestrial pathways (Helton et al. 1985). The study indicates that the contribution to latent facility from runoff to a great lake is less than 15 percent of what would be expected by direct deposit onto the lake. For both a great lake and a river, the expected latent facilities are only a small fraction of the latent fatalities predicted from land contamination. (Terrestrial pathways, including ingestion of crops, are considered in the atmospheric pathway in Section 5.3.3.2.)

Radioactive material released to the atmosphere tends to spread and disperse in air and dilute in water. The concentration of the contaminated material is thus related to the volume of contaminated air and water and meteorological and hydrological conditions at the time of release. These dilution processes reduce the intensity of the hazard downwind and downstream from the point of release but tend to increase the areal extent of the exposure hazard.

Several studies provide partial benchmarks that can be used to comparatively evaluate the surface water ingestion pathway at reactors located adjacent to bodies of fresh water. The Liquid Pathway Generic Study (LPGS) (NUREG-0440) examines surface water contamination via groundwater transport following a severe accident at a generic small river site, large river site, Great Lakes site, estuary site, coastal site, and dry site. Transport via groundwater to surface water bodies, however, is not directly applicable to the direct deposition pathway examined here. Results of the LPGS study indicate that the maximum individual total body dose associated with a severe core-melt accident for the small river site was one to two orders of magnitude higher than for the large river and Great Lakes site. The high values for the small river site were related to lower flow rates. Uninterdicted population drinking-water dose estimates calculated in the LPGS are as follows: large river site, 1.08×10^5 person-rem; small river site,

8.87×10^6 person-rem; and Great Lakes site, 2.34×10^6 person-rem.

Two analyses establish precedent for the direct-deposition, surface-water ingestion pathway. One (NUREG-0769, Addendum 1) is an estimate of risk performed for the Enrico Fermi Atomic Power Plant Unit 2. This assessment indicates that estimated individual and societal uninterdicted doses from the surface water pathway are of the same order of magnitude as interdicted doses from the airborne pathway. A whole body dose to an individual after a 3-year period of exposure was estimated at 0.8 rem. Interdiction comparable to that for the terrestrial pathway could substantially reduce this dose estimate and is equally likely. A second study for the Indian Point reactors (Codell 1985) developed empirical models based on considerations of radionuclide data associated with fallout from atmospheric weapons tests. A maximum 194 person-rem/RY whole-body uninterdicted dose via drinking water was estimated and compared with a maximum 2610 person-rem/RY whole-body dose from the direct airborne pathways. Although both latent and early fatality risks are associated with direct airborne pathways, only latent risks were found to be associated with the liquid (drinking-water) pathway because doses were well below the predicted rate and threshold for early fatalities or radiation illness.

Analyses in environmental documents prepared subsequent to the Fermi and Indian Point studies and the LPGS used results of these three studies as benchmarks. Representative conclusions from these documents are summarized here. Using site-specific parameters for the Perry plant (NUREG-0884), individual and societal latent cancer fatality risks from unrestricted use of Lake Erie were found to be about twice the risks from the Fermi reactor but the same order of magnitude as the air and ground pathways. For the Limerick plant (NUREG-0974), the small surface area of the nearby receiving water body (the Schuylkill River) relative to the total area of fallout is cited as the basis for concluding that the surface water pathway would be of small importance compared with the land pathway. The analysis for the Vogtle plant (NUREG-1087) qualitatively compares site-specific characteristics with those from both the Fermi and Indian Point studies and concludes that the surface water pathway would be of little importance compared with the results from atmospheric fallout onto land.

Environmental parameters important for input in performing the above analyses, and for use in analyses of additional sites, are the surface area of the receiving body, the volume of water in the body, and the flow rate. In the absence of a rigorous site-specific analyses, these data can provide estimates of the extent of contamination in the receiving water body and the residence time of the contaminant in the affected water body. Comparing these estimates and site environmental parameters with those for Fermi can provide some indication of the comparative hazard associated with drinking contaminated surface water among sites and the need for site-specific analyses. Accounting for population and meteorological data in the comparison can provide further indication of relative risk among sites.

The method used for evaluating the direct-deposition surface water ingestion pathway compares water body surface area, volume, and flow rate data at plants for which analyses have not been performed with similar data used in the Fermi 2 analysis. Table 5.13 lists all plants by adjacent water body category. Type of plant site categories have been assigned consistent with the LPGS analysis. Plants

Table 5.13 Nuclear power plants by water body category

Estuary or coastal	Great lakes	Small river or impoundment		Large river
Diablo Canyon	Zion	Bellefonte	Vogtle	Grand Gulf
Crystal River	Fermi	Haddam Neck	Clinton	Trojan
Maine Yankee	Ginna	Braidwood	Quad Cities	WNP-2[a]
Seabrook	Perry	Dresden	Monticello	River Bend
Salem	Big Rock Point	Duane Arnold	Cooper	
South Texas	Palisades	Waterford	Shearon Harris	
San Onofre	Nine Mile Point	Prairie Island	Limerick	
St. Lucie	Kewaunee	Fort Calhoun	Three Mile Island	
Calvert Cliffs	Cook	McGuire	Catawba	
Hope Creek	FitzPatrick	Peach Bottom	Summer	
Shoreham	Davis-Besse	Browns Ferry	Oconee	
Surry	Point Beach	Arkansas	Sequoyah	
Millstone		Hatch	Vermont Yankee	
Turkey Point		Byron Station	Connecticut Yankee	
Pilgrim		La Salle	Robinson	
Oyster Creek		Wolf Creek	Watts Bar	
Brunswick		Yankee Rowe	North Anna	
Indian Point		Callaway		
Shoreham		Beaver Valley		
		Susquehanna		
		Farley		

[a]WNP-2 = Washington Nuclear Project 2.

were selected for analysis to represent the spectrum of environmental characteristics found at all plants; those not evaluated are considered to possess environmental characteristics within the range of those evaluated.

Nine Mile Point and Zion were selected to include Great Lakes other than Lake Erie. Zion was selected because, of those plants located near Lake Michigan, Zion's location near the southwestern shore of the lake would enable a large portion of a plume to be deposited onto the lake near a highly populated area. Trojan and Grand Gulf were selected to represent each of the two large rivers adjacent to plants. Because the LPGS analysis indicates higher population dose estimates for small rivers (NUREG-0440), a larger number of small river sites have been evaluated. Small river sites were selected to represent (1) a range of flow rates, (2) proximity to small rivers that are the only affected water body, and (3) proximity to small rivers where other water bodies are also affected. An estuary site, in which the principal water body is not used as a source of drinking water, is included for comparison purposes only.

Great Lakes data as presented in the Fermi analysis are used in this evaluation. The assumptions used for determining river width, depth, and flow rate throughout the affected river reach are as follows: (1) large rivers and small rivers are uniformly 6- and 3-m (20- and 10-ft) deep, respectively, (2) river width at the reactor site is the same throughout the affected area, and (3) reported flow rate at the site is assumed throughout. Surface area and volume data for small lakes and reservoirs were obtained from federal and state agencies. In those cases in which part of a small lake is included in the affected area, the entire surface area and volume of the lake are included. As in the Fermi analysis, contaminant is assumed to be thoroughly mixed in the water body.

For the purposes of this analysis, it is assumed that essentially all atmospheric fallout occurs within 80 km (50 miles) of the reactor. For river sites, the "potentially" affected area includes all surface water bodies within 80 km (50 miles) of the reactor while the "likely" affected area assumes that only a limited portion of the potentially affected area is affected. (The likely affected area includes water body surface areas and volumes within 80 km of the reactor site and within 6 of the 22.5° compass sectors toward which the wind blows the greatest percentage of time.) All major surface water bodies are assumed to be sources of drinking water at the evaluation year (MYR). For Great Lakes and the estuary site, it is assumed that the adjacent water body is both the potentially and likely affected area. The potentially and likely affected populations at the MYR are obtained as above for the affected area. Data are presented in Tables 5.14a and 5.14b.

To facilitate comparison of environmental parameters and analysis of those parameters among sites, selected data in Tables 5.14a and 5.14b are presented in histograms in Figures 5.8 through 5.11. The data included in the figures and a brief description of types of information provided by the figures follow. Figure 5.8 compares surface areas and water volumes of potentially affected areas. In addition to illustrating the smaller surface area of rivers available to receive fallout compared with the Great Lakes, these data provide some indication of relative dilution capacity (water volume) of the bodies of water. Figure 5.9 compares surface areas and water volumes of likely affected areas. These data further illustrate the smaller affected surface area and dilution capacity of rivers compared with the Great Lakes. Figure 5.10 depicts the three-order-of-magnitude spread in water body flow rate that contributes to additional dilution over longer time periods. Figure 5.11 compares estimated contaminant residence times in the likely affected water bodies and the surface-area-to-volume ratios to provide some indication of the relative level of contamination per unit of water. The data in this figure (obtained by simple computation from data presented in previous figures) are the principal basis for comparison with the Fermi plant.

In addition to examining the drinking-water pathway, NUREG-0769 (1981) considers the aquatic food, shoreline, and swimming exposure pathways for the Fermi reactor. Since the principal uninterdicted, whole-body population dose in the Fermi analysis is derived from aquatic food (8×10^7 person-rem), as compared to drinking water (4×10^6 person-rem), shoreline (2×10^6 person-rem), and swimming (6×10^3 person-rem), the uninterdicted aquatic food pathway is examined. Particularly in the case of estuaries, aquatic food consumption constitutes the principal pathway of exposure.

The process for examining the aquatic food pathway began with a comparison of edible aquatic food harvest data from major eastern U.S. and Gulf Coast estuaries,

Table 5.14a Comparison of Fermi 2 site data with data from other representative nuclear plants

Plant	Type of site[a]	Potentially affected surface area (m^2)	Potentially affected water volume (m^3)	Likely affected surface area (m^2)[b]	Likely affected water volume (m^3)[b]	Average flow rate (m^3/year)
Fermi	Lake	2.57×10^{10}	4.58×10^{11}	2.57×10^{10}	4.58×10^{11}	1.75×10^{11}
Beaver Valley	Small river	9.44×10^{7}	2.83×10^{8}	6.74×10^{7}	2.02×10^{8}	3.31×10^{10}
Braidwood	Small river	2.27×10^{7}	6.82×10^{7}	1.28×10^{7}	3.58×10^{7}	3.47×10^{9}
Browns Ferry	Small river	5.19×10^{8}	2.45×10^{9}	2.38×10^{8}	1.16×10^{9}	3.82×10^{10}
Byron Station	Small river	2.12×10^{7}	6.36×10^{7}	4.85×10^{6}	1.46×10^{7}	4.42×10^{9}
Callaway	Small river	1.24×10^{8}	3.73×10^{8}	6.41×10^{6}	1.92×10^{7}	1.17×10^{10}
Catawba	Small river	6.99×10^{7}	4.25×10^{8}	6.79×10^{7}	3.65×10^{8}	3.47×10^{9}
Clinton	Small river	1.03×10^{8}	4.71×10^{8}	3.20×10^{7}	1.33×10^{8}	2.21×10^{8}
Dresden	Small river	2.27×10^{7}	6.82×10^{7}	6.41×10^{6}	1.92×10^{7}	3.78×10^{9}
Duane Arnold	Small river	4.27×10^{7}	1.18×10^{8}	4.27×10^{7}	1.18×10^{8}	2.68×10^{9}
Grand Gulf	Large river	1.19×10^{8}	7.15×10^{8}	1.19×10^{8}	7.15×10^{8}	6.02×10^{11}
Hope Creek	Estuary	2.07×10^{9}	3.45×10^{10}	2.07×10^{9}	3.45×10^{10}	3.71×10^{11}
Limerick	Small river	6.03×10^{7}	1.81×10^{8}	1.28×10^{7}	3.85×10^{7}	1.70×10^{9}
McGuire	Small river	3.80×10^{8}	2.15×10^{9}	2.72×10^{8}	1.48×10^{9}	2.37×10^{9}
Monticello	Small river	5.46×10^{8}	3.45×10^{9}	5.46×10^{8}	3.45×10^{9}	4.10×10^{9}
Nine Mile Point	Lake	1.97×10^{10}	1.64×10^{12}	1.97×10^{10}	1.64×10^{12}	2.09×10^{11}
North Anna	Small river	6.59×10^{7}	6.81×10^{8}	6.08×10^{7}	6.66×10^{8}	3.15×10^{8}
Oconee	Small river	3.46×10^{8}	5.86×10^{9}	3.46×10^{8}	5.86×10^{9}	9.46×10^{8}
Prairie Island	Small river	5.70×10^{8}	3.53×10^{9}	5.70×10^{8}	3.53×10^{9}	1.34×10^{10}
Quad Cities	Small river	6.24×10^{7}	1.87×10^{8}	4.33×10^{7}	1.30×10^{8}	4.23×10^{10}
Robinson	Small river	9.40×10^{7}	5.08×10^{8}	1.51×10^{7}	5.63×10^{7}	1.58×10^{8}
Shearon Harris	Small river	1.17×10^{8}	1.11×10^{9}	8.64×10^{7}	1.01×10^{9}	2.78×10^{9}
Summer	Small river	3.33×10^{8}	3.35×10^{9}	6.79×10^{7}	4.19×10^{8}	5.36×10^{9}
Three Mile Island	Small river	4.71×10^{7}	1.41×10^{8}	4.71×10^{7}	1.41×10^{8}	3.04×10^{10}
Trojan	Large river	8.73×10^{7}	5.24×10^{8}	8.73×10^{7}	5.24×10^{8}	3.85×10^{11}
Vermont Yankee	Small river	6.20×10^{7}	1.86×10^{8}	6.20×10^{7}	1.86×10^{8}	7.73×10^{9}
Wolf Creek	Small river	1.50×10^{8}	6.41×10^{8}	7.04×10^{7}	2.05×10^{8}	1.42×10^{9}
Yankee Rowe	Small river	1.97×10^{8}	1.87×10^{9}	1.48×10^{7}	4.43×10^{7}	6.62×10^{8}
Zion	Lake	5.80×10^{10}	4.87×10^{12}	5.80×10^{10}	4.87×10^{12}	1.58×10^{11}

[a]As designated in Liquid Pathway Generic Study analysis (NUREG-0440).
[b]In the likely affected water body.
Note: Multiply square meters by 1.20 to find square yards; multiply cubic meters by 1.307 to find cubic yards.

Table 5.14b Comparison of Fermi 2 site data with data from other representative nuclear plants

Plant	Type of site[a]	Residence time (years)[b]	Surface area to volume ratio[b]	Potentially affected population[c]	Percentage of population likely to be affected	Average annual wind velocity (mph)	Average annual precipitation (inches)	
							Rain	Snow
Fermi	Lake	2.6×10^{0}	5.6×10^{-2}	6,647,763	41	8.9	31	31
Beaver Valley	Small river	6.1×10^{-3}	3.3×10^{-1}	4,169,673	48	9.3	36	46
Braidwood	Small river	1.1×10^{-2}	3.3×10^{-1}	5,092,832	43	10.3	30	24
Browns Ferry	Small river	3.0×10^{-2}	2.1×10^{-1}	926,918	13	8–12	47	3
Byron Station	Small river	3.3×10^{-3}	3.3×10^{-1}	1,141,541	38	9.9	18	34
Callaway	Small river	1.6×10^{-3}	3.3×10^{-1}	463,360	11	10.3	37	19
Catawba	Small river	1.1×10^{-1}	1.9×10^{-1}	2,337,775	13	6.9	42	56
Clinton	Small river	6.0×10^{-1}	2.4×10^{-1}	869,226	6	11.4	35	23
Dresden	Small river	5.1×10^{-3}	3.3×10^{-1}	7,453,539	17	9.7	33	37
Duane Arnold	Small river	4.4×10^{-2}	3.6×10^{-1}	754,825	46	8.0	33	31
Grand Gulf	Large river	1.2×10^{-3}	1.7×10^{-1}	504,930	18	7.7	50	2
Hope Creek	Estuary	9.3×10^{-2}	6.0×10^{-2}	5,424,373	26	8.9	40	23
Limerick	Small river	2.3×10^{-2}	3.3×10^{-1}	7,615,980	37	9.1	59	20
McGuire	Small river	6.2×10^{-1}	1.8×10^{-1}	2,543,485	23	6.9	43	6
Monticello	Small river	8.4×10^{-1}	1.6×10^{-1}	2,815,967	82	NA	24	42
Nine Mile Point	Lake	7.8×10^{0}	1.2×10^{-2}	811,475	9	10.0	34	88
North Anna	Small river	2.1×10^{0}	9.1×10^{-2}	1,478,490	61	6.8	44	16
Oconee	Small river	6.0×10^{0}	5.9×10^{-2}	1,311,318	20	7.6	53	NA
Prairie Island	Small river	2.6×10^{-1}	1.6×10^{-1}	2,961,583	79	6.3	25	44
Robinson	Small river	3.6×10^{-1}	2.7×10^{-1}	991,450	28	6.2	33	NA
Shearon Harris	Small river	3.6×10^{-1}	8.6×10^{-2}	2,122,597	49	4.6	36	NA
Summer	Small river	7.8×10^{-2}	1.6×10^{-1}	1,385,612	27	NA	45	2
Trojan	Large river	1.4×10^{-3}	1.7×10^{-1}	2,822,894	91	8.2	42	7
Vermont Yankee	Small river	2.4×10^{-2}	3.3×10^{-1}	1,709,869	45	7.8	43	60
Wolf Creek	Small river	1.4×10^{-1}	3.4×10^{-1}	273,225	35	10.3	31	15
Yankee Rowe	Small river	6.7×10^{-2}	3.3×10^{-1}	1,796,823	38	NA	NA	100
Zion	Lake	3.1×10^{1}	1.2×10^{-2}	8,199,956	10	NA	32	58

[a]As designated in Liquid Pathway Generic Study analysis (NUREG-0440).
[b]In the likely affected water body.
[c]Population projected for the middle year of license renewal (Table 5.5); 80-km (50-mile) radius from the site.
NA = Data not available.
Note: To convert mph to kph, multiply by 1.61; to convert inches to centimeters, multiply by 2.54.

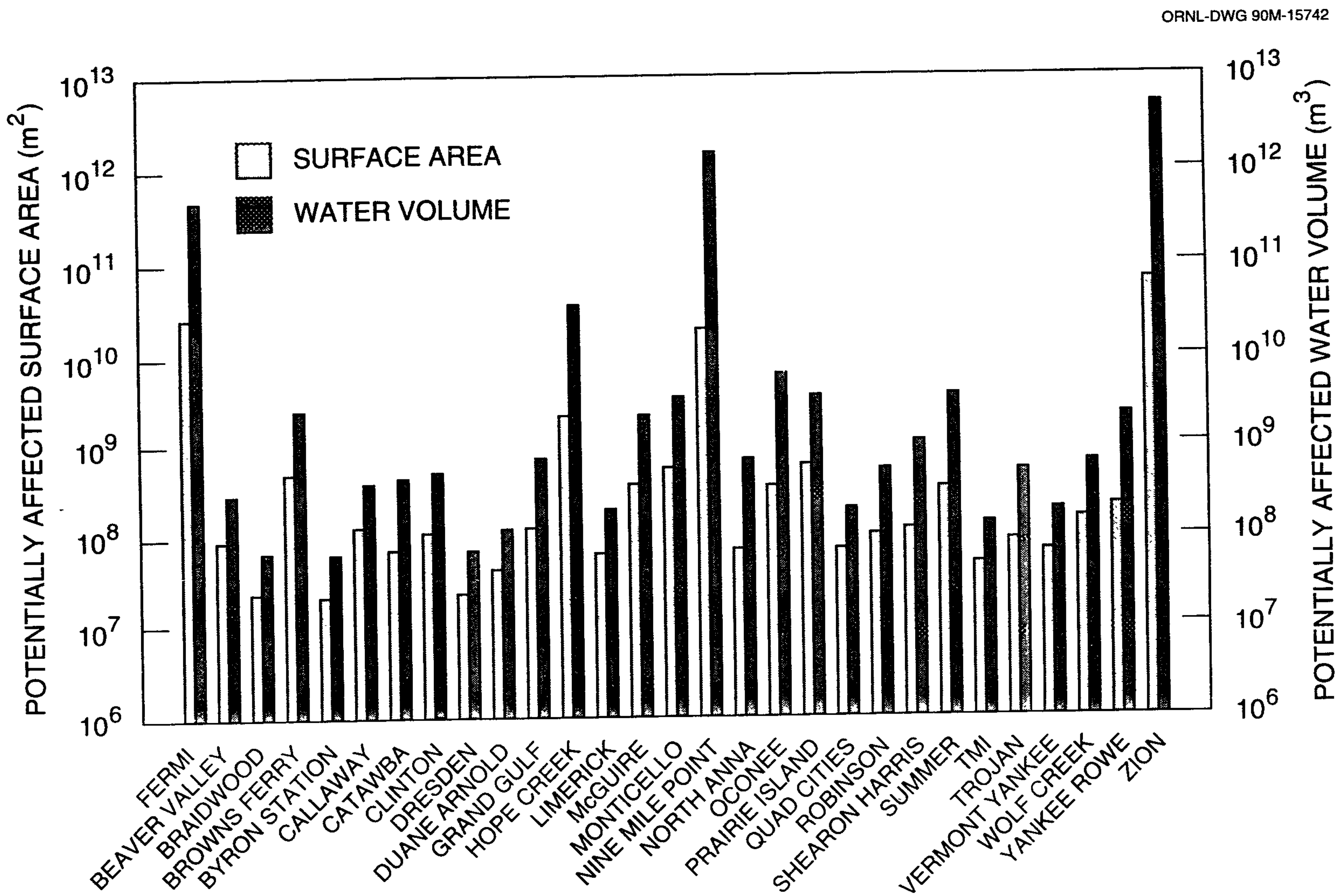

Figure 5.8 Water body surface areas and volumes within 80 km (50 miles) of representative nuclear power plant sites (potentially affected water bodies).

ORNL-DWG 90M-15743

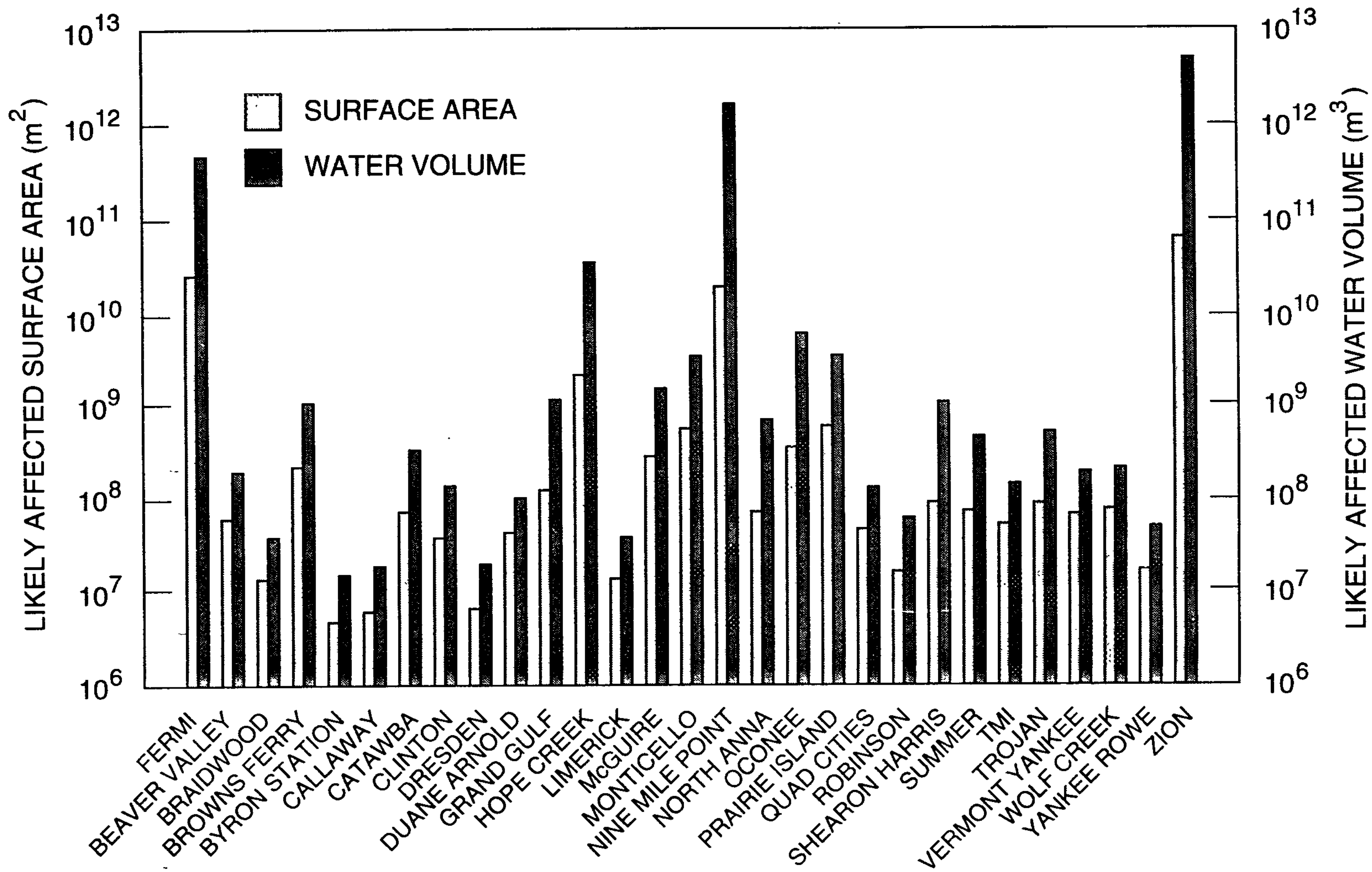

Figure 5.9 **Water body surface areas and volumes within 80 km (50 miles) of the reactor site and within six of the 22.5° compass sectors that exhibit the greatest percentage of time for which the wind blows toward that compass direction (likely affected water bodies).**

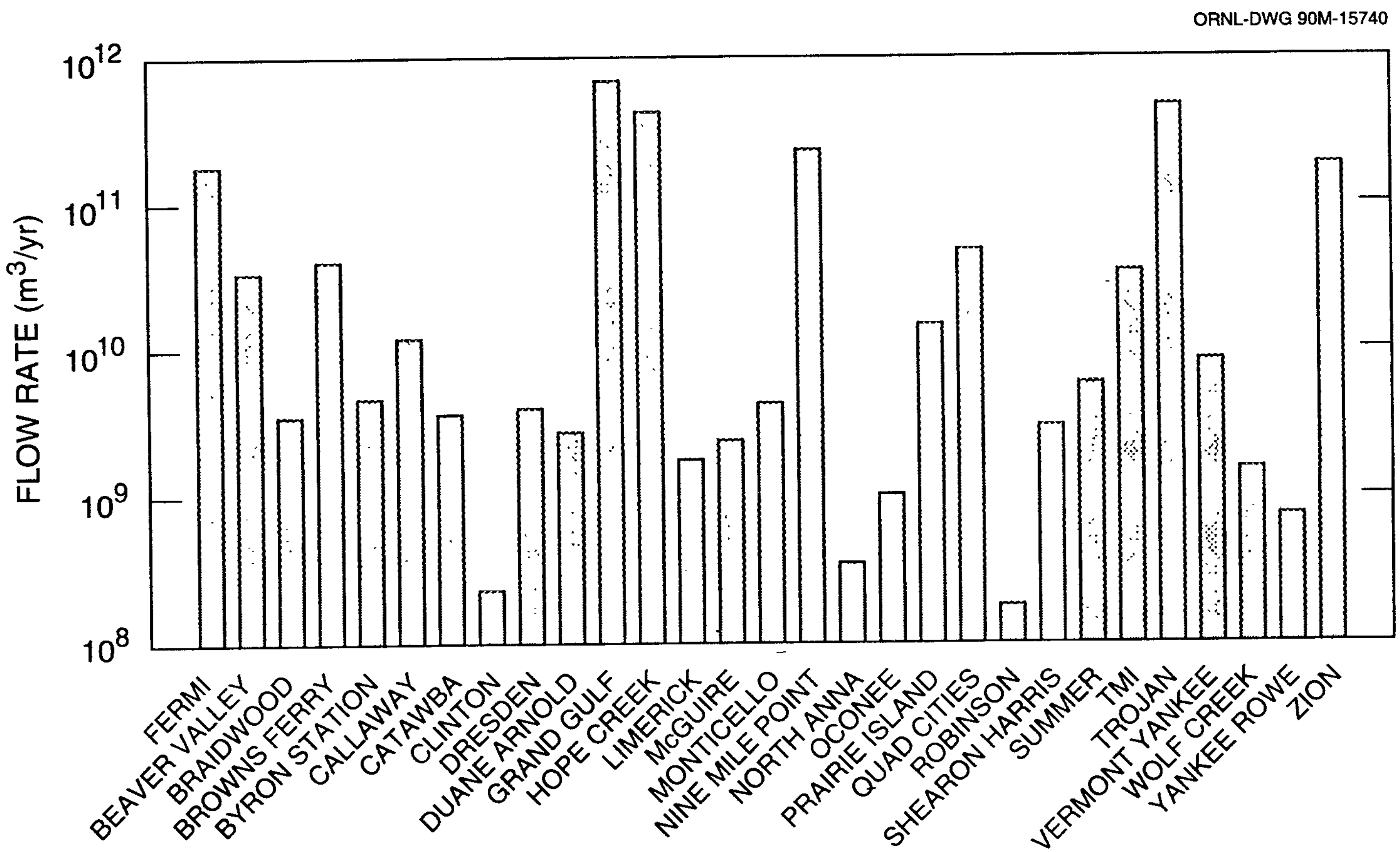

Figure 5.10 Water body flow rate at representative nuclear power plant sites.

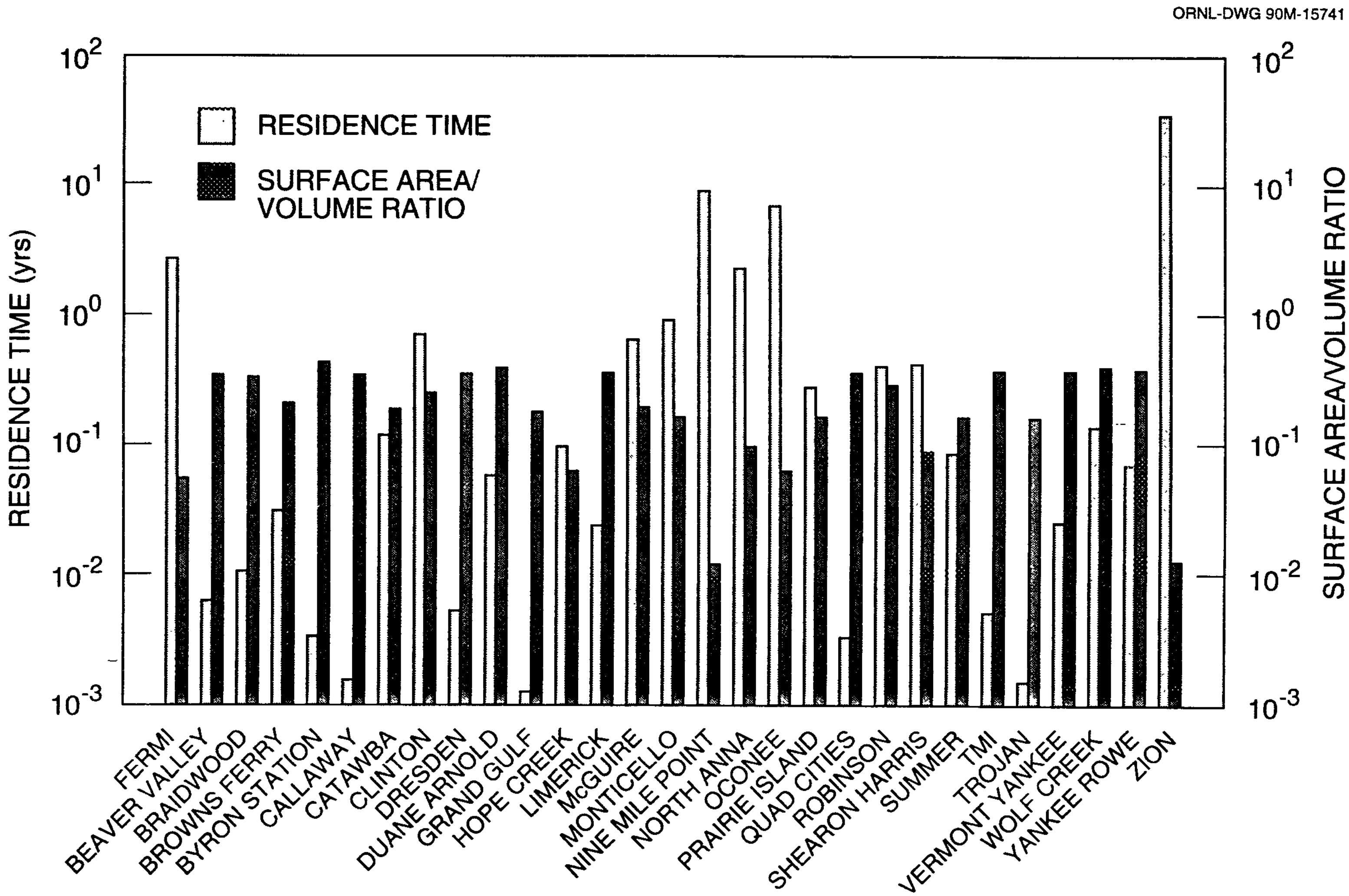

Figure 5.11 Contaminant residence time (flushing rate) and surface area–volume ratios for water bodies within an 80-km (50-mile) radius of selected nuclear power plants.

three Great Lakes, and generic large and small rivers. Sites were selected to include major aquatic food producing water bodies adjacent to plant sites. Data for East Coast estuaries, the eastern Gulf Coast, and the Great Lakes sites were obtained from the U.S. Department of Commerce (1980) and NUREG-0056. In the absence of site-specific data for river sites, generic aquatic harvest data from LPGS (NUREG-0440) were applied to a representative large and small river site. It is recognized that the quantity of aquatic food harvested from a water body varies temporally with the environmental quality of the water body. As in LPGS, it is assumed that 53 percent of the round weight of marine fish, 26 percent of the crustacea, and 28 percent of the freshwater fish are edible by humans. Mollusc data are reported in weight of edible meat. Recreational harvest data for molluscs and crustacea are unavailable and not included. While aquacultural harvests may be large locally [as much as about 3000 kg/ha in 1971 (2700 lbs/acre)], potential dose from this aquatic food source, like commercial harvests, is readily interdicted, and aquaculture harvest data are not included.

Many commercially and recreationally important marine fauna depend on the estuarine waters of the eastern Atlantic and Gulf Coasts for some portion of their life cycle. These include summer and winter flounder, striped bass, bluefish, alewives, black and rock sea basses, butterfish, croaker, weakfish, kingfish, shad, spot, menhaden, blackfish, mackerel, and shrimp. The presence of these fauna in an affected estuary for a few months and their subsequent migration from the estuary for later harvest elsewhere is acknowledged, although their contribution to the food pathway cannot be reasonably quantified and accommodated in the present analysis. However, compared with those organisms that are harvested in the estuary, the contribution of migratory fauna to estimates of dose and population risk is considered to be relatively small.

The modeling methodology in the Fermi analysis accounts for changes in radioactive nuclide concentrations in both sediment and surface water. The sediment model accounts for both the removal of radionuclides through sedimentation, as well as leaching back of the radionculides from the sediment into the water column. Surface water transport models are used to determine dispersing waterborne concentration functions, resulting in time-dependent water concentrations. The bioaccumulation approach is considered to be appropriate when the organisms have been in a reasonably constant concentration field for a period of sufficient duration for trophic and biological exchange processes to approach equilibrium. Since the time frame of interest for aquatic food concentrations extends up to 1 year, utilization of the various time-dependent waterborne radionuclide concentrations, when divided into periods of reasonably constant concentration, will provide reliable determinations of aquatic food concentrations of radioactive nuclides. A detailed discussion of the use of the bioaccumulation factor is provided in Appendix C of NUREG-0440, *Liquid Pathway Generic Study.*

Annual aquatic harvest data are compared with similar data used in the Fermi analysis to arrive at comparative estimates of whole-body population dose (assuming a constant source term among sites). From these data, estimates of population exposure and individual latent cancer fatality risk per RY are calculated as in the Fermi analysis. It is assumed that all of the edible aquatic harvest is consumed by humans, and a linear relationship between edible aquatic food harvest and population dose is assumed using data in the Fermi analysis for comparison.

Population exposure values are computed as the product of the projected population dose (scaled using the Fermi analysis), an assigned probability for an atmospheric release (about 2×10^{-5}; consistent with the Fermi analysis), and the probability of the wind blowing toward the water body. Probability estimates of deposition onto the water body are obtained from site-specific meteorological data, which provide the fraction of time the wind is blowing toward the water body.

5.3.3.3.2 Results

Results for the aquatic food pathway follow those for the drinking-water pathway. In the case of the drinking-water pathway, comparisons of each type of environmental data with those at Fermi and the implications of those comparisons with respect to surface water contamination are presented. Great Lakes and the estuarine site comparisons precede those for river sites.

For all sites evaluated, average annual precipitation and wind data are similar to those at Fermi, which suggests no appreciably different effects from meteorological conditions on fallout among sites. The surface areas of the estuarine and Great Lakes sites evaluated are the same order of magnitude or less than those of the Fermi plant, which indicates that these sites would receive less than or essentially the same proportion of contaminant as Fermi. For the other Great Lakes sites evaluated, water volume values nearly one order of magnitude greater than those of Fermi would result in significantly greater dilution. Because water volume is one order of magnitude lower for the estuarine site, less dilution would occur. Similar flow rates for the Great Lakes sites would not alter the comparative dilution capacity. A flow rate that is greater by an apparent factor of two for the estuarine site would suggest an increase in dilution. While it is acknowledged that the contribution of tidal flow to the overall flow rate is large, tidal flow may incompletely remove contaminants, and a reasonable means of accommodating that phenomenon in the analysis is not available. Therefore, tidal flow is simply included with other flow data. Nine Mile Point exhibits a contaminant resident time that is a factor of 3 longer than that of Fermi; Zion has a residence time that is an order of magnitude greater than that of Fermi, and Hope Creek's is nearly 2 orders of magnitude less. Surface-area-to-volume ratios about a factor of 5 lower for Nine Mile Point and Zion suggest lower contaminant concentrations for these sites. Essentially the same surface-area-to-volume ratio for Hope Creek indicates a contaminant concentration similar to that of Fermi.

Comparisons of the estuary and Great Lakes site data with Fermi data indicate that contamination of these sites is of the same order of magnitude as Fermi. In the case of the Great Lakes sites, effects from longer comparative residence times are countered by lower surface-area-to-volume ratios (lower contaminant concentrations). Comparisons of those parameters for the estuarine site indicates much lower residence times than for Fermi and essentially the same contaminant concentration.

In the case of the river sites, the data corroborate the assumption that the surface area of the water body available to receive fallout is small compared with

Fermi. Compared to Fermi, however, 2- to 3-orders-of-magnitude-lower water volumes for both small and large rivers result in a significantly reduced capacity for dilution in that portion of the river that receives fallout. Factors of 2 to 3 higher comparative flow rates for large rivers increase dilution capacity, whereas comparative 1- to 3-orders-of-magnitude-lower flow rates for small rivers contribute to further reduced dilution capacity. The ability of many river sites to remove contaminants rapidly is evident in the residence time data, the values of which are measured in days or weeks rather than years, as for the Great Lakes sites. Longer residence times for some small rivers are attributed to low flow rates or proximity to small lakes. Comparatively higher surface-area-to-volume ratios for river sites indicate higher concentrations of contaminant in the affected portion of the river.

In contrast to the estuarine and Great Lakes sites evaluated—in which the data are amenable to direct interpretative comparison with the Fermi analysis—a direct comparison between river and Great Lakes systems does not yield viable results. Therefore, combinations of characteristics are utilized in arriving at data interpretations for river sites. While comparatively small portions of rivers may receive fallout, the concentration of contaminant in all river sites evaluated is essentially the same as or exceeds that of Fermi by as much as a factor of 6. Residence times for large rivers are more than 3 orders of magnitude less than for Fermi, while small river values vary from nearly 3 orders of magnitude less to more than a factor of 2 greater than for Fermi. Examination of the data in Table 5.14b indicates that certain small river sites could result in a combination of residence time and concentration that would exceed Fermi by a factor of 2 to 3; however, the potentially affected population is much smaller than at Fermi.

River sites that may receive relatively high concentrations of contaminant but which exhibit flow rates sufficient to enable the removal of contaminants within short periods of time (hours to several days) would reduce potential contaminant exposure time such that risk at these sites is likely to be bound by the Fermi analysis. However, such is not the case at all river sites, and they may not be bound by the Fermi analysis. These small river sites include the 13 (Table 5.15) with the following combined characteristics: (1) low on-site average annual flow rates, (2) comparatively long residence times, and (3) comparatively large surface-area-to-volume ratios.

However, particularly for these 13 sites, an estimate of the uninterdicted population dose per RY from drinking water may be made by considering the Fermi value (4×10^6 person-rem). Using an estimated value of 2×10^{-5}/RY for the likelihood of release and a 0.445 probability of the wind blowing over the lake results in an estimated 36 person-rem/RY for Fermi. Assuming a 25 percent MYR increase in population, the uninterdicted person-rem per RY value would be approximately 45, which is less than 2 percent of the value from the atmospheric pathway (Table 5.6). Because combined residence time and surface-area-to-volume ratios for the 13 small river sites in Table 5.15 exceed values at Fermi by less than a factor of 3, and these sites have populations lower than Fermi by at least a factor of 2, the population dose at these sites would be expected to remain a small fraction of the value estimated for the atmospheric pathway. In addition, these sites are considered to be at least as amenable to interdictive measures as

Table 5.15 Reactor sites that may not be bound by the Fermi 2 surface water analysis

Catawba	Clinton	North Anna
McGuire	Monticello	Robinson
Oconee	Prairie Island	Wolf Creek
Shearon Harris	Summer	
Yankee Rowe	Duane Arnold	

Fermi, which would further reduce population dose.

Results of the uninterdicted aquatic food pathway analysis are presented in Table 5.16, which compares estimated annual aquatic food harvest, population dose, and population exposure among sites. Because of conservative assumptions in several steps in the analysis, these values are considered to constitute upper bound value estimates. It is also assumed that the entire harvest is consumed by humans, which results in maximum population dose to those sites with the greatest harvest, independent of population. This assumption implies a linear relationship between harvest and population dose.

It can be seen in Table 5.16 that those sites with the greatest aquatic harvest result in the highest values of population exposure per RY. For most sites, population exposure estimates are well below those estimated for the atmospheric pathway (Table 5.6). For those with values that exceed the atmospheric pathway value, it is reasonable to expect that dose reduction would occur as a result of interdiction. Interdiction has the potential to reduce the dose by factors of from 2 to 10 (NUREG-0769, Addendum I; NUREG-0440, Table 7.3.2); accordingly, values of population exposure for all sites would be essentially the same as or significantly less than values from the atmospheric pathway.

Interdiction could consist of preventing use of the water or making contaminated food difficult to obtain. Thus, limiting people's contact with contamination through such measures as preventing or confiscating catches of recreational and commercial fish and shellfish, prohibiting water-based recreation, and eliminating surface water as a drinking-water source would have to be employed.

This type of interdiction might have to be long term because the residence times could be long in certain situations. The food pathway of ocean and estuarine sites would be the hardest in which to effect interdiction. Not only are the physical transport mechanisms of these systems complex, but many of the important recreational and commercial organisms are highly mobile. Thus, the ability of humans to obtain these organisms would need to be controlled.

5.3.3.3.3 Conclusion

Analyses for both the drinking water and aquatic food pathways have been performed with and without considering interdiction. In the case of the drinking-water pathway, the Great Lakes and the estuarine sites are bound by the Fermi

Table 5.16 Comparison of aquatic food harvest, uninterdicted population dose and exposure among representative sites

Plant	Water body	Annual edible aquatic food harvest (kg)[a]	Estimated population dose—whole body (person-rem)[b]	Population exposure per reactor-year (person-rem)[c]
Calvert Cliffs	Chesapeake Bay	3.0×10^8	7.1×10^8	5500
Crystal River	Gulf Coast	6.4×10^7	1.5×10^8	1400
Fermi	Lake Erie	6.7×10^7	1.6×10^8	1400
Hope Creek	Delaware Bay	8.1×10^7	2.0×10^8	270
Millstone	Long Island Sound	5.8×10^7	1.4×10^8	500
Nine Mile Point	Lake Ontario	1.8×10^7	4.2×10^7	300
Seabrook	Gulf of Maine	7.4×10^7	1.7×10^8	2100
Zion	Lake Michigan	2.7×10^7	6.4×10^7	650
Small river	Generic	2.2×10^4	5.2×10^4	0.4
Large river	Generic	2.0×10^4	4.7×10^4	0.4

[a]Includes combined commercial and recreational harvest estimates.
[b]Assumes linear relationship between aquatic harvest and population dose using data in Fermi analysis (NUREG-0769) as basis for comparison.
[c]Derived as in the Fermi analysis (NUREG-0769) using site-specific data to obtain wind probability values. For the river sites, meteorological data from those sites in the drinking-water pathway analysis with the highest likely/potentially affected surface area ratios were used.
Note: Multiply by 2.2 to convert kilograms to pounds; multiply by 0.01 to convert person-rem to person-sieverts.

analysis while small river sites with relatively low annual flow rates, long residence times, and large surface-area-to-volume ratios may potentially not be bound by the Fermi analysis. In all cases, however, interdiction can reduce relative risk to levels at or below that of Fermi and significantly below that for the atmospheric pathway. River sites that may have relatively high concentrations of contaminants but which remove contaminants within short periods of time (hours to several days) are amenable to short-term interdiction. A similar level of reduced risk can be achieved at those sites with longer residence times (months) by more extensive interdictive measures.

For the aquatic food pathway, population dose and population exposure per RY are directly related to aquatic food harvest. For river sites, uninterdicted population exposure is orders of magnitude lower than that for the atmospheric pathway. For Great Lakes sites, the uninterdicted population exposure is a substantial fraction of that predicted for the atmospheric pathway but is reduced significantly by interdiction. For estuarine sites with large annual aquatic food harvests, dose reduction of a factor of 2 to 10 through interdiction provides essentially the same population exposure estimates as the atmospheric pathway.

For these reasons, population dose for the drinking-water pathway is found to be a small fraction of that for the atmospheric pathway. Risk associated with the aquatic food pathway is found to be small relative to the atmospheric pathway for most sites and essentially the same as the atmospheric pathway for the few sites with large annual aquatic food harvests.

5.3.3.4 Possible Releases to Groundwater

5.3.3.4.1 Methodology

This section discusses the potential for radiation exposure from the groundwater pathway as the result of postulated severe accidents at a nuclear reactor during the license-renewal period. Severe accidents are the only accidents capable of producing significant groundwater contamination.

For this pathway, the core is postulated to "melt down," breach the reactor vessel, and fall onto the reactor building floor. As a result of chemical energy and decay heat, the melted fuel reacts with the concrete floor. The basemat of the containment building is eventually breached, and molten core debris and radioactive water penetrate strata beneath the plant. The soluble radionuclides in the debris can be leached and transported with groundwater and contaminated reactor water to downgradient domestic wells used for drinking water or to surface water bodies used for drinking water, aquatic food, and recreation. In reality, the probability of such an accident is small. In general, the probable frequency of core melt is less than 10^{-4}/RY; however, some plants may have core damage frequencies that slightly exceed this value. From NUREG-1150, the conditional probability of basemat melt-through ranges from 0.05 to 0.24 occurrences per core melt. Therefore, it is reasonable and conservative to assume a 10^{-4} probability of occurrence of basemat melt-through per reactor-year for this analysis.

In this analysis, site-specific information on groundwater travel time; retention-adsorption coefficients; distance to surface water; and soil, sediment, and rock characteristics is compared with previous groundwater contamination analyses. Previous analyses are contained in LPGS and FESs.

First, uninterdicted doses received through the groundwater pathway are compared; however, the effects of interdiction are discussed later in this section.

Groundwater contamination due to severe accidents has been evaluated generically in LPGS (NUREG-0440). LPGS assumes that core melt and subsequent basemat melt-through occur and evaluates the consequences. LPGS examines six generic sites using typical or comparative assumptions on geology, adsorption factors, etc. Twenty-seven sites (hereafter called current sites) of the 74 nuclear power plant sites performed groundwater pathways analyses for FES and compared the results with the conclusions in LPGS. These comparisons indicate whether the current plant sites present significantly larger population doses than those calculated in LPGS. For the other 47 sites (hereafter called earlier sites) for which no groundwater pathway analyses were performed, this study compares the physical characteristics of each site with both the generic sites used in the LPGS study and the current sites.

The LPGS results are believed to provide generally conservative uninterdicted population dose estimates in the six generic plant-site categories. Five of these categories are site groupings in common locations adjacent to small rivers, large rivers, the Great Lakes, oceans, and estuaries. In a severe accident, contaminated groundwater could reach nearby surface water bodies and the population could be exposed to this source of contamination through drinking of surface water, ingestion of finfish and shellfish, and shoreline contact. Exposure by drinking contaminated groundwater is considered to be minor or nonexistent in these five categories because of a limited number of drinking-water wells. The sixth category is a "dry" site located either at a considerable distance from surface water bodies or where groundwater flow is away from a nearby surface water body. In this case, the only population exposure results from drinking contaminated groundwater. In each LPGS category, the generic site is a PWR that produces 1150 MW(e) and is located 457 m (1500 ft) from the nearest surface water (or from the boundary of the exclusion area in the dry site case).

In LPGS, five of the site categories (the dry site is the one exception) have the same generic groundwater characteristics. The groundwater velocity is 2.04 m/day (6.7 ft/day) and travel time to the nearest surface water is 0.61 year. The adsorption-retention factors (the products of these factors and the groundwater travel time are travel times of each isotope) for ^{90}Sr and ^{137}Cs are 9.2 and 83, respectively, and the corresponding amounts of each isotope reaching surface water (taking into account their radioactive decay rates) are 88 percent and 31 percent of the core-melt inventory, respectively. The groundwater velocity and travel time to the exclusion boundary of the dry site are 1.32 m/day (4.35 ft/day) and 0.95 year, respectively. In this case, the adsorption-retention factors (retardation coefficients) for ^{90}Sr and ^{137}Cs are 28 and 253, respectively. All LPGS parameters were taken from the WASH-1400 study (NUREG-75/014).

A summary of uninterdicted population doses for LPGS generic wet sites is provided in Table 5.17. The largest LPGS drinking-water dose to the population is attributed to the small river site (8.9×10^6 person-rem). The largest total population dose is attributed to the estuarine site (1.8×10^8 person-rem), which is more than an order of magnitude greater than the next largest total population dose (9.9×10^6 person-rem) for the small river site.

In the following comparisons, current FES results are tabulated separately and by generic category for ease of comparison. A major objective of these comparisons is to establish whether the generic LPGS or current FES severe accident liquid pathway analyses provide conservative uninterdicted population dose estimates in each site category. According to LPGS (NUREG-0440), the generic liquid pathway uninterdicted dose estimates are one or more orders of magnitude lower than those attributed to the atmospheric pathway. Therefore, if the 27 current site FES dose estimates do not significantly exceed those of LPGS, the liquid pathway may also be considered an insignificant contributor to the population dose that could result from a severe accident for the plants. The remaining 47 earlier sites are then placed into the appropriate categories and their physical characteristics are compared with those of the selected largest dose estimate site to determine if they also represent comparatively insignificant contributors to population dose.

Table 5.17 Summary of surrogate uninterdicted population doses for Liquid Pathway Generic Study base cases

Generic site[a]	Drinking-water dose (person-rem)[b]	Seafood ingestion dose (person-rem)	Shoreline exposure (person-rem)	Total (person-rem)
Large river	1.08×10^5	6.83×10^3	7.457×10^3	1.228×10^5
Small river	8.865×10^6	6.563×10^5	3.577×10^5	9.88×10^6
Great Lakes	2.34×10^6	6.369×10^5	4.066×10^5	3.540×10^6
Estuary	0	1.463×10^7	1.626×10^8	1.772×10^8
Coastal	0	5.348×10^5	2.36×10^3	5.372×10^5

[a]Data for the dry site are not provided.
[b]Multiply person-rem by 0.01 to find person-sieverts.
Source: NUREG-1054.
Note: These doses should not be accepted at face value, but should be used only for comparison with other sites.

5.3.3.4.2 Small River Sites

Table 5.18 compares results of current small-river plant sites (i.e., those with groundwater pathway analyses in their FESs) with the LPGS results. Beneath the name of each plant is its location, a brief description of the groundwater pathway, surface water bodies affected, and average stream flow rates past each plant site. Numerical tabulations include the estimated percentages of radionuclides ^{90}Sr and ^{137}Cs reaching the nearest downgradient surface water body as well as groundwater travel times and radionuclide adsorption-retention factors, which—together with radionuclide decay rates—were used to calculate these percentages. Also included are estimates of the magnitude of three potential uninterdicted population dose sources: drinking-water, finfish- and shellfish-ingestion, and shoreline-swimming exposure.

Population dose-estimate ratios (plant/LPGS) for drinking water, ingestion, and shoreline exposures are presented in the right-hand column of Table 5.18. These dose-estimate ratios are also based on the assumption of no interdiction. At face value, the majority of these dose-estimate ratios are several orders of magnitude less than 1. However, these dose-estimate ratios are sometimes based on parameters that may be nonconservative. There was also a lack of population dose information in FESs. Therefore, dose estimate ratios must be inferred from the percentage of radionuclides reaching surface water. At several sites, these ratios are near unity (i.e., the site and LPGS dose estimates are the same order of magnitude); at two sites (Byron Station and Clinton), ingestion dose ratios are significantly larger than unity (i.e., the site seafood ingestion dose is more than an order of magnitude greater than the corresponding LPGS dose).

Table 5.18 Current small river site severe accident liquid pathway analyses compared with Liquid Pathway Generic Study (LPGS) results

Average on-site flow rates less than 2830 m^3/s (100,000 ft^3/s)

Plant	Location and ground-water pathway	Distance from reactor to nearest downgradient surface water (m) [a]	Groundwater velocity (m/d) [a]	Groundwater travel time from reactor to surface water (years)	Adsorption-retention factor (Sr/Cs)	% radio-nuclide reaching surface water (Sr/Cs)	Drinking-water population ($\times 10^6$)	Annual aquatic food catch ($\times 10^6$ kg) [b]	Annual shoreline user rate (user-h $\times 10^6$)	Dose-estimate ratios. drinking water, ingestion, direct contact
LPGS	20 km SW of Oak Ridge, Tenn.—soil and weathered limestone to Clinch River, then to Tennessee, Ohio, and Mississippi rivers. Average flow rate is 50 m^3/second. [c]	457	2.04	0.6	9.2/83	88/31	0.62	1.2	110	1, 1, 1
Beaver Valley	40 km [d] NW of Pittsburgh, Pa.—terrace alluvial aquifer to Ohio River, then to Mississippi River Average on-site flow rate of river is 1,050 m^3/second.	~137	0.03	12.3	9.2/83 [e]	6/0	NP [f]	NP	NP	~0.01 (combined)
Braidwood	38 km SSW of Joliet, Ill.—pleistocene till and Pennsylvanian sandstone to Mazon River, then to Kankakee, Illinois, and Mississippi rivers. Average on-site flow rate of river is 110 m^3/second.	5940 (Strip-mine area)	0.01	1780	1/1 [g]	0/0	NP	NP	NP	~0 (combined)
Byron Station	27 km SW of Rockford, Ill.—through limestone to springs discharging to tributaries of Rock River, then to the Mississippi River. Average on-site flow rate of river is 140 m^3/second.	1100	0.12	24.7	1/1 [g]	56/57	2.1	9.6	110	1.3, 24, 3
Callaway	16 km SE of Fulton, Mo.—shallow limestone-sandstone aquifer to tributary of Mud Creek, then to the Missouri and Mississippi rivers. Average on-site flow rate of river is 2000 m^3/second.	~760	0.03	68.5	7.1/14.5	<1/~0	NP	NP	NP	<< 1 (combined)

See footnotes at end of table.

Table 5.18 (continued)

Plant	Location and ground-water pathway	Distance from reactor to nearest downgradient surface water (m) [a]	Groundwater velocity (m/d) [a]	Groundwater travel time from reactor to surface water (years)	Adsorption-retention factor (Sr/Cs)	% radio-nuclide reaching surface water (Sr/Cs)	Drinking-water population ($\times 10^6$)	Annual aquatic food catch ($\times 10^6$ kg) [b]	Annual shoreline user rate (user-h $\times 10^6$)	Dose-estimate ratios, drinking water, ingestion, direct contact
Catawba	10 km NNW of Rock Hill, S.C.—through shallow fractures in granite to Lake Wylie, then to Catawba River and a set of lakes near Charleston, S.C. Average on-site flow rate of river is 110 m^3/second.	210	0.61	1 0	6/560	88/~0	0 43	3.0	NP	0 7, 1.8, 0
Clinton	10 km E of Clinton, Ill.—sand lenses in glacial till to Lake Clinton, then to Salt Creek, Sangamon, Illinois, and Mississippi rivers. Average on-site flow rate of river is 7 m^3/second.	NP	NP	0.5	17/211 [h] 68/960 [i]	82/10 42/~0	2 1	7.0	NP	0.6, 23 [h] NP 0 3, 1.3 [i] NP
Harris	32 km SW of Raleigh, N.C.—fractures in diabase (volcanic) rocks to cooling water reservoir, then to Cape Fear River and Atlantic Ocean. Average on-site flow rate of river is 88 m^3/second.	730	0.30	6.6	49/480	0.1/~0	NP	NP	NP	<< 1 (combined)
Limerick	34 km NW of Philadelphia, Pa.—shallow fractures in sandstone/siltstone to Shuylkill River, then to the Delaware River, Delaware Bay and Atlantic Ocean. Average on-site flow rate of river is 54 m^3/second.	240	0.20	3.3	20/193	18/~0	1.9	NP	NP	~1, NP, NP

See footnotes at end of table.

Table 5.18 (continued)

Plant	Location and ground-water pathway	Distance from reactor to nearest downgradient surface water (m) [a]	Groundwater velocity (m/d) [a]	Groundwater travel time from reactor to surface water (years)	Adsorption-retention factor (Sr/Cs)	% radionuclide reaching surface water (Sr/Cs)	Drinking-water population ($\times 10^6$)	Annual aquatic food catch ($\times 10^6$ kg) [b]	Annual shoreline user rate (user-h $\times 10^6$)	Dose-estimate ratios, drinking water, ingestion, direct contact
South Texas	19 km S of Bay City, Tex.—wetlands to the Colorado River and the Gulf of Mexico (could have been classified as an estuary site).	4900 (Wetlands)	0 21	62.6	9 2/83 [c]	–0/–0	NP	NP	NP	<< 1 (combined)
Summer	42 km NW of Columbia, S.C.—shallow fractures in igneous and metamorphic rocks to the Broad River, then to the Congaree River and Lakes Marion and Moultrie, then marshes and estuaries to the Atlantic Ocean. Average on-site flow rate of river is 170 m^3/second.	NP	NP	7.4	8.6/154	19/–0	–0 62	3.5	NP	0 9, 2.0, –0
Susquehanna	11 km NE of Berwick, Pa.—lateral flow in fractured shale and Pleistocene-Holocene alluvium to a tributary of Lake Took-A-While, then to the Susquehanna and Delaware rivers to Delaware Bay and the Atlantic Ocean. Average on-site flow rate of river is 380 m^3/second.	NP	NP	9.2	35/500	0.2/–0	NP	NP	NP	<< 1 (combined)
Vogtle	42 km SE of Augusta, Ga.—construction backfill to shallow limestone, discharge to springs feeding Mathes Pond, then to the Savannah River and Atlantic Ocean. Average on-site flow rate of river is 340 m^3/second.	850	0.15	15.3	21.5/165	0.05/–0	0.06	< 1 2	NP	10^{-5}, 10^{-4}, 0

See footnotes at end of table.

Table 5.18 (continued)

Plant	Location and ground-water pathway	Distance from reactor to nearest downgradient surface water (m) [a]	Groundwater velocity (m/d) [a]	Groundwater travel time from reactor to surface water (years)	Adsorption-retention factor (Sr/Cs)	% radio-nuclide reaching surface water (Sr/Cs)	Drinking-water population ($\times 10^6$)	Annual aquatic food catch ($\times 10^6$ kg) [b]	Annual shoreline user rate (user-h $\times 10^6$)	Dose-estimate ratios, drinking water, ingestion, direct contact
Wolf Creek	6 km NE of Burlington, Kans.—shallow limestone to cooling water reservoir, then to Neosho River (presumably), then through a series of Lakes to the Arkansas and Mississippi rivers. Average on-site flow rate is 45 m^3/second	790	0.006	356	9.2/83 [e]	~0/~0	NP	NP	NP	<< 1 (combined)

[a]Multiply by 3.28 to convert to ft or ft/d.
[b]Multiply by 2.20 to convert to pounds.
[c]Multiply by 35.3 to convert to ft^3/second.
[d]Multiply by 0.625 to convert to miles.
[e]Assumed same value as used in the LPGS.
[f]NP = not provided.
[g]Highly conservative estimate (no adsorption).
[h]Conservative estimate.
[i]Realistic estimate.

However, the seafood ingestion dose at the generic small river site is only about 6 percent of the total generic population dose as shown in Table 5.17, and Byron Station's total population dose is about three times that of the LPGS generic site for small rivers. The dose-estimate ratios in Table 5.18 suggest that the Byron Station FES severe accident liquid pathway analysis provides the highest population dose groundwater pathway for sites located along small rivers. However, Byron Station's groundwater pathway population dose is less than an order of magnitude greater than the LPGS dose. Therefore, the FES groundwater pathway population dose for the small river category does not exceed that of the atmospheric pathway.

At 11 of the 27 current sites, the population doses were found to be essentially zero. In these cases, percentages of ^{90}Sr and ^{137}Cs reaching surface water are generally low, based on long groundwater travel times, large adsorption-retention factors, or both. In some cases, the liquid pathway analysis was terminated without calculating population dose estimates. Most current FESs refer to Isherwood (1977), NUREG/CR-1596, or Parsons (1962) for representative adsorption data instead of acquiring site-specific data.

In contrast, the Byron Station liquid pathway analysis (citing a lack of site-specific adsorption data) used the highly conservative assumption that neither ^{90}Sr nor ^{137}Cs was adsorbed and that these isotopes would be transported at the same velocity as groundwater. As a result, the analysis shows that more than half the Byron Station severe accident inventory of ^{90}Sr and ^{137}Cs would reach surface water. Consequently, dose sources and estimates were found to be high.

In NUREG-1054, Codell recommends caution in using adsorption data to characterize the groundwater pathway through fractured rock. In cases involving groundwater pathways in open fractures that were not accounted for, the adsorption-retention factors and groundwater velocity may have been significantly overestimated and underestimated, respectively, leading to nonconservative (low) population dose estimates. Current FESs for Callaway, Harris, Limerick, Summer, Vogtle, and Wolf Creek all cite low groundwater velocities (site-specific data) or large adsorption-retention factors (literature values as cited previously) as well as groundwater pathways in fractured rock. Therefore, because it was not clear whether these sites were bound by the Byron Station population dose estimates, they were investigated further. However, the Summer and Vogtle sites have much smaller drinking-water populations and seafood catches than Byron Station. So, even if no adsorption were assumed for these two sites, their dose estimates would not be likely to exceed those of Byron Station.

The Callaway, Harris, Limerick, Summer, Vogtle, and Wolf Creek FSARs contain liquid pathway analyses for a postulated rupture of a liquid radioactive waste tank. Each of these plants is discussed further in the following paragraphs.

In four cases (Callaway, Harris, Limerick, and Vogtle), the FSAR findings are compatible with those of corresponding FESs. Furthermore, it is clear from the Limerick FSAR that the fracture pathway is not a significant liquid conduit (runoff water from Hurricane Agnes had to be pumped from the Limerick open excavation because it did not drain through the fractured rock). It is assumed in the Vogtle FSAR that fractured limestone drains freely, but it has been adequately demonstrated that radionuclides are sufficiently retained by an extensive construction fill between the radioactive waste tank and the limestone. Fractured volcanic rocks have been identified as groundwater conduits in the Harris FSAR, but the groundwater velocity and radionuclide retardation values for these rocks are not significantly different from those listed in the FES; and in the Callaway FSAR, unfractured sandstone, rather than a fractured limestone, has been identified as the primary groundwater pathway.

In one case (Summer), the FSAR analysis is inconsistent with that of FES. The Summer FSAR identifies the groundwater pathway as weathered rock without clay minerals and gives no credit for cation exchange (adsorption-retention factor = 1); however, in FES, adsorption-retention factors are 8.6 and 154 for strontium and cesium, respectively. Based on FSAR's conservative adsorption estimate, 77 percent of the strontium and cesium would reach surface water (about 50 percent more radionuclides than at Byron Station), rather than 19 percent strontium and < 1 percent cesium as estimated in the FES. Based on FSAR data, Summer's plant-LPGS drinking-water dose ratio would be between 3 and 4, rather than 0.9 as listed in Table 5.18. However, the drinking water population and aquatic catch estimates are less than those of Byron Station by about a factor of 3. Therefore, the conservative analysis for Summer and LPGS result in roughly similar population doses that are less than that at Byron Station.

In one case (Wolf Creek), the FSAR analysis is not sufficiently detailed to permit a direct comparison with FES. The Wolf Creek FES groundwater velocity estimate is extremely low compared with those of other small river sites [0.006 m/day (0.0065 yd/day) compared with 0.01 to 0.6 m/day (0.012 to 0.65 yd/day) for other sites]. All but one site reported groundwater velocities at least an order of magnitude greater than that at Wolf Creek. Therefore, Wolf Creek's estimated groundwater velocity may be unreasonably low. Based on this low groundwater velocity, FES concludes that less than 1 percent of the radionuclide inventory in a core-melt accident would reach surface water.

The Wolf Creek liquid pathway dose estimates have been recalculated, based on a higher groundwater velocity. It was assumed that the groundwater velocity at Wolf Creek may be similar to that at South Texas [0.21 m/day (0.23 yd/day)] where the terrain is similarly flat. If one assumes no retardation of radionuclides at Wolf Creek, 80 percent of the radioactive strontium would reach surface water before decaying—about 1.5 times more than at Byron Station. However, Byron Station has a larger downstream population dose (St. Louis and Memphis for Byron Station compared with Fort Smith and Little Rock, Arkansas, for Wolf Creek). The Mississippi River between St. Louis and its confluence with the Arkansas River has a greater fish catch. Therefore, for this Wolf Creek analysis, population dose is considered to be comparable to that at Byron Station (the largest groundwater pathway population dose estimate for small rivers).

In general, sites that are located on a floodplain or on glacial till may be expected to produce dose estimates that are lower than those for the LPGS case, assuming that the melted reactor core does not reach bedrock beneath the site (resulting in a groundwater pathway through fractured rock). Low groundwater gradients on floodplains and low hydraulic conductivity in glacial till (with the exception of glacial outwash deposits) generally result in low groundwater velocities. Furthermore, significant percentages of clay minerals are generally available for radionuclide adsorption in both floodplain deposits and glacial till. Beaver Valley, Braidwood, Clinton, South Texas, and possibly Susquehanna are representative of sites on floodplains or glacial till.

Table 5.19 compares earlier small river sites (i.e., sites without FES groundwater pathway analyses) with the Byron Station and LPGS generic small river sites. Because no severe accident pathway analyses were provided for the earlier sites, reactor size, distance from the reactor to the nearest downgradient surface water, and river flow rates are the only parameters directly comparable to the current site analysis. The total downstream population at risk (all municipalities along the river from the plant-site to the sea) is an indicator of potential drinking-water, ingestion, and shoreline exposures for these sites. No groundwater travel times or adsorption-retention factors are available for these sites.

Cooper, Farley, Fort Calhoun, Hatch, and Quad cities are sites listed in Table 5.19 that most likely would not exceed the Byron Station or LPGS dose estimates because of their locations on thick floodplain or coastal plain sediments. Groundwater pathways through fractured rock or Pleistocene outwash deposits are unlikely at these sites. Floodplains and coastal plains are expected to have low groundwater velocities (because of low groundwater gradients) or relatively high adsorption-retention factors (because of high clay content), or both.

The other sites in Table 5.19 have large populations downstream at risk and are located on either fractured rock or a Pleistocene aquifer (suggesting the presence of outwash deposits) or have a groundwater pathway that is not well known. Groundwater velocities may be higher than those at Byron Station, and adsorption cannot be relied upon to delay entry of ^{90}Sr and ^{137}Cs into nearby surface water. Therefore, uninterdicted doses at some of these sites may significantly exceed those at Byron Station. It is uncertain whether all small river site groundwater pathway population doses without interdiction would be less than that of the atmospheric pathway.

5.3.3.4.3 Large River Sites

Table 5.20 compares current large river plant sites with the LPGS generic large river site. The format for this table is the same as that for Table 5.18. The Grand Gulf and River Bend plants are located far from the Mississippi River shoreline but on its floodplain where the groundwater velocity is expected to be low and floodplain sediments would be expected to adsorb radionuclides to some extent. The River Bend site analysis was based on conservative estimates of adsorption-retention factors, and the resulting plant–LPGS population dose ratio is 0.39. The adsorption-retention factors for Grand Gulf are higher; however, using the same adsorption-retention factors for Grand Gulf as for River Bend would not have produced significantly higher doses. Therefore, the dose-estimate ratios

Table 5.19 **Earlier small river sites without severe accident liquid pathway analyses compared with Byron Station and Liquid Pathway Generic Study (LPGS) results**
Average on-site flow rates are less than 2830 m^3/second (100,000 ft^3/second)

Plant	Location and groundwater pathway	Reactor size [MW(e)]	Distance from reactor to nearest downgradient surface water (m)[a]	Average on-site river flow rate (m^3/second)[b]	Downstream population at risk × 10^6 (1988)
LPGS	20 km[c] SW of Oak Ridge, Tenn.—soil and weathered limestone and shale to Clinch River; then to Tennessee, Ohio, and Mississippi rivers.	1150	457	50	3.7[d]
Byron Station	27 km SW of Rockford, Ill.—through limestone to springs discharging to tributaries of Rock River, then to the Mississippi River.	1120	1100	140	6.1
Arkansas Nuclear	112 km E of Fort Smith, Ark.—weathered rock and soil to Lake Dardanelle on Arkansas River, then to Mississippi River.	908	~150	1020	2.5
Arnold	13 km NW of Cedar Rapids, Iowa—Pleistocene-Holocene aquifers toward Cedar River, then to Iowa and Mississippi rivers. Also, toward Cedar Rapids groundwater resources.	538	300-600	85	5.8
Bellefonte	11 km ENE of Scottsboro, Ala.—residual soil and shallow fractures in limestone to Town Creek Embayment of Guntersville Reservoir on the Tennessee River, then to downstream reservoirs and the Ohio and Mississippi rivers.	1314	~610	1090	3.2
Browns Ferry	48 km W of Huntsville, Ala.—weathered limestone and soil to Wheeler Reservoir on the Tennessee River, then to downstream reservoirs and the Ohio and Mississippi rivers.	1065	~150	1210	3.1
Connecticut Yankee (Haddem Neck)	16 km SE of Middletown, Conn.—presumably Pleistocene sediments and Holocene soil to Connecticut River, then to Long Island Sound.	582	~150	470	<0.1
Cooper	SE corner of Nebr.—alluvial sands to Missouri River, then to Mississippi River.	778	~60	880	7.2
Dresden	80 km SW of downtown Chicago, Ill.—Pleistocene aquifer to Illinois River, then to Mississippi River. At low flow the Illinois River is mostly sewage effluent.	794	~610	120	6.0
Farley	26 km east of Dothan, Ala.—coastal plain sediments to the Chattahoochee River.	829	<300	300	<0.1
Fort Calhoun	30 km N of Omaha, Nebr.—alluvial sediments to the Missouri River, then to the Mississippi River.	482	~150	765	7.9
Hatch	~110 km W of Savannah, Ga.—a few wells; coastal plain sediments to streams and ponds, eventually to the Altamaha River and Atlantic Ocean.	780	~300	370	<0.1

See footnotes at end of table.

Table 19 (continued)

Plant	Location and groundwater pathway	Reactor size [MW(e)]	Distance from reactor to nearest downgradient surface water (m)[a]	Average on-site river flow rate (m^3/second)[b]	Downstream population at risk × 10^6 1988
La Salle	120 km SW of downtown Chicago—glacial deposits to South Kickapoo Creek, to Illinois River (8 km N), then to Mississippi River.	1081	150 to 300	310	6.0
McGuire	27 km NW of Charlotte, N.C.—weathered rock and soil to Catawba River, then to a series of lakes in S.C., then Wateree and Congaree rivers, more lakes and wetlands to Atlantic Ocean.	1180	~600	75	1.7
Monticello	48 km NW of Minneapolis, Minn.—alluvium to headwaters of the Mississippi River; groundwater resources in alluvium.	545	~150	130	8.7
North Anna	64 km NW of Richmond, Va.—soil and weathered rock to Lake Anna, to North Anna River, then to York Estuary and Chesapeake Bay.	907	150 to 300	10	<0.1
Oconee	48 km W of Greenville, S.C.—residual soil and fractured shallow bedrock to Lake Keowee, Keowee River to Seneca River (11 km downstream), then to Hartwell Lake on the Savannah River.	886	<300	30	<0.1
Peach Bottom	30 km S of Lancaster, Pa.—weathered rock to Conowingo Pond, a reservoir on the Susquehanna River, then to Delaware Bay and the Atlantic Ocean.	1065	~90	1020	<0.1
Prairie Island	64 km SE of Minneapolis, Minn.—some groundwater resources; alluvial soils to Sturgeon Lake on Vermillion River, adjacent to Mississippi River.	530	~150	425	6.3
Quad Cities	48 km NE of Moline, Ill.—alluvial soils to Mississippi River.	789	~180	1340	6.1
Robinson	48 km NW of Florence, S.C.—alluvium, coastal plain sediments and Tuscaloosa sand to Lake Robinson on Black Creek, a tributary of Lynches River, then to Pee Wee Estuary on Atlantic Ocean; also groundwater users.	700	~180	5	0.2

See footnotes at end of table.

Table 19 (continued)

Plant	Location and groundwater pathway	Reactor size [MW(e)]	Distance from reactor to nearest downgradient surface water (m)[a]	Average on-site river flow rate (m^3/second)[b]	Downstream population at risk × 10^6 (1988)
Sequoyah	29 km NE of downtown Chattanooga, Tenn.—terrace alluvium and weathered rock to Chicamauga Reservoir on the Tennessee River, then through a series of reservoirs to Ohio and Mississippi rivers.	1148	Unknown	930	3.7
Three Mile Island	16 km SE of Harrisburg, Pa.—Susquehanna alluvium to Susquehanna River (the facility is on an island in the river), then to Delaware Bay and the Atlantic Ocean.	819	~180	965	<0.1
Vermont Yankee	8 km SE of Brattleboro, Vt. and 72 km N of Springfield, Mass.—Pleistocene glacial deposits to Vernon Pond on the Connecticut River, then to Long Island Sound; some groundwater users.	514	~60	245	1.7
Watts Bar	11 km SE of Spring City, Tenn. and 4 km downstream from Watts Bar Dam—limestone and river alluvium to Chickamauga Reservoir on the Tennessee River, then through a series of reservoirs to the Ohio and Mississippi rivers.	1170	~300	750	3.7
Yankee Rowe	34 km NE of Pittsfield, Mass.—groundwater pathway unknown, but Deerfield River (the receiving surface water body) is a tributary of the Connecticut River, then to Long Island Sound and the Atlantic Ocean.	175	90	21	1.7

[a]Multiply by 3.28 to convert to ft.
[b]Multiply by 35.3 to convert to ft^3/second.
[c]Multiply by 0.625 to convert to miles.
[d]Similar to Watts Bar.

Table 5.20 Current large river site severe accident liquid pathway analyses compared with Liquid Pathway Generic Study (LPGS) results
Average on-site flow rates greater than 2830 m^3/second (100,000 ft^3/second)

Plant	Location and groundwater pathway	Distance from reactor to nearest downgradient surface water (m)[a]	Ground-water velocity (m/d)[a]	Groundwater travel time from reactor to surface water (year)	Adsorption-retention factor (Sr/Cs)	% radionuclide reaching surface water (Sr/Cs)	Drinking-water population (× 10^6)	Annual aquatic food catch (× 10^6 kg)[b]	Annual shoreline user rate (user-h × 10^6)	Dose-estimate ratios drinking water, ingestion, direct contact (plant/LPGS)
LPGS	On the lower Mississippi River. On-site flow rate is 13,900 m^3/second.[c]	457	2.04	0.61	9.2/83	88/31	0 10	0.07	6	1, 1, 1
Grand Gulf	40 km[d] S of Vicksburg, Miss.—fractures in Catahoula Formation to Pleistocene terrace alluvium, then to oxbow lakes which flush into the Mississippi River during floods. Average flow rate is 19,100 m^3/second.	2230	0.46	13.3	29/990	0.3/~0	1.35	4.41	NP[e]	0.007, 0.013, 0
River Bend	38 km NNW of Baton Rouge, La.—terrace and alluvial aquifers to Mississippi River. Average flow rate is 12,700 m^3/second.	3050	1.04	8.06	15/144	4.4/~0	1.20	NP	NP	0.39, 0, 0
WNP-2[f,g]	19 km NW of Richland, Wash.—flow in unconfined glacio-fluvial aquifer to Columbia River, then to Pacific Ocean (many nearby water wells, but none are used for public water consumption). Average flow rate is 3250 m^3/second.	4880	2.13	6.26	1400/8400	0/0	NP	NP	NP	0, 0, 0
WNP-2[h]		4880	2.13	6.26	15/144	11/< 1	1.20	4.41	6	1.1, 3.1, 0.03, (1.5)[i]

[a]Multiply by 3.28 to convert to ft or ft/d.
[b]Multiply by 2.20 to convert to pounds.
[c]Multiply by 35.3 to convert to ft^3/second.
[d]Multiply by 0.625 to convert to miles.
[e]NP = not provided.
[f]Final environmental statement of the nonconservative liquid pathway analysis (NUREG-0440).
[g]WNP-2 = Washington Nuclear Project 2.
[h]Staff's conservative analysis replacing the final environmental statement adsorption-retention estimates with more conservative values and WNPs population doses assumed to be similar to Grand Gulf and River Bend.
[i]Total population dose.

in Table 5.20 suggest that the LPGS generic site analysis provides the largest uninterdicted population dose estimate for large rivers, at least for sites with locations similar to those of Grand Gulf and River Bend.

The Washington Nuclear Project 2 (WNP-2) site in Table 5.20 differs from the other two sites in that the assumed groundwater velocity is higher than that used in LPGS. However, the adsorption-retention factors for WNP-2 appear to be nonconservative. If conservative adsorption-retention factors similar to those of Grand Gulf and River Bend are used for WNP-2, an estimate of the population dose can be made (Portland, Oregon, is downstream of the WNP-2 site). The staff's conservative analysis for WNP-2 (using adsorption and drinking-water dose from River Bend and aquatic catch from Grand Gulf) yields a total population dose of 1.5 times that of the LPGS for large rivers. The difference in the conservative WNP-2 and LPGS groundwater pathway population doses is small in comparison with the order of magnitude greater atmospheric pathway population dose.

Table 5.21 compares the only earlier large river plant site (Trojan) with the LPGS generic large river site. This site is located much closer to the nearest downgradient surface water (the Columbia River) than is the generic site, and fractured rock underlies the site, suggesting that the groundwater travel time may be less than that of the LPGS. Therefore, the uninterdicted dose from the Trojan Plant would probably be less than that of the LPGS study.

Table 5.21 Earlier large river sites without severe accident liquid pathway analyses compared to the Liquid Pathway Generic Study (LPGS) results
Average on-site flow rates greater than 2830 m^3/second (100,000 ft^3/second)

Plant	Location and ground-water pathway	Reactor size [MW(e)]	Distance from reactor to nearest downgradient surface water (m)[a]	Average on-site/river flow rate (m^3/second)[b]	Downstream population at risk x 10^6 (1988)
LPGS	On the lower Mississippi River.	1150	457	13,900	1.9
Trojan	48 km[c] NW of Portland, Oreg.—soil and shallow fractured rock to the Columbia River, then to the Pacific Ocean.	1130	~90	12,200	0.1

[a]Multiply by 3.28 to convert to ft.
[b]Multiply by 35.3 to convert to ft^3/second.
[c]Multiply by 0.625 to convert to miles.

5.3.3.4.4 Great Lakes Sites

Table 5.22 compares current Great Lakes plant sites with the LPGS generic Great Lakes site. These sites are all located on or adjacent to flat Pleistocene lake bed sediments which underlie modern lake sediments and shorelines. These sediments generally have a high clay and silt content. Groundwater passing through fractured rock must also pass through these lake-bed sediments before reaching the lake. Therefore, groundwater gradients and groundwater velocities are expected to be low, and adsorption-retention factors are expected to be high relative to those of the generic site. However, the current sites have larger populations at risk (the generic site is on Lake Ontario, the farthest downstream of the string of Great Lakes) and are closer to the shoreline than the Great Lakes generic site. Taking all these factors into account yields dose-estimate ratios between 0 for Nine Mile Point and 1.4 for Fermi (the latter site has, by far, the largest drinking water population). Therefore, the severe accident liquid pathway analysis for the Fermi site provides the largest uninterdicted population doses for current FES sites adjacent to the Great Lakes. The differences between groundwater population doses for the Fermi and LPGS sites are small in comparison with differences in atmospheric pathway doses for the sites.

Table 5.23 compares earlier Great Lakes sites with the Fermi and LPGS generic Great Lakes sites. Populations at risk at sites near standing bodies of water (lakes, estuaries, and oceans) are defined as all people living within 80 km (50 miles) of the site, rather than as all people living downstream from a river site. Geologic conditions at these sites are similar to those of the current plant sites described in Table 5.22. Although some of these sites have groundwater pathways through Pleistocene outwash and fractured rock, groundwater must also pass through lake-bed sediments before reaching the lake. The Zion site is comparable to Fermi in size, distance from shoreline, and population within 80 km. Therefore, Zion's population doses would probably be similar to those of Fermi. All other sites would have population doses lower than those of Fermi, based on smaller reactor sizes, greater distances to shoreline, and lower populations within 80 km. Therefore, groundwater pathway population doses at all Great Lakes sites are expected to be less than or equal to that of the Fermi site.

5.3.3.4.5 Ocean Sites

Table 5.24 compares current ocean plant sites with the LPGS generic ocean site. The Seabrook severe accident liquid pathway analysis has the largest estimated uninterdicted population doses for sites adjacent to the ocean. Based on short groundwater travel time and low adsorption-retention factors, nearly all the strontium inventory (94 percent) and more than half the cesium inventory (58 percent) reaches the Gulf of Maine, compared with LPGS generic estimates of 88 percent and 31 percent, respectively. These percentage comparisons suggest that a severe accident at Seabrook has the potential for producing a larger maximum individual dose than that of the LPGS generic ocean site. In consideration of the large annual seafood catch and shoreline user rates, the uninterdicted total population dose estimate for Seabrook is 6 times that of the LPGS generic ocean site. Seabrook's estimated groundwater pathway population dose is still below that of the atmospheric

Table 5.22 Current Great Lakes site severe accident liquid pathway analyses compared with Liquid Pathway Generic Study (LPGS) results

Plant	Location and groundwater pathway	Distance from reactor to nearest downgradient surface water (m)[a]	Ground-water velocity (m/d)[a]	Groundwater travel time from reactor to surface water (years)	Adsorption retention factor (Sr/Cs)	% radionuclide reaching lake (Sr/Cs)	Drinking-water population (× 10^6)	Annual aquatic food catch (× 10^6 kg)[b]	Annual shoreline user rate (user-h × 10^6)	Dose-estimate ratios drinking water, ingestion, direct contact (plant/LPGS)
LPGS	On Lake Ontario, the far downstream lake.	457	2.04	0.6	9.2/83	88/31	2.0	12.1	560	1,1,1
Fermi	48 km[d] SW of Detroit, Mich.—shallow fractures in vugular dolomite to Lake Erie, then to Lake Ontario.	140	0.19	2.0	23/219	30/0	14.0	NP	NP[c]	1.4, NP, ~0
Nine Mile Point	10 km NE of Oswego, N.Y. (collocated with FitzPatrick)—"Pulaski/Whetstone" confined aquifer to Lake Ontario.	183	0.08	6.3	245/9065	0/0	NP	NP	NP	~0, ~0, ~0
Perry	(11 km NE of Painesville, Ohio—Man-made under-drain to Lake Erie, then to Lake Ontario. Realistic and conservative dose estimates are for water table by natural flow and artificially depressed pumping down, respectively.	~366	NP	NP	NP/NP	67/69	4.12	18.2	218	0.1 (realistic) 1.2 (conservative) both combined

[a]Multiply by 3.28 to convert to ft or ft/d.
[b]Multiply by 2.20 to convert to pounds.
[c]NP = not provided.
[d]Multiply by 0.625 to convert to miles.

Table 5.23 Earlier Great Lakes sites without severe accident liquid pathway analyses compared to the Fermi and Liquid Pathway Generic Study (LPGS) Great Lakes sites

Plant	Location and groundwater pathway	Reactor size [MW(e)]	Distance to nearest downgradient surface water (m)[a]	Population within 80 km[b] × 10^6	
				1990	2030
LPGS	On Lake Ontario, the far downstream lake.	1150	457	----	----
Fermi	48 km SW of Detroit, Mich.—shallow fractures in vugular dolomite to Lake Erie, then to Lake Ontario.	1093	140	5.4	6.2
Big Rock Point	Near Charlevoix, Mich. (northern lower Michigan)—unknown groundwater pathway to Lake Michigan.	69	Unknown	Low	Low
Cook	SW corner of Mich.—Pleistocene sands to Grand Marais Embayment of Lake Michigan.	1100	<150	1.3	1.4
Davis-Besse	34 km E of Toledo, Ohio—fractured and cavitose dolomite to Lake Erie (site located in the wetland).	906	~915	1.9	2.2
Ginna	24 km NE of Rochester, N.Y.—poorly described, but probably through shallow fractures in bedrock and Pleistocene sediments to Lake Ontario.	470	~150	1.1	1.1
FitzPatrick	Co-located with Nine Mile Point nuclear power station, 10 km NE of Oswego, N.Y. and 58 km NE of Syracuse, N.Y.—Oswego Sandstone, Pleistocene till, and lacustrine deposits to Lake Ontario; a few wells in the vicinity.	816	~300	0.8	0.8

See footnotes at end of table.

Table 5.23 (continued)

Plant	Location and groundwater pathway	Reactor size [MW(e)]	Distance to nearest downgradient surface water (m)[a]	Population within 80 km[b] × 10^6	
				1990	2030
Kewaunee	43 km SE of Green Bay, Wisc.—Pleistocene glacial outwash and fractured dolomite to Lake Michigan.	545	~150	0.6	0.7
Palisades	56 km W of Kalamazoo, Mich.—lake sediments and glacial till to Lake Michigan.	805	~90	1.2	1.3
Point Beach	48 km SE of Green Bay and 80 miles N of Milwaukee, Wisc.—Pleistocene glacial outwash and fractured dolomite to Lake Michigan.	497	~150	0.6	0.7
Zion	10 km N of Waukegan, Illinois and 5 km S of the Wisc. state line—hydraulically connected glacial drift and fractured limestone aquifers to Lake Michigan.	1040	~200	7.5	8.2

[a]Multiply by 3.28 to convert to ft.
[b]Multiply by 0.625 to convert to miles.

Table 5.24 Current ocean site severe accident liquid pathway analyses compared with Liquid Pathway Generic Study (LPGS) results

Plant	Location and groundwater pathway	Distance from reactor to nearest downgradient surface water (m)[a]	Groundwater velocity (m/d)[a]	Groundwater travel time from reactor to surface water (years)	Adsorption-retention factor (Sr/Cs)	% radio-nuclide reaching ocean (Sr/Cs)	Annual aquatic catch (× 10^6 kg)[b]	Annual shoreline user rate (user-h × 10^6)	Dose-estimate ratios ingestion, direct contact (plant/LPGS)
LPGS		457	2.04	0.61	9.2/83	88/31	24.7	15.0	1,1
Millstone	5 km[c] SSW of New London, Conn.—through pipeline backfill to Niantic Bay, then to Long Island Sound and the Atlantic Ocean.	305	0.15	5.5	28/268	3/0	86.5	10.8	0.03, ~0
San Onofre	8 km SE of San Clemente, Calif.—San Mateo Sandstone to Gulf of Santa Catalina and the Pacific Ocean.	~150	0.76	0.55	31/2200	70/0	56.8	NP[d]	<1, ~0
Seabrook	21 km SSW of Portsmouth, N.H.—fractured quartzite and granite and soil to a nearby marsh and Browns River Estuary, then to Hampton Harbor and the Gulf of Maine on the Atlantic Ocean.	110	0.61	0.49	5/50	94/58	104	40.5	6 (combined)
St. Lucie	11 km SE of Fort Pierce, Fla.—beach sand to Big Mud Creek/Indian River to the Atlantic Ocean.	213	0.02	27.4	9.5/86	0.13/0	34.6	NP	0.008, ~0

[a]Multiply by 3.28 to convert to ft or ft/d.
[b]Multiply by 2.20 to convert to pounds.
[c]Multiply by 0.625 to convert to miles.
[d]NP = not provided.

pathway but at a reduced level of confidence.

Table 5.25 compares earlier ocean plant sites with both the LPGS generic and Seabrook ocean sites. The Seabrook reactor is the largest in Table 5.25. This reactor is also closest to the shoreline and has a large nearby population comparable to that of the Pilgrim site. However, the Pilgrim reactor is little more than half the size of Seabrook and, thus, may have a population dose roughly half that of Seabrook. The Diablo Canyon reactor is roughly comparable to Seabrook in size and distance from shore but has only one-tenth the population within 80 km. Furthermore, the sandstones and volcanic rocks at Diablo Canyon may have higher adsorption-retention factors than the quartzite and granite at Seabrook. Therefore, Diablo Canyon's potential population dose is expected to be at least 1 order of magnitude less than that of Seabrook and also less than that of the LPGS generic ocean site. Turkey Point is located on a flat coastal plain where the groundwater gradient is expected to be low; hence, groundwater velocity and travel time are expected to be correspondingly low and high, respectively, with respect to Seabrook. The Turkey Point reactor is located about the same distance from the shoreline as is the LPGS generic site and four times farther inland than Seabrook. However, a barge canal is less than 50 m (164 ft) from Unit 3. Interdiction at Turkey Point could be accomplished by closing off or filling in the barge canal. Thus, based on the above site-specific assumptions, it can be concluded that Seabrook represents the largest uninterdicted population dose at ocean sites other than Turkey Point.

5.3.3.4.6 Estuarine Sites

Table 5.26 compares current FESs for which groundwater pathway analysis is available with the LPGS generic estuarine site. There is only one estuarine site (Hope Creek) for which a current FES is available. However, a detailed severe accident liquid pathway analysis is also available for the Indian Point site (ConEd 1982).

Hope Creek's estimated uninterdicted total population dose is less than 1 percent of the LPGS generic dose for estuaries. The LPGS annual aquatic catch and shoreline use are 3 and 83 times, respectively, as large as Hope Creek's. Even if 100 percent of Hope Creek's strontium inventory reaches surface water, the LPGS population dose would not be exceeded.

Indian Point's estimated uninterdicted population doses vary from insignificant to 0.44 times that of the LPGS, depending upon the magnitude of the assumed strontium and cesium adsorption-retention estimates. The first Indian Point estimates in Table 5.26 are from Consolidated Edison (ConEd) (1982). These dose estimates are very low (from 1.5×10^{5} to 4.9×10^{5}) compared with the LPGS generic estuarine dose estimate (1.8×10^{8}) in Table 5.26. ConEd's adsorption-retention factors for strontium and cesium are 270 and 1626, respectively, compared with 9.2 and 83 for the LPGS case. The very large adsorption-retention factors at Indian Point are based on the assumption that groundwater flow is through intergranular pore spaces in rock with very low porosity (0.5 percent). ConEd's groundwater flow assumption may be nonconservative because flow is more likely to occur through open fractures rather than intergranular pore spaces. Other

Table 5.25 Earlier ocean sites without severe accident liquid pathway analyses compared to Seabrook

Plant	Location and groundwater pathway	Reactor size [MW(e)]	Distance from reactor to nearest downgradient surface water (m)[a]	Population within 80 km[b] × 10^6	
				1990	2030
Seabrook	21 km SSW of Portsmouth, N.H.—fractured quartzite and granite and soil to a nearby marsh and Brown's River Estuary, then to Hampton Harbor and the Gulf of Maine on the Atlantic Ocean.	1150	110	3.8	4.2
Diablo Canyon	19 km W of San Luis Obispo, Calif.—not well documented, presumably Miocene Monterey Formation (interbedded sandstones and volcanics) and soils to Diablo Cove and the Pacific Ocean.	1100	~150	0.3	0.4
Pilgrim	56 km SE of Boston, Mass.—glacial outwash to Cape Cod Bay and the Atlantic Ocean.	655	~150	4.4	4.8
Turkey Point	40 km S of Miami, Fla.—permeable limestone to a barge canal, then to Biscayne Bay and the Atlantic Ocean.	693	~50	2.7	4.2

[a]Multiply by 3.28 to convert to ft.
[b]Multiply by 0.625 to convert to miles.

Table 5.26 Current estuary site severe accident liquid pathway analyses compared with Liquid Pathway Generic Study (LPGS) results

Plant	Location and groundwater pathway	Distance from reactor to nearest downgradient surface water (m)[a]	Ground-water velocity (m/d)[a]	Groundwater travel time from reactor to surface water (years)	Adsorption-retention factor (Sr/Cs)	% radio-nuclide reaching estuary (Sr/Cs)	Annual aquatic catch ($\times 10^6$ kg)[b]	Annual shoreline user-rate (user-h $\times 10^6$)	Dose-estimate ratios ingestion, direct contact (plant/LPGS)
LPGS		457	2.04	0.61	9.2/83	88/31	15.7	330	1,1
Hope Creek	Co-located with the Salem nuclear power station on an artificial island, about 13 km[c] SW of Salem, N.J.—fine to coarse-grained sand and gravel (Vincentown Formation) to Delaware Estuary, then to Delaware Bay and the Atlantic Ocean.	290	0.40	2.03	12/127	56/< 1	4.7	4	0.007 (combined)
Indian Point[d,e]	40 km N of New York City—fractured limestone to Hudson estuary.	145	0.76	0.52	270/1626	2/0	10.5	324	1×10^{-3} (combined)
Indian Point[d,f]		145	0.076	5.2	13.5/82	17/< 1	10.5	324	0, 1.1, 0.4, 0.44[g]

[a]Multiply by 3.28 to convert to ft or ft/d.
[b]Multiply by 2.20 to convert to pounds.
[c]Multiply by 0.625 to convert to miles.
[d]The largest reactor at Indian Point produces 965 MW(e).
[e]ConEd, nonconservative analysis; assumes flow through porous media, porosity = 0.005, limestone density = 2.7 g/cm^3, distribution coefficients for Sr and Cs are 0.5 and 3.0 cm^3/g, respectively, hydraulic conductivity = 0.061 m/d, hydraulic gradient = 0.062.
[f]Staff's conservative analysis; assumes flow through fractured media, porosity = 0.10, hydraulic conductivity = 0.122 m/d, all other parameters are the same as those presented by ConEd.
[g]Total population dose—the sum of drinking water, aquatic ingestion, and shoreline exposure doses.

parameters (reactor size, groundwater travel time, aquatic catch, and shoreline user-hours) are roughly comparable for Indian Point and the LPGS.

The second set of Indian Point estimates in Table 5.26 is based on a conservative assumption used in this analysis. Indian Point's reactor foundations are located on highly fractured (brecciated) limestone, and some of these fractures are open (ConEd). If the primary groundwater flow is through open fractures, the effective porosity of the fractured rock may range between 0 percent and 20 percent. Assuming that the effective porosity is 10 percent, adsorption-retention factors for strontium and cesium are about 13.5 and 82, respectively. These Indian Point adsorption-retention factors are comparable to those for the LPGS case and those for Seabrook (Table 5.25), which is also located on fractured rock. The staff analysis also uses ConEd's most conservative value of the hydraulic conductivity (0.122 m/day). Indian Point's aquatic, shoreline, and total population doses are 1.1, 0.38, and 0.44 times the respective LPGS generic estuary doses based on this second analysis.

Table 5.27 compares earlier FESs with the LPGS generic site for estuaries. The Salem reactor adjoins Hope Creek, and its estimated population dose is expected to be similar. All other sites have smaller reactors, have smaller nearby populations, or are located farther from surface water. All but Maine Yankee and Indian Point are located on coastal plains or alluvial sediments having at least some clay minerals in them, and coastal plain sites have low groundwater velocities and relatively high adsorption-retention factors. None of these sites should exceed the LPGS population dose for estuaries.

5.3.3.4.7 Dry Sites

Table 5.28 compares current dry plant sites with the LPGS generic dry site. Only one site (Palo Verde) provides significant information on which a comparison could be based. Palo Verde is located in a desert valley where the groundwater gradient and velocity are expected to be low. Alluvium in the groundwater pathway should have adsorption-retention factors comparable to those of the LPGS (if not greater, as indicated in Table 5.28). In contrast, the LPGS generic site is on the Snake River plain above the Snake River Canyon. Fractured volcanic rocks and Pleistocene glacial and alluvial sediments underlie the LPGS generic site. Accordingly, the groundwater gradient and velocity at the LPGS site are extraordinarily high, and the groundwater travel time is low. Even without adsorption, strontium would require five times as long to reach the Palo Verde site boundary as in the LPGS generic case. Because of its location on the Snake River plain, the LPGS site's uninterdicted population dose is believed to represent the largest dose for dry sites. Therefore, all dry sites are expected to have significantly lower groundwater pathway population doses than those of the atmospheric pathway.

Table 5.29 compares the only earlier dry site (Rancho Seco) with the Palo Verde and LPGS generic dry sites. As seen in the table, the Rancho Seco and Palo Verde sites are strikingly similar. The only significant difference is that the Rancho Seco reactor is only three-fourths as large as those of Palo Verde. Therefore, a severe accident at Rancho Seco is expected to produce a population dose similar to or less than that at Palo Verde.

Table 5.27 Earlier estuary sites without severe accident liquid pathway analyses compared with Liquid Pathway Generic Study (LPGS) results

Plant	Location and groundwater pathway	Reactor size [MW(e)]	Distance from reactor to nearest downgradient surface water (m)[a]	Population within 80 km[b] × 10^6	
				1990	2030
LPGS		1150	457	—	—
Brunswick	30 km S of Wilmington, N.C.—coastal plain sediments to Walden Creek, then to Cape Fear River and the Atlantic Ocean.	790	<150 to Walden Creek ~2300 to Cape Fear River	0.2	0.3
Calvert Cliffs	64 km S of Annapolis, Md.—coastal plain sediments to Chesapeake Bay and the Atlantic Ocean.	845	< 150	3.0	3.5
Crystal River	11 km NW of Crystal River, and 120 km N of Clearwater, Fla.—cavitose limestone and coastal plain sediments to surrounding wetlands and Salt Creek, then to the Gulf of Mexico.	825	< 90 wetlands ~1500 Gulf of Mexico	0.4	0.7
Maine Yankee	61 km NE of Portland, Maine—glacial till and shallow fractured granite to Back River, then to Montsweag Bay and the Atlantic Ocean.	840	< 150	0.6	0.8
Oyster Creek	13 km S of Tom's River, N.J.—coastal plain sediments to wetland; then to Oyster Creek, South Branch of Forked River, Barnegat Bay, and the Atlantic Ocean.	660	~150 to wetlands ~300 to river	4.0	4.6
Salem	Adjoining Hope Creek nuclear reactor, 13 km SW of Salem, N.J.—artificial island construction fill and coastal plain sediments (sand and gravel of the Vincentown Formation) to Delaware Estuary, then to Delaware Bay and the Atlantic Ocean.	918	90 to 150	4.8	5.2
Surry	13 km S of Williamsburg, Va.—coastal plain sediments to the James River, then to Chesapeake Bay and the Atlantic Ocean.	789	~610	1.9	2.5

[a]Multiply by 3.28 to convert to ft.
[b]Multiply by 0.625 to convert to miles.

Table 5.28 Current dry site severe accident liquid pathway analyses compared with Liquid Pathway Generic Study (LPGS) results

Plant	Location and groundwater pathway	Distance from reactor to exclusion boundary (m)[a]	Groundwater velocity (m/d)[a]	Groundwater travel time to exclusion boundary (years)	Adsorption-retention factor (Sr/Cs)	% radionuclide reaching exclusion boundary (Sr/Cs)	Drinking water population (per km^2)[b]	Dose-estimate ratio drinking water (plant/LPGS)
LPGS	Snake River Plain of SE Idaho—fractured and brecciated volcanic rock and Pleistocene glacial and alluvial deposits to groundwater resources.	457[c]	1.32	0.95	28/253	Unknown	3.9	1
Comanche Peak[d]	64 km[e] SW of Fort Worth, Tex.—groundwater is contained on-site; groundwater mound beneath cooling water reservoir prevents backflow to river; no downgradient wells identified.	NP[f]	NP	NP	NP	NP	NP	0
Palo Verde	54 km W of Phoenix, Ariz.—Lateral along water table in upper alluvial unit.	790	0.016	140	89/NP	~0/NP	4.2	~0
Waterford[g]	32 km W of New Orleans, La.—away from Mississippi River toward surrounding wetlands (the river channel is confined by natural levees and under normal flow conditions the elevation of the river's surface is above that of the surrounding wetlands).	NP	NP	17	>> 1/>> 1	NP	80	10^{-2} to 10^{-3}

[a]Multiply by 3.28 to convert to ft or ft/d.
[b]Multiply by 2.56 to convert to population per square mile.
[c]Provided by NUREG-0841.
[d]No credible groundwater pathway identified; no further information provided.
[e]Multiply by 0.625 to convert to miles.
[f]NP, not provided.
[g]Although Waterford is not located at a "dry site," for the purpose of this groundwater pathway analysis its groundwater travel characteristics behave like a dry site since flow is away from the Mississippi River. Accordingly, for analysis purposes it was classified as a dry site.

Table 5.29 Earlier dry sites with no severe accident liquid pathway analyses compared with Palo Verde and Liquid Pathway Generic Study (LPGS) sites

Plant	Location and groundwater pathway	Reactor size [MW(e)]	Distance from reactor to exclusion boundary (m)[a]	Groundwater velocity (m/day)[a]	Groundwater travel time to exclusion boundary (years)
LPGS	Southeastern Idaho Snake River Plain—groundwater flow is in highly permeable fractured volcanic rock, Pleistocene gravel, and sand.	1150	457	1.32	0.95
Palo Verde	54 km[b] W of Phoenix, Ariz.—lateral along the water table in an upper alluvial unit.	1270	790	0.016	140
Rancho Seco	40 km SE of Sacramento, California—sand and gravel zones in the Mehrten Formation (presumably alluvium); flow is west toward the Sacramento Basin, and the nearest public water supply wells are 22 km to the west.	918	800	0.019[c]	115

[a]Multiply by 3.28 to convert to ft or ft/day.
[b]Multiply by 0.625 to convert to miles.
[c]Calculated by Oak Ridge National Laboratory staff from data provided in Rancho Seco environmental impact statement.

5.3.3.4.8 Results

Table 5.30 summarizes sites having uncertain groundwater pathway population doses compared with the LPGS study or other FES groundwater analyses. All but two of these sites are along small rivers. Uncertain groundwater pathways were the greatest concern.

Fractured rock, solution cavities in limestone, weathered rock, incompletely described geologic conditions, and the uncertain character of glacial or Pleistocene deposits are important geologic concerns. Several sites have large nearby populations, one is unusually close to surface water, and another is close to a stream with very low average flow rate.

The above liquid pathway analyses can be considered representative of uninterdicted population doses from a severe accident during the initial 40-year operating term. Liquid pathway population dose estimates at MYR would be smaller for a few plants, 10 to 30 percent higher for the majority of plants, and perhaps 50 percent higher for a few plants because of the general increase in population over a 50-year time interval beyond the FES analysis. Assuming such increases in population are representative of liquid dose increases, their effect on the results would be insignificant in relation to other uncertainties in the liquid pathway analysis.

However, it should be recognized that the uncertainty factor for liquid pathway uninterdicted population dose estimates in Tables 5.17 through 5.28 may be 10 or more. Codell (1985) does not recommend that these values be accepted at face-value; rather, they should be used for comparative purposes only (NUREG-1054). As stated previously, several parameters that are needed to perform a liquid pathway analysis (i.e., porosity, hydraulic conductivity, and adsorption coefficient) are not known with sufficient precision to provide better than order-of-magnitude estimates of population doses.

The LPGS and FES liquid pathway analyses (described above) provide uninterdicted population dose estimates based on the assumptions that core meltdown and penetration of the basemat have taken place. Such analyses are deterministic (i.e., they assume that the worst-case accident has occurred). However, the probability of occurrence of such an event is low (estimated to be no more than 10^{-4}/RY). Contamination of groundwater is not likely to occur in the event of a core meltdown unless the basemat is penetrated. Therefore, the deterministic population doses given in Table 5.17 should be multiplied by a factor of about 10^{-4} to obtain the risk (probability estimates times consequences) of annual uninterdicted population doses for an 1150-MW reactor.

The population doses provided by these analyses are also based on the assumption that contaminated surface water and groundwater are not interdicted. Interdiction would lower the population doses significantly and could consist of preventing the contaminants from reaching the surface water, preventing use of the water, or making it difficult to obtain contaminated food. It is assumed, however, that interdicting the source of contamination once it enters the groundwater is not by itself sufficient because it may be impractical to completely isolate a contaminated aquifer from its surroundings. At best, containment measures such as grout curtains slow the

Table 5.30 Sites having uncertain groundwater pathway population doses with respect to the Liquid Pathway Generic Study and other final environmental statement analyses

Category site	Major concern	~Downstream population × 10^3
Small river		
Arkansas Nuclear	Weathered rock	2506
Arnold	Pleistocene-holocene aquifer	5780
Bellefonte	Fractured limestone	3243
Browns Ferry	Limestone	3078
Connecticut Yankee	Uncertain pathway	< 10
Dresden	Pleistocene aquifer	6037
La Salle	Uncertain characteristics of glacial deposits	6012
McGuire	Weathered rock	1683
Monticello	Large nearby population	8690
North Anna	Weathered rock	< 10
Oconee	Fractured rock	752
Peach Bottom	Weathered rock	< 10
Prairie Island	Large nearby population	6302
Robinson	Low stream flow	231
Sequoyah	Weathered limestone	3681
Three Mile Island	Surrounded by Holocene alluvium	20
Vermont Yankee	Uncertain characteristics of glacial deposits	1724
Watts Bar	Limestone	3681
Yankee Row	Uncertain pathway	1724
Large river		
Trojan	Fractured rock	
WNP-2[a,b]	Fractured rock	

[a]WNP-2 = Washington Nuclear Project 2.
[b]This site has an existing severe accident liquid pathway analysis. Analytical results for this site may be non-conservative.

groundwater movement but do not prevent it. However, the increased travel time reduces the rate of groundwater discharge to surface water bodies and reduces the concentration of radionuclides through prolonged radioactive decay. In any event, limiting people's contact with contamination through such measures as preventing or confiscating catches of recreational and commercial fish and shellfish, prohibiting water-based recreation, and eliminating surface water as a drinking-water source may have to be employed.

Ocean and estuarine sites would be the hardest in which to effect interdiction because of the food pathway. Not only are the physical transport mechanisms of these systems complex, but many of the important recreational and commercial organisms are highly mobile. Thus, total confinement of the contamination would not be likely and controlling the taking of these organisms by man would need to be relied upon. However, it is reasonable to expect that dose reduction would occur as a result of interdiction of the pathways. It is estimated that the dose could be reduced by an order of magnitude (NUREG-0440, Table 7.3.2).

The risk to the population from releases to groundwater can be estimated by considering the information in Tables 5.17 through 5.29.

- For large river sites, risk to the population can be estimated from the LPGS analyses as approximately 12 person-rem/RY (assuming the annual probability is 1×10^{-4} for a core melt with penetration of the basemat). For the large river site that has a larger population dose estimate than the LPGS (WNP-2) it is estimated that WNP-2 exceeds the LPGS by 50 percent (Table 5.20) for a risk of approximately 18 person-rem/RY. Pathway interdiction can reduce this dose by an order of magnitude; thus, the predicted annual population dose for large river sites is only a small fraction of that from the atmospheric pathway.

- For small river sites, the risk to the population can be estimated from the LPGS analyses as approximately 1000 person-rem/RY with drinking-water risk contributing 890 person-rem/RY, ingestion contributing 70 person-rem/RY, and shoreline exposure contributing 40 person-rem/RY. Table 5.18 shows that the Byron Station FES-predicted population doses are higher than the LPGS small river site and would result in an annual population risk of approximately 3000 person-rem/RY at MYR. However, pathway interdiction could reduce this figure by a factor of 10, thus making the risk from groundwater releases only a small fraction of that from the atmospheric pathway for Byron Station. All other plants listed in Table 5.18 have much lower risk from groundwater releases than Byron Station.

From Table 5.19, there may be as many as 19 small river sites that could exceed the Byron Station dose estimate. However, conservatively assuming that all of the radionuclides would reach the river and considering the potentially greater population that could be exposed, it is estimated that in several cases the Byron Station population doses could be exceeded by up to a factor of 10; but in most cases the population doses would be similar to or less than those of Byron Station. Accordingly, the risk from groundwater releases at small river sites is, in most cases, a small fraction of that from atmospheric releases and in several cases may be similar to that from atmospheric releases.

- For Great Lakes sites, the risk to the population can be estimated from the LPGS analyses as approximately 350 person-rem/RY. However, the Fermi-2 FES analyses estimate a risk to the population of approximately 40 percent higher than the LPGS (Table 5.22), or approximately 500 person-rem/RY, uninterdicted. Pathway interdiction could reduce this by a factor of 10, thus making the annual population risk from groundwater releases only a small fraction of that from atmospheric releases. Since Section 5.3.3.4.4 concludes that the Fermi analysis provides the largest estimated groundwater pathway population dose of all Great Lake sites, the risk from groundwater releases at these sites is only a small fraction of that from atmospheric releases.

- For estuarine sites, the LPGS analyses predict a high population risk without interdiction (17,700 person-rem/RY). Pathway interdiction could reduce this by a factor of 10. Section 5.3.3.4.6 indicates that the LPGS analyses provide the largest estimated population risk for all estuarine sites. Therefore, the risk from groundwater releases at estuarine sites is lower than or comparable to that from atmospheric releases.

- For ocean sites, the risk to the population can be estimated from the LPGS analysis as approximately 55 person-rem/RY. From review of the Seabrook FES, it is estimated that the risk to the population may be as much as six times higher for Seabrook (Table 5.24), or approximately 330 person-rem/RY. Since pathway interdiction can reduce this by a factor of 10, it is a small fraction of the predicted risk from atmospheric releases from Seabrook. For other ocean sites, as discussed in Section 5.3.3.4.5, the Seabrook analysis provides a larger groundwater pathway population dose than all but Turkey Point. However, from the data in Table 5.25, assuming all the radionuclides from the reactor reach the groundwater, the population dose from Turkey Point at MYR would not be expected to exceed Seabrook (considering the differences in reactor size and surrounding population). Therefore, it can be concluded that the risk from groundwater releases at ocean sites would be a small fraction of that from atmospheric releases.

- For dry sites, all predicted releases are orders of magnitude lower than the LPGS. From the LPGS (NUREG-0440, Table 6.2.21), the uninterdicted population risk from drinking water could be as high as 10^4 person-rem, which would be one person-rem/RY on an annual risk basis. This is much less than the risk from atmospheric releases.

5.3.3.4.9 Conclusion

Based on the above discussion, it is concluded that groundwater generally contributes only a small fraction of that risk attributable to the atmospheric pathway but in a few cases may contribute a comparable risk.

5.3.3.5 Economic Impacts

The purpose of this section is to determine if the economic costs of the severe accidents that have been estimated in the 27 FESs that contain severe accident analyses can be used to predict the future costs of such accidents at all sites. Similar to Section 5.3.3.2, the EI is used as a predictor of cost because the cost should be dependent upon the economic impact in the same way and for the same reason as population dose estimates are dependent.

CRAC was used to calculate off-site severe accident costs for the area contaminated by the accident. The off-site costs that were considered relate to avoidance of adverse health effects and are categorized as follows:

- evacuation costs,
- value of crops contaminated and condemned,
- value of milk contaminated and condemned,
- costs of decontamination of property where practical, and
- indirect costs resulting from the loss of use of property and incomes derived therefrom (including interdiction to prevent human injury).

The severe accident analysis for the 27 FES plants uses these five cost category models to estimate an average (annual) expected cost due to a severe accident. These costs are a sum of the costs for a range of accidents multiplied by the probability that each of the accidents will occur. Costs in this section are stated in 1980 dollars to facilitate comparisons among plants. Key cost variables include projected population distributions, habitable land fraction, and statewide land-use statistics that identify land and crop values. The off-site consequence code then computes the off-site mitigation costs described above. For the FES plants that have severe accident analyses, estimated off-site accident costs could reach as high as $6 billion to $8 billion, but the probability of an accident with such high consequences would only be once in one million operating years. Higher costs are estimated for accidents with much lower probabilities. Projected costs of adverse health effects from deaths and illnesses would average about 10–20 percent of off-site mitigation costs. These costs are not considered in the economic cost calculations. One addition to these off-site costs was made in NRC risk analyses beginning in 1984. Recognizing that termination of economic activities in a contaminated area would create adverse economic impacts in wider regional markets and sources of supplies outside the contaminated area, NRC began estimating these additional economic costs in FESs. These costs are calculated only for a 1-year period after an accident and can reach into the billions of dollars.

Because some key variables affecting cost are strongly related to population density, it may be possible to predict mitigation costs for contaminated areas off-site using the EI developed in Section 5.3.3.2.1. To test this possibility, the expected cost of an accident calculated in 27 FESs having severe accident analyses was normalized for a plant size of 1000 MW(t) (Table 5.31) and then regressed against the EI value at 150 miles for that plant (Table 5.4).

Upper bound normalized expected costs of accidents during the MYR period for all plants were then predicted using this regression and the EI for populations for the MYR period. The estimates were then

Table 5.31 Average expected costs during the current license period and predicted expected costs during the middle year of license renewal (MYR) resulting from a severe accident

Plant	Average expected cost/RY[a] (dollars)	10-mile MYR population	MYR 95% projected cost/RY[b] (1994 dollars)
Arkansas	—	33,992	477,750
Beaver Valley	29,000	155,141	1,565,550
Bellefonte	—	35,846	2,278,500
Big Rock Point	—	11,037	73,500
Braidwood	14,000	32,652	6,357,750
Browns Ferry	—	36,400	1,984,500
Brunswick	—	15,348	992,250
Byron	8,400	23,900	4,226,250
Callaway	4,300	6,877	1,528,800
Calvert Cliffs	—	24,564	4,336,500
Catawba	7,100	130,735	1,764,000
Clinton	6,700	16,543	3,344,250
Comanche Peak	3,900	19,400	882,000
Cooper	—	6,768	2,116,800
Crystal River	—	20,368	1,249,500
D.C. Cook	—	63,680	2,094,750
Davis-Besse	—	19,714	3,013,500
Diablo Canyon	—	29,591	661,500
Dresden	—	48,248	2,609,250
Duane Arnold	—	94,461	463,050
Farley	—	16,421	624,750
Fermi 2	23,000	93,010	2,138,850
FitzPatrick	—	34,403	1,029,000
Fort Calhoun	—	17,978	220,500
Ginna	—	39,649	404,250
Grand Gulf	3,060	10,943	1,984,500
Haddam Neck	—	91,760	2,249,100
Hatch	—	6,607	1,881,600
Hope Creek	40,000	32,844	4,704,000
Indian Point	—	247,253	8,246,700
Kewanee	—	12,966	551,250
La Salle	—	20,204	3,785,250
Limerick	62,200	178,626	3,505,950
Maine Yankee	—	41,435	771,750
McGuire	—	72,117	1,697,850
Millstone 3	80,000	130,000	3,461,850
Monticello	—	28,091	992,250
Nine Mile Point	8,000	35,208	1,396,500
North Anna	—	11,668	2,352,000

See footnotes at end of table.

Table 5.31 (continued)

Plant	Average expected cost/RY[a] (dollars)	10-mile MYR population	MYR 95% projected cost/RY[b] (1994 dollars)
Oconee	—	77,790	1,234,800
Oyster Creek	—	96,364	1,675,800
Palisades	—	39,720	2,572,500
Palo Verde	2,260	1,378	1,176,000
Peach Bottom	—	34,894	3,858,750
Perry	7,300	89,247	2,028,600
Pilgrim	—	45,921	1,176,000
Point Beach	—	26,447	588,000
Prairie Island	—	28,450	441,000
Quad Cities	—	42,521	2,131,500
Rancho Seco	—	12,489	2,646,000
River Bend	50,000	33,120	1,580,250
Robinson	—	37,681	1,543,500
Salem	—	32,868	8,636,250
San Onofre	19,000	91,940	2,734,200
Seabrook	5,800	130,574	882,000
Sequoyah	—	66,110	1,433,250
Shearon Harris	3,770	26,423	1,690,500
Shoreham	—	113,644	2,138,850
South Texas	2,600	4,149	2,998,800
St. Lucie	4,250	166,860	1,058,400
Summer	4,800	14,997	2,205,000
Surry	—	103,830	1,146,600
Susquehanna	9,000	54,887	3,153,150
Three Mile Island	—	170,142	3,748,500
Trojan	—	21,958	3,050,250
Turkey Point	—	11,136	551,250
Vermont Yankee	—	2,354	2,763,600
Vogtle	16,000	2,648	2,763,600
Waterford	4,500	1,930	3,998,400
Watts Bar	—	95,237	573,300
WNP-2[c]	2,600	22,878	918,750
Wolf Creek	3,600	7,239	1,411,200
Yankee Row	—	27,263	1,249,500
Zion	—	293,491	2,138,850

[a]RY = reactor year; estimates presented in the final environmental statements for operation license.
[b]Distribution free values (nonparametric—see Appendix G). Includes MELCOR Accident Consequence Code System-implied correction factors as well as an inflation multiplier derived from the Implicit Gross Domestic Price Inflator Index = 125.9/85.7 = 1.47 (from 1980 to 2nd quarter 1994).
[c]WNP-2 = Washington Nuclear Project 2.
Note: 10 miles ≐ 16 km.

nonnormalized to convert to expected costs (MYR).

Economic consequences were also benchmarked to the MACCS computer code to ensure the calculated values were based on the most current models and data. The benchmark computations indicated that the CRAC calculations used to estimate the economic impacts for the FES plants did not have a continuous linear relationship with population. The MACCS code predicted higher costs than did the CRAC code; low population sites were underpredicted by substantial margins. The differences were primarily due to the difference in the handling of decontamination costs in the two codes. Results from Tingle (1993) indicate that in order to be comparable to results calculated from MACCS, the regression values should be adjusted though the use of population-dependent correction factors. Table 5.31 reflects average expected cost values that were derived from the regression and then corrected with the following factors:

- Sites with MYR 10-mile (16-km) populations ≤ 10,000 multiply cost data by 40.
- Sites with MYR 10-mile populations > 10,000 and ≤ 50,000 multiply cost data by 25.
- Sites with MYR 10-mile populations > 50,000 multiply cost data by 15.

Also, the FES values were in 1980 dollars. To correct for this the average expected cost values were adjusted to 1994 dollars.

In addition to assessing the economic impact of severe accidents, six of the 27 FESs that analyze severe accidents also assess the amount of off-site land that could be contaminated and subject to long-term interdiction as a result of a severe accident.

These plants and their predicted conditional mean values of land contamination are listed below:

- Hope Creek 7000 m^2/year (8400 yd^2/year)
- Limerick 1 and 2 1500 m^2/year (1800 yd^2/year)
- Millstone 3 4000 m^2/year (4800 yd^2/year)
- Nine Mile Point 2 20,000 m^2/year (24,000 yd^2/year)
- River Bend 40,000 m^2/year (48,000 yd^2/year)
- South Texas 1 and 2 600 m^2/year (720 yd^2/year)

These predicted values would not be expected to change for the license renewal period since they are not affected by increases in population.

As can be seen by the values listed above, the predicted conditional land contamination is small (10 acres/year at most). This is also consistent with WASH-1400 (NUREG-75/014) and a 1982 study on siting criteria (NUREG/CR-2239) which predicts small conditional land contamination values. The land contamination values for these six plants can be considered representative of all plants since they cover the major vendor and containment types and include sites at the upper end of annual rainfall. However, even considering that land contamination values can vary at other sites, it is not expected that predicted land contamination from plants at other sites would vary more than 1 or 2 orders of magnitude from the values listed above and would, therefore, still be a small impact.

5.3.4 Uncertainties

FESs referred to in this section have been based mostly upon the methodology presented in RSS, which was published in 1975 (NUREG-75/014).

Although substantial improvements have been made in various facets of the RSS methodology since its publication, large uncertainties in the results of these analyses remain, including uncertainties associated with the likelihood of the accident sequences and containment failure modes leading to the release categories, the source terms for the release categories, and the estimates of environmental consequences. A comprehensive discussion of the uncertainties associated with risk assessments is provided in NUREG-1150. The relatively more important contributors to uncertainties in the results presented in this environmental statement are as follows.

5.3.4.1 Probability of Occurrence of Accident

If the probability of a release category were to change by some percentage, the probabilities of various types of consequences from that release category would also change by the same percentage. Thus, an order of magnitude uncertainty in the probability of a release category would result in a corresponding order of magnitude uncertainty in both societal and individual risks stemming from the release category. In RSS, there are substantial uncertainties in the probabilities of the release categories. This uncertainty is due, in part, to difficulties associated with the quantification of human error and to limitations in the database on failure rates of individual plant components and in the database on external events and their effects on plant systems, structures, and components that are used to calculate the probabilities. However, since the publication of RSS, substantial NRC programs to improve nuclear plant safety have been implemented such as resolution of generic safety issues (NUREG-0933), Station Blackout and Anticipated Transient Without Scram Rulemakings, and improvements resulting from reviews of the TMI accident (NUREG-0737). These programs, as well as others, all served to reduce the average risk of the overall nuclear industry such that in this GEIS, the use of RSS risk values and their associated frequencies of an accident (because they are embodied within the risk calculation) are reasonable upper estimates of risk for the industry. This is true for even those plants that have not had the benefit of a PRA analysis.

5.3.4.2 Quantity and Chemical Form of Radioactivity Released

There are also significant uncertainties associated with the timing, quantity, and chemical form of each radionuclide species that would be released from a reactor unit during a particular accident sequence. Radioactive material originates in the fuel and would be released from any damaged fuel during an accident. Some would be attenuated by physical and chemical processes en route to being released to the environment. Depending on the accident sequence, such factors as attenuation in the reactor vessel, the rest of the cooling system, the containment, and adjacent buildings would influence both the magnitude and chemical form of radioactive releases. Additional radionuclide releases may originate from on-site dry cask storage facilities for those sites which develop the capability, although the radionuclide inventory is much less than that in the reactor core. Information available in NUREG-0956, in NUREG-1150, and from the latest research activities sponsored by NRC and the industry indicates that the uncertainty in radionuclide source terms is large and represents a significant contribution to the uncertainty in the absolute value of risk. In comparison with the RSS source terms (which are used in the FES analyses), source terms in recent studies were in some instances higher and in other instances lower. However, for the early containment failure sequences, which have the greatest impact on risk, the RSS source terms appear to be larger than the mean values estimated from the recent work and are typically at the upper bound of the uncertainty range of estimates for NUREG-1150.

5.3.4.3 Atmospheric Dispersion Modeling for the Radioactive Plume Transport

Uncertainties are involved in modeling the atmospheric transport of radioactivity in gaseous and particulate states and the actual transport, diffusion, and deposition or fallout that would occur during an accident (including the effects of condensation and precipitation). The phenomenon of plume rise from heat associated with the atmospheric release, effects of precipitation on the plume, and fallout of particulate matter from the plume all have considerable impact on the magnitudes of early health consequences along with the distances from the reactors where these consequences would occur. These factors can result in overestimates or underestimates of both early and later effects (health and economic).

Other areas that have effects on uncertainty are as follows:

- **Duration, energy release, and in-plant radionuclide decay time.** These areas relate to the differences between assumed release duration, energy of release, and the in-plant radioactivity decay times compared with those that would actually occur during a real accident.

  For an atmospheric release of relatively long duration (greater than a half-hour), the actual cross-wind spread (i.e., the width) of the radioactive plume would likely be larger than the width calculated by the dispersion model in the staff code (CRAC). However, the effective width of the plume is calculated in the code using a plume expansion factor that is determined by the release duration. For a given quantity of radionuclides in a release, the plume and, therefore, the area that would come under its cover would become wider if the release duration were longer. In effect, this would result in lower air and ground concentrations of radioactivity but a greater area of contamination.

  The thermal energy associated with the release affects the plume rise phenomenon; a plume that rises quickly or to a high altitude (as in the Chernobyl accident) results in relatively lower air and ground concentrations in the closer-in regions and relatively higher concentrations in the farther-out regions (because of fallout) than would be predicted for plumes that do not rise. Therefore, if large thermal energy were associated with a release containing a large fraction of core-inventory radionuclides, it could increase the distance from the reactor over which early health effects may occur. If, on the other hand, the release behavior were dominated by the presence of large amounts of condensing steam, very much the reverse could occur because of close-in deposition of radionuclides induced by the falling water condensed from the steam.

The time from reactor shutdown until the beginning of the release to the environment (atmosphere), known as the time of release, is used to calculate the depletion of radionuclides by radioactive decay within the plant before release. The depletion factor for each radionuclide (determined by the radioactive decay constant and the time of release) multiplied by the release fraction of the radionuclide and its core inventory determines the actual quantity of the radionuclide released to the environment. Later releases would result in the release of fewer curies to the environment for given values of release fractions.

These parameters can all have significant impacts on accident consequences, particularly early consequences.

- **Meteorological sampling scheme used.** There is a possibility that the meteorological sequences used with the selected start times (sampling) in CRAC may not adequately represent all meteorological variations during the year, or that the year of meteorological data may not represent all possible conditions. This factor is judged to produce greater uncertainties for early effects and less for latent effects.

- **Emergency response effectiveness and warning time.** This relates to the differences between modeling assumptions regarding the emergency response of the people residing near nuclear facilities compared with what would happen during an actual severe reactor accident. Included in these considerations are such subjects as evacuation effectiveness under different circumstances, possible sheltering and its effectiveness, the effectiveness of population relocation, and the fraction of people assumed not to relocate. The warning time is the interval between the time the plant operating staff recognize plant conditions which would indicate that protective actions should be taken for the general population and the time of the release of radioactive material from the plant. In calculations with CRAC, it is assumed that the protective action taken would always be evacuation. Therefore, in the calculation, the evacuating public could be caught by a radioactive plume and exposed or could evacuate into a passing plume. In reality, there are other protective actions that might be called for by public officials—for instance, sheltering to avoid such a situation. This can affect the simplified assumptions about protective actions in the calculated results and would most likely be in the direction of larger calculated early effects. Longer warning times are always more favorable in reality because they would allow time for consideration of several protective action options. The uncertainties associated with emergency response effectiveness and warning time could cause large uncertainties in early health consequences. The uncertainties in latent health consequences and costs are considered smaller than those for early health consequences.

- **Dose-conversion factors and dose-response relationships for early health consequences.** There are uncertainties associated with the conversion of contamination levels to doses, relationships of doses to health effects, and considerations of the availability of what was described in RSS as supportive medical treatment (a specialized medical treatment program, of limited availability in the local area but with additional availability outside the area, that would minimize the early health effect consequences of high levels of radiation exposure following a severe reactor accident). Although all health impacts have not been enumerated in this evaluation, the primary ones have been, and references to other documents such as RSS provide additional insights into the subject.

- **Dose-conversion factors and dose-response relationships for latent health consequences.** Estimates of dose and latent (delayed and long-term) health effects on individuals and on their succeeding generations involve uncertainties associated with conversion of contamination levels to doses and of doses to health effects. The staff judges that this category has a large uncertainty. The uncertainty could result in relatively small underestimates of consequences, but also in substantial overestimates of consequences. Previous FES analyses have been based on results that utilized dose-response relationships provided in BEIR-III (or earlier reports). Consequently the results presented in this GEIS have been corrected to account for the more recent dose-response relationships provided in BEIR-V and to reflect models and relationships found in the most current consequence assessment codes.

- **Chronic exposure pathways.** Uncertainty arises from the possibility that different protective action guide levels may be used for interdiction or decontamination of the exposure pathways (both the atmospheric pathway and the groundwater pathway) than those assumed in the staff analysis. Furthermore, uncertainty arises because there is a lack of precise knowledge about the fate of the radionuclides in the environment as influenced by natural processes such as runoff and weathering. The staff's qualitative judgment is that the uncertainty from these considerations is substantial.

- **Economic data and modeling.** This relates to uncertainties in the economic parameters and economic modeling such as costs of evacuation, relocation, medical treatment, and decontamination of properties and other costs of property damage. Uncertainty in this area could be substantial.

NUREG-1150 contains a state-of-the-art quantification of the uncertainties in core-melt frequency, containment behavior, and source term evaluation. Also included are discussions of the major factors affecting the uncertainty. For further detail on the topics discussed in Sections 5.3.4.1 through 5.3.4.3, refer to the appropriate topics in NUREG-1150.

5.3.4.4 Assumption of Normality for Random Error Components

The predictions of risk values (early and latent fatalities and total dose) were developed statistically by regressing consequence values calculated in recent nuclear plant FESs. A "standard" assumption in the calculation of confidence bounds for these predictions is that the regression errors have a normal distribution. However, without specific evidence of normality, normal-theory confidence bounds for the risk may be too high or low, possibly by a significant margin. Therefore, alternative confidence bounds were considered, which do not rely on the errors having a specified distribution such as the normal, but depend instead on a large-sample approximation. When the normal-theory and alternative bounds differed, the ones leading to higher calculated values were used. (This subject is discussed in Appendix G.)

5.3.4.5 Exposure Index

The concept of using a parameter such as EI to predict future risks is also subject to uncertainty. Such issues are discussed below.

- **Selection of EI parameters.** EI is a calculated parameter based on plant-specific information: population surrounding the plant and wind direction frequency data for the plant. The data on population projections used in the calculation of EI values are based on the 1980 census. EI estimates were made for years 1990, 2000, 2010, 2030, and 2050 and for populations at 10 and 150 miles from the plant. Population estimates for these years were obtained from data provided by the Bureau of Economic Analysis. It is estimated that the uncertainty in these population projections is relatively small, certainly less than a factor of two, and, consequently, would not significantly impact the conclusions of this evaluation.

  The wind data were obtained from plant license documentation such as environmental reports or final safety analysis reports; site-specific data are used in this analysis.

  However, other parameters such as exclusion area distance, rainfall, evacuation speed, and terrain can also affect the consequence calculations. The NUREG-1150 study found that for the five plants studied, the fatality magnitudes (early and latent) were driven primarily by the core-damage frequency, the source term releases, site meteorology, population distribution, and the effectiveness of emergency response measures. All these factors were considered in the CRAC analyses done for the FES plants, using site-specific information for meteorology, population, and emergency response actions. The FES plant analyses enveloped a broad range of such site-specific values. Consequently, it is likely that the use of the UCB limit to estimate future environmental impacts would envelop the effects of these parameters for all plants. The FES analyses were usually performed assuming populations representative of the middle year of the normal 40-year license period. Populations would continue to increase as operation continued into a renewal period. Thus, renewal period risks were predicted using population representative of the middle year of the renewal period. Wind direction frequency is very plant-specific and was not considered to be adequately enveloped for the non-FES plants by the FES plant's wind direction frequencies, especially when these frequencies are weighted by the plant-specific population. However, by selection of population and wind direction frequency for the EI and using UCB values to envelop the effects of other parameters, the uncertainty introduced by the selection of EI parameters should be minimized.

- **Selection of distances.** Although the selection of 10 miles and 150 miles for computing EI values produces rather strong correlations between the EI values and the reported effects in FESs (Appendix G), other distances could exist whose selection would result in stronger correlations. Indeed, as shown in Table 5.5, the FES plants showed a range of 7 to 50 miles for occurrence of total acute fatalities whereas the GEIS analysis used only one distance, 10 miles. However, the effect of stronger correlations would serve primarily to reduce the uncertainty of the regression, thus resulting in a general reduction in the UCB values. Consequently, because the correlations that are used in the study are relatively strong and GEIS uses the UCB values to estimate risk, the possibility of under prediction should be small.

- **Regressing early fatalities for only large plants.** As described in Section 5.3.3.2.1, the regressions for early fatality estimates were performed using data for FES plants having thermal power levels greater than about 3025 MW(t). Although there is some relationship between plant size and predicted early fatalities (all other factors being held constant), the relationship is not linear because of the threshold effects for early fatalities. Therefore, normalization for plant size for the early fatality regression process was not considered appropriate; rather, early fatalities were predicted based only on the data for large plants. This approach should generally provide overpredictions for plants less than 3025 MW(t) resulting in most of the uncertainty being in the direction of smaller predicted effects. For plants equal to or greater than 3025 MW(t), small uncertainty in the calculated values may be present. However, the use of UCBs for predicting risk values should minimize the possibility of underprediction.

- **Normalization of plants for latent fatalities, costs, and dose.** As described in Section 5.3.3.2.1, the regression for latent fatality and dose curves were performed using FES data that had been normalized to 1000 MW(t) in order to reduce the influence of plant size on the fitted parameters. Actual plant size was used for making the predictions and, therefore, the final results reflect nonnormalized values. The regression of latent fatalities, dose, and costs using normalized FES values assumes a linear relationship between power level and source term released. The use of UCBs to predict risk values should minimize the possibility of underprediction.

5.3.4.6 Summary

The state of the art for the quantitative evaluation of the uncertainties for PRA analyses is presented in the NUREG-1150 studies. The NUREG-1150 results indicate that reduction of uncertainty considerations or previously unanalyzed phenomena and sequences and consideration of plant changes have resulted in individual risk components that are both higher and lower than originally provided in RSS. However, NUREG-1150 shows that the cumulative effect is a reduction in risk for those plants studied, and it is also likely to be the case for the industry as a whole. The GEIS results, when reviewed against current data and methodology, have large uncertainties associated with them. The bounds on this uncertainty could be between a factor of 10 and 1000 and could result in the values used being higher or lower.

5.4 SEVERE ACCIDENT MITIGATION DESIGN ALTERNATIVES (SAMDAs)

In 1980 NRC issued an interim policy statement on the consideration of severe accidents in environmental impact statements (EISs) (45 *FR* 40101) applicable to Construction Permit and Operating License applications submitted on or after July 1, 1980. That policy statement states that it is "the intent of the Commission that the staff take steps to identify additional cases that might warrant early consideration of either additional features or other actions which would prevent or mitigate the consequences of serious accidents." Recently, these features have become commonly referred to as SAMDAs. The policy statement goes on to say, "cases for such consideration are those for which a Final Environmental Statement has already been issued at the Construction Permit stage but for which the Operating License review stage has not yet been reached." This statement was made in recognition of the fact that changes in plant design features may be more easily incorporated in plants when construction has not yet progressed very far.

In August 1985, NRC issued its policy statement on severe reactor accidents. That policy statement presented NRC's conclusion that existing plants pose no undue risk to public health and safety and that there was no present basis for immediate action on generic rulemaking or other regulatory changes for those plants because of severe accident risk. Nevertheless, it called for each licensee to perform an analysis designed to discover instances of particular vulnerability to core melt or unusually poor containment performance given a core-melt accident. NRC believed that this policy statement was a sufficient basis for not requiring a consideration of SAMDAs at the operating license review stage for previously constructed plants. However, a 1989 court decision ruled that such a policy statement was not sufficient to preclude a consideration of SAMDAs and that such a consideration is required for plant operation, *Limerick Ecology Action v. NRC*, 869 F.d 719 (3rd Cir. 1989). In order to assess whether SAMDAs can be adequately addressed generically for all plants in this GEIS, it is necessary to consider the level of experience the commission has regarding SAMDAs and the extent to which this experience can reasonably address the SAMDA issue for all plants.

5.4.1 Commission Experience Regarding Severe Accident Mitigation

NRC has gained considerable experience regarding severe accident mitigation during the past several years through implementation of its severe accident policy statement. Specific major actions that have been initiated and, in some cases, completed are (1) evaluation of containment performance and various alternatives for improvement, (2) initiation of individual plant examination, and (3) initiation of an accident management program. Additionally, NRC has performed three site-specific evaluations of SAMDAs pursuant to the 1989 court decision. These

SAMDA analyses were included in the final environmental impact statements for Limerick 1 and 2 and Comanche Peak 1 and 2 operating license reviews, and the Watts Bar supplemental final environmental statement for operation. These actions are addressed below.

5.4.1.1 Containment Performance

NRC has examined each of five U.S. reactor containment types (BWR Mark I, II and III; PWR Ice Condenser; and PWR Dry) with the purpose of examining the potential failure modes, potential fixes, and the cost benefit of such fixes. This examination has been called the containment performance improvement (CPI) program and has been documented in a series of reports (NUREG/CR-5225; NUREG/CR-5278; NUREG/CR-5528; NUREG/ CR-5529; NUREG/CR-5565; NUREG/CR-5567; NUREG/CR-5575; NUREG/CR-5586; NUREG/CR-5589; NUREG/CR-5602; NUREG/CR-5623; NUREG/ CR-5630). Tables 5.32 through 5.34 summarize the results of this program. As can be seen from these tables, many potential changes were evaluated but only a few containment improvements were identified for site-specific review. The items evaluated in the CPI program were also included in the list of plant-specific SAMDAs examined in the Limerick, Comanche Peak, and Watts Bar FES supplements, discussed later.

5.4.1.2 Individual Plant Examinations

In accordance with NRC's policy statement on severe accidents, each licensee has been requested to perform an individual plant examination (IPE) to look for vulnerabilities to both internal and external initiating events (Generic Letter 88-20, Supplements 1–4). This examination will consider potential improvements on a plant-specific basis. In effect, IPE could be considered equivalent to a monitoring program that looks at the severe accident performance of each licensed plant. Detailed guidance has been issued to each licensee regarding the scope and conduct of IPE and the reporting requirements. NRC staff intends to review each submittal and, if plant modifications not proposed by the licensee appear warranted, to pursue the incorporation of such modifications via NRC's backfit rule (10 CFR Part 50.109). To date, 22 IPEs have been reviewed by NRC. These IPEs have resulted in plant procedural and programmatic improvements (i.e., accident management) and, in only a few cases, minor plant modifications, to further reduce the risk and consequences of severe accidents.

5.4.1.3 Accident Management

Accident management involves the development of procedures that promote the most effective use of available plant equipment and staff in the event of an accident. NRC has indicated its intent (Generic Letter 88-20, Supplement 2) to request that licensees develop an accident management framework that will include implementation of accident management procedures, training, and technical guidance. It is expected that insights gained as a result of IPE will be factored into the accident management program. As discussed earlier, the majority of improvements identified from the completed IPEs to date have been in the area of accident management or other procedural and programmatic improvements.

5.4.1.4 SAMDA Analyses

Site specific SAMDA analyses were performed for Limerick, Comanche Peak, and Watts Bar. A listing of the specific

Table 5.32 Potential boiling-water reactor containment improvements considered in the containment performance improvement program

Number	Potential improvement	Resolution	Comments
1	Enhanced ADS, low pressure water supply, and backup power	Include in IPE	*a*
2	Hardened vent	Implemented for Mark-Is, included in IPE for Mark-II and IIIs	*b*
3	ATWS sized-hardened vent	Drop	*c*
4	External filter	Drop	*c*
5	Dedicated suppression pool cooling	Drop	*c*
6	Alternate decay heat removal	Drop	*c*
7	Core debris control	Drop	*c*
8	Enhanced drywell spray	Drop	*c*
9	Drywell head flood	Drop	*c*
10	Enhanced reactor building DF	Drop	
11	Backup power for hydrogen ignitors (Mark IIIs)	Included in IPE	*d*

Acronyms: ADS = automatic depressurization system, IPE = individual plant examination, ATWS = anticipated transit without scram, DF = decontamination factor.
[a]Analysis showed that potential improvement may be cost beneficial.
[b]Cost beneficial for Mark-Is.
[c]Not cost effective—potential improvement will be too expensive with too little benefit.
[d]May be cost beneficial.

Table 5.33 Potential pressurized-water reactor ice condenser improvements considered in the containment performance improvement program

Potential improvement	Resolution	Comments
Reactor cavity flooding	Drop	Not cost beneficial. Might cause ex-vessel steam explosion.
Backup water to the containment spray system	Drop	Not cost beneficial
Backup power to the air return fan system	Drop	Not cost beneficial. May increase containment pressurization
Reactor depressurization	Include in accident management	Currently being pursued as a viable accident management strategy
Improved hydrogen ignitor system (backup power)	Include in individual plant examination (IPE)	Most cost beneficial of all alternatives considered (although it still does not meet the backfit test). To be looked at within the IPE program
Containment inerting	Drop	Not cost beneficial, may reduce accessibility for maintenance
Filtered vent	Drop	Not cost beneficial
Ex-vessel core debris curb	Drop	Large uncertainty as to effectiveness
Steam generator tube rupture improvements—increased testing	Further research needed	Being examined in separate Nuclear Regulatory Commission program by the Materials Engineering Branch, RES
Containment bypass improvements	Included in generic issues program	Being examined as part of a separate interfacing system loss of coolant accident generic issue (GSI 105)

Table 5.34 Potential pressurized-water reactor (PWR) large, dry containment improvements considered in the containment performance improvement program

Potential improvement	Resolution	Comments
Operator depressurization using power-operated relief valve	Drop	No conclusive findings on its benefit to risk reduction
Addition of a cavity flooding system	Drop	Not cost beneficial. The effect of a flooded cavity on the direct containment heating threats may be beneficial or detrimental, depending on each plant
Addition of hydrogen control system	Assess in individual plant examination (IPE)	Recommend all dry PWR containments assess the likelihood of local hydrogen detonation in the IPE

SAMDAs reviewed for applicability to Limerick is provided in Table 5.35. The staff examined each SAMDA (individually and, in some cases, in combination) to determine its individual risk reduction potential. This risk reduction was then compared with the cost of implementing the SAMDA to provide cost-benefit evidence of its value. Considering that the estimates of risk at Limerick used by the staff in these evaluations were considered to be high and that the uncertainties associated with the costs, effectiveness, and/or operational disadvantages of some SAMDAs were large, the staff concluded that there was no clear evidence that modifications to Limerick were justified for the purpose of further mitigating severe accident risks.

The staff made a similar assessment of SAMDAs for the Comanche Peak Steam Electric Station. A list of the SAMDAs reviewed in this evaluation is provided in Table 5.36. As with the Limerick evaluation, the staff had no basis for concluding that modifications to Comanche Peak were justified for the purpose of further mitigating environmental concerns as they relate to severe accidents. Recently, the staff evaluated SAMDAs for the Watts Bar Nuclear Plant. As in the Limerick and Comanche Peak analyses, no plant modifications were justified for the purpose of further mitigating severe accident risk and consequences.

Several important items from these analyses should be noted.

- First, the SAMDAs considered at Limerick, Comanche Peak, and Watts Bar covered a broad range of accident prevention and mitigation features. These features included the items that were evaluated for all containment types as part of the CPI Program.

- Second, the Limerick analyses were for a plant at a high population site. Since risk to the public is generally proportional to the population surrounding the plant, one would

Table 5.35 Severe accident mitigation design alternatives (SAMDAs) considered for the Limerick Generating Station

1. Installation of alternative means to maintain suppression pool subcooling to improve plant's capability to remove decay heat and prevent containment overpressure challenge

2. Provision of an alternative means of decay heat removal

3a. Installation of containment vent of sufficient size to prevent containment overpressure due to an anticipated transient without scram event

3b. Installation of containment vent and filter of sufficient size to prevent containment overpressure due to an inability to remove decay heat

3c. Installation of containment vent (no filter) of sufficient size to prevent containment overpressure due to an inability to remove decay heat[a]

4. Installation of core debris control devices to prevent core/concrete interaction and remove decay heat from the core debris

5a. Provide enhanced drywell spray capability to increase the reliability for removal of heat from the drywell atmosphere and the core debris, thereby minimizing the threat of containment failure due to overpressure

5b. Provide modification for flooding of the drywell head to help mitigate accidents that result in leakage through the drywell head seal

6. Provide the capability for diesel-driven, low-pressure makeup to the reactor to help in mitigation of core damage resulting from accident sequences in which the reactor vessel is depressurized and all other means of injecting water to the vessel have been lost

7. Improve the reliability of the automatic depressurization system to reduce the probability of vessel failure at high pressure during a severe accident

8. Establish an improved decontamination factor for secondary containment through enhancement to the fire protection system and/or the standby gas treatment system hardware and procedures to improve fission product removal

[a]This SAMDA has been implemented for plants having Mark I containments.

Table 5.36 Listing of severe accident mitigation design alternatives considered for the Comanche Peak Steam Electric Station

1. Additional Instrumentation for Bypass Sequences: Install pressure-monitoring or leak-monitoring instruments (permanent pressure sensors) between the first two pressure isolation valves on low-pressure injection lines, residual heat removal (RHR) suction lines, and high-pressure injection lines. The additional instrumentation would improve the ability to detect valve leakage or open valves, and would decrease the frequency of interfacing system loss-of-coolant accidents (LOCAs).

2. Deliberate Ignition System: Provide a system to promote ignition of combustible gases (hydrogen and carbon monoxide) at low concentrations. The ignition system would prevent large-scale deflagrations or detonations in events involving gradual releases of combustibles (such as from cladding oxidation or core-concrete interactions) but may be ineffective for rapid releases of hydrogen that could occur coincident with reactor vessel failure at high pressure.

3. Reactor Coolant System Depressurization: Provide a capability to rapidly depressurize the reactor coolant system. Reactor depressurization would allow injection using low-pressure systems and would reduce the threat of direct containment heating and induced failures of steam generator tubes and primary coolant piping in the event low-pressure injection systems are not available. Depressurization could be achieved by a system specially designed to manually depressurize the reactor vessel or by actuation of existing pressurizer power-operated relief valves, reactor vessel heat vent valves, and secondary system valves.

4. Independent Containment Spray System: Provide an independent containment spray system, using the existing spray headers if appropriate. The spray system would cool the containment and the core debris, thereby reducing the challenge to containment from overtemperature and long-term overpressure by steam. However, unless the sprays terminate core-concrete interactions, the noncondensable gases released from the concrete are expected to cause the containment to eventually fail by overpressure.

5. Reactor Cavity Flooding System: Provide a capability to flood the reactor cavity before and after reactor vessel breach. Cavity flooding would promote debris coolability, reduce core-concrete interactions and noncondensable gas production, and provide fission product scrubbing.

6. Filtered Containment Venting: Provide a capability to vent the containment through a vent path routed to an external filter. The filtered vent would mitigate challenges to containment from long-term overpressure and hydrogen burn (by reducing the baseline containment pressure) but may not be effective for mitigating energetic events such as hydrogen burns coincident with reactor vessel failure.

Table 5.36 (continued)

7. Additional Diesel Generator: Provide an additional diesel generator with cross-ties to both Class 1E buses. This modification would increase the availability of the AC power system and reduce the frequency of station blackout sequences.

8. Additional DC Battery Capability: Provide additional DC battery capability to ensure eight hours of instrumentation and control power, as opposed to four in the event of a station blackout. This would extend the time available for recovery and reduce the frequency of long-term station blackout sequences.

9. Alternative Means of Core Injection: Provide a capability for makeup water to the reactor using a low-pressure, diesel-driven pump of sufficient capacity and associated piping hardware and procedures. The diesel-driven pump would serve as a backup to the front-line, low-pressure injection systems and could also be used to maintain core cooling in the event of a LOCA.

10. Improved Availability of Recirculation Mode: Provide a system to automatically switch the suction of the safety injection and centrifugal charging pumps to the RHR pump discharge when the refueling water storage tank is depleted. Automatic switchover would reduce the potential for operator error and improve the availability of core cooling in the recirculation mode.

11. Additional Service Water Pump: Add a third 100 percent service water pump to improve the availability of the station service water system. This would reduce the frequency of sequences involving failure of vital plant equipment due to loss of cooling.

generally expect SAMDAs for plants at high population sites to have the most favorable cost-benefit ratio. Since SAMDAs were found not to be justified at Limerick, it is unlikely that they would be justified for plants at other sites.

- Third, plant procedural and programmatic improvements (rather than plant modifications) were the only cost-beneficial improvements identified from these analyses.

5.4.1.5 Conclusion

Although NRC has gained considerable experience regarding severe accident mitigation improvements, the ongoing regulatory programs related to severe accident mitigation (i.e., individual plant examination/individual plant examination of external events and Accident Management) have not been completed for all plants. Since these programs have identified plant programmatic and procedural improvements (and in a few cases, minor plant modification) as cost effective in reducing severe accident consequence and risk, it would be premature to generically conclude that a consideration of severe accident mitigation is not required for license renewal.

However, based on the experiences discussed above, the NRC expects that a site-specific consideration of severe accident mitigation for license renewal will only identify procedural and programmatic improvements (and perhaps minor hardware changes) as being cost-beneficial in reducing severe accident risk or consequence. Therefore, a site-specific consideration of alternatives to mitigate severe accidents shall be performed for license renewal unless such a consideration has already been included in a previous EIS or related supplement. Staff evaluations of alternatives to mitigate severe accidents have already been completed and included in an EIS or supplement for Limerick, Comanche Peak, and Watts Bar; therefore, severe accident mitigation need not be reassessed for these plants for license renewal.

5.5 SUMMARY AND CONCLUSIONS

The foregoing discussions have dealt with the environmental impacts of accidents during operation after license renewal. The primary assumption for this evaluation is that the frequency (or likelihood of occurrence) of an accident at a given plant would not increase during the plant lifetime (inclusive of the license renewal period) because regulatory controls ensure the plant's licensing basis is maintained and improved, where warranted. However, it was recognized that the changing environment around the plant is not subject to regulatory controls and introduces the potential for changing risk. Estimation of future severe accident consequences and risk was based upon existing risk and consequence analyses found in FES for recently licensed plants because these include severe accident analyses and constitute a representative set of plants and sites for the United States.

5.5.1 Impacts from Design-Basis Accidents

The environmental impacts of postulated accidents were evaluated for the license renewal period in GEIS Chapter 5. All plants have had a previous evaluation of the environmental impacts of design-basis accidents. In addition, the licensee will be required to maintain acceptable design and performance criteria throughout the renewal period. Therefore, the calculated releases from design-basis accidents would not be expected to change. Since the consequences of these events are evaluated for the hypothetical maximally exposed individual at the time of licensing, changes in the plant environment will not affect these evaluations. Therefore, the staff concludes that the environmental impacts of design-basis accidents are of small significance for all plants. Because the environmental impacts of design basis accidents are of small significance and because additional measures to reduce such impacts would be costly, the staff concludes that no mitigation measures beyond those implemented during the current term license would be warranted. This is a Category 1 issue.

5.5.2 Impacts from Severe Accidents

5.5.2.1 Atmospheric Releases

The evaluation of health and dose effects caused by atmospheric releases used a prediction process to identify those plant sites that are bounded by existing analyses. Existing analyses represent only a subset of operating plants. A particular portion of this subset, specifically those plants having severe accident analyses in their respective FESs, was used in this evaluation. EI (which is a function of population and wind direction), in conjunction with the FES severe accident analyses, was then used to develop a means to predict consequences for all plants. Average values and 95 percent UCB values were estimated. Table 5.6 provides the results of this prediction process.

Results indicate that the predicted effects of a severe accident during MYR at the 74 sites of nuclear power plants in the United States are not expected to exceed a small fraction of that risk to which the population is already exposed. In addition, the dose to individuals was also predicted. Results indicate that the highest average individual dose would be 3×10^{-4} rem/RY. This dose compares to an average of 3×10^{-1} rem/person/year for all other causes, including radon. Therefore, the probability-weighted consequences from atmospheric releases associated with severe accidents is judged to be of small significance for all plants.

5.5.2.2 Fallout onto Open Bodies of Water

The results of comparative analyses for the drinking-water pathway concluded that Great Lakes sites have the same order-of-magnitude risk that was calculated in the Fermi 2 FES, which is only a small fraction of the risk from atmospheric pathway releases. River sites with potentially greater risk than in the Fermi FES are amenable to interdiction, which can significantly reduce risk. In the case of the aquatic food pathway, interdicted population exposures are less than or essentially the same as atmospheric pathway releases. For both the drinking water and aquatic food pathways, the probability-weighted consequences from fallout due to severe accidents is of small significance.

5.5.2.3 Releases from Groundwater

The comparative analyses for this pathway were done by first segregating all sites into six general categories as called out in the NRC LPGS (NUREG-0440) and then estimating if the risk consequences calculated in existing analyses (including the LPGS) bounds the risks for all other plants within each category.

Of the six categories, three are judged to be bound by existing analyses. These categories are Great Lake sites, estuaries, and dry sites.

For the other categories, estimates were made of the degree to which groundwater releases could exceed existing analyses. For all six categories, the staff concluded that the risk to the population was either a small fraction of that for atmospheric releases or, in a few cases, comparable to that from atmospheric releases. Therefore, the probability-weighted consequences from groundwater releases due to severe accidents is judged to be of small significance for all plants.

5.5.2.4 Societal and Economic Risks

The expected costs resulting from a severe accident at nuclear power plants during their renewal periods have been predicted from evaluations presented in 27 FESs. Estimates of the extent of land contamination have also been presented. In both cases, the conditional impacts are judged to be of small significance for all plants.

5.5.2.5 SAMDAs

The staff concluded that the generic analysis summarized above applies to all plants and that the probability-weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to ground water, and societal and economic impacts of severe accidents are of small significance for all plants. However, not all plants have performed a site-specific analysis of measures that could mitigate severe accidents. Consequently, severe accidents are a Category 2 issue for plants that have not performed a site-specific consideration of severe accident mitigation and submitted that analysis for Commission review.

5.6 ENDNOTES

1. While a dose as low as 10 rem may cause such observable physiological changes as chromosomal aberrations, these changes are not classified as clinical injury.
2. Also referred to as the Rogovin report.
3. Grand Gulf, Sequoyah, Surry, Peach Bottom, and Zion.
4. The FitzPatrick and Nine Mile Point units are located closely enough to assume that they are located on the same site. A similar observation can be made for the Hope Creek and Salem units.
5. Because the hypothetical sites were to be modeled as either PWRs or BWRs, those using population data of actual PWR sites utilized updated WASH-1400 source terms taken from the Byron FES (NUREG-0848), while those using population data for BWRs utilized updated WASH-1400 source terms taken from the Clinton FES (NUREG-0854).

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NUCLEAR REGULATORY COMMISSION

10 CFR Part 51

RIN 3150–AD63

Environmental Review for Renewal of Nuclear Power Plant Operating Licenses

AGENCY: Nuclear Regulatory Commission.

ACTION: Final rule.

SUMMARY: The Nuclear Regulatory Commission (NRC) is amending its regulations regarding environmental protection regulations for domestic licensing and related regulatory functions to establish new requirements for the environmental review of applications to renew the operating licenses of nuclear power plants. The amendment defines those environmental impacts for which a generic analysis has been performed that will be adopted in plant-specific reviews for license renewal and those environmental impacts for which plant-specific analyses are to be performed.

The amendment improves regulatory efficiency in environmental reviews for license renewal by drawing on the considerable experience of operating nuclear power reactors to generically assess many of the environmental impacts that are likely to be associated with license renewal. The amendment also eliminates consideration of the need for generating capacity and of utility economics from the environmental reviews because these matters are under the regulatory jurisdiction of the States and are not necessary for the NRC's understanding of the environmental consequences of a license renewal decision.

The increased regulatory efficiency will result in lower costs to both the applicant in preparing a renewal application and to the NRC for reviewing plant-specific applications and better focus of review resources on significant case specific concerns. The results should be a more focused and therefore a more effective NEPA review for each license renewal. The amendment will also provide the NRC with the flexibility to address unreviewed impacts at the site-specific stage of review and allow full consideration of the environmental impacts of license renewal.

The NRC is soliciting public comment on this rule for a period of 30 days. In developing any comment specific attention should be given to the treatment of low-level waste storage and disposal impacts, the cumulative radiological effects from the uranium fuel cycle, and the effects from the disposal of high-level waste and spent fuel.

DATES: Absent a determination by the NRC that the rule should be modified, based on comments received, the final rule shall be effective on August 5, 1996. The comment period expires on July 5, 1996.

ADDRESSES: Send comments to: The Secretary of the Commission, U.S. Nuclear Regulatory Commission, Washington, DC 20555–0001, Attention: Docketing and Services Branch, or hand deliver comments to the Office of the Secretary, One White Flint North, 11555 Rockville Pike, Rockville, Maryland between 7:30 a.m. and 4:15 p.m. on Federal workdays. Copies of comments received and all documents cited in the supplementary information may be examined at the NRC Public Document Room, 2120 L Street NW. (Lower Level), Washington, DC between the hours of 7:45 a.m. and 4:15 p.m. on Federal workdays.

FOR FURTHER INFORMATION CONTACT: Donald P. Cleary, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, DC 20555–0001, telephone: (301) 415–6263; e-mail DPC@nrc.gov.

SUPPLEMENTARY INFORMATION:

I. Introduction

The Commission has amended its environmental protection regulations in 10 CFR part 51 to improve the efficiency of the process of environmental review for applicants seeking to renew an operating license for up to an additional 20 years. The amendments are based on the analyses conducted for and reported in NUREG–1437, ''Generic Environmental Impact Statement for License Renewal of Nuclear Plants'' (May 1996). The Commission's initial decision to undertake a generic assessment of the environmental impacts associated with the renewal of a nuclear power plant operating license was motivated by its beliefs that:

(1) License renewal will involve nuclear power plants for which the

environmental impacts of operation are well understood as a result of data evaluated from operating experience to date;

(2) Activities associated with license renewal are expected to be within this range of operating experience, thus environmental impacts can be reasonably predicted; and

(3) Changes in the environment around nuclear power plants are gradual and predictable with respect to characteristics important to environmental impact analyses.

Although this amendment is consistent with the generic approach and scope of the proposed amendment published on September 17, 1991 (56 FR 47016), several significant modifications have been made in response to the public comments received. The proposed amendment would have codified the findings reached in the draft generic environmental impact statement (GEIS) as well as certain procedural requirements. The draft GEIS established the bounds and significance of potential environmental impacts at 118 light-water nuclear power reactors that, as of 1991, were licensed to operate or were expected to be licensed in the future.

All potential environmental impacts and other matters treated by the NRC in an environmental review of nuclear power plants were identified and combined into 104 discrete issues. For each issue, the NRC staff established generic findings encompassing as many nuclear power plants as possible. These findings would have been codified by the proposed amendment. Of the 104 issues reviewed for the proposed rule, the staff determined that 80 issues could be adequately addressed generically and would not have been reviewed in plant-specific license renewal reviews. For 22 of the issues, it was found that the issue was adequately addressed for some but not all plants. Therefore, a plant-specific review would be required to determine whether the plant is covered by the generic review or whether the issue must be assessed for that plant. The proposed amendment provided guidance on the application of these findings at the site-specific license renewal stage. For the two remaining issues, it was found that the issue was not generically addressed for any plant, and thus a plant-specific review would have been required for all plants.

Other major features of the proposed amendment included a conditional finding of a favorable cost-benefit balance for license renewal and a provision for the use of an environmental assessment that would address only those issues requiring plant-specific review. A finding of no significant impact would have resulted in a favorable cost-benefit balance for that plant. If a finding of no significant impact could not be made for the plant, there would have to have been a determination as to whether the impacts found in the environmental assessment were sufficient to overturn the conditional cost-benefit balance found in the rule.

Although the final amendments to 10 CFR part 51 maintain the same generic approach used in the proposed rule, there are several modifications.The final amendments to 10 CFR part 51 now contain 92 issues. The reduction of the number of issues from 104 in the proposed rule to 92 in the final rule is due to (1) the elimination from the review of the consideration of the need for electric power and associated generating capacity and of the direct economic benefits and costs associated with electric power, (2) removing alternatives as an issue from Table B–1 and addressing review requirements only in the text of the rule, (3) combining the five severe accident issues used in the proposed rule into one issue, (4) eliminating several regional economic issues under socioeconomics that are not directly related to environmental impacts, (5) making minor changes to the grouping of issues under aquatic ecology and groundwater, (6) identifying collective offsite radiological impacts associated with the fuel cycle and all impacts of high level waste and spent fuel disposal as separate issues, and (7) adding environmental justice as an issue for consideration.

Of the 92 issues in the final rule, 68 issues were found to be adequately addressed in the GEIS, and therefore, additional assessment will not be required in a plant-specific review. Twenty-four issues were found to require additional assessment for at least some plants at the time of the license renewal review. In the final rule, the 2 issues in the proposed rule that would have required review for all plants are now included in the set of 24 issues of the final rule.

Public comments on the adequacy of the analysis for each issue were considered by the NRC staff. Any changes to the analyses and findings that were determined to be warranted were made in the final GEIS and incorporated in the rule. Several changes were made to the procedural features of the proposed rule in response to comments by the Council on Environmental Quality, the Environmental Protection Agency, and a number of State agencies. First, the NRC will prepare a supplemental site-specific environmental impact statement (SEIS), rather than an environmental assessment (as initially proposed), for each license renewal application. The SEIS will be issued for public comment as part of the individual plant review process. The NRC will delay any conclusions regarding the acceptability of the overall impacts of the license renewal until completion of the site-specific review. In addition, the SEIS will be prepared in accordance with existing public scoping requirements. The NRC will also review and consider any new and significant information presented during the review of individual license renewal applications. In addition, any person may challenge the validity of the conclusions codified in the rule by filing a petition for rulemaking pursuant to 10 CFR 2.802. Finally, the NRC will review the rule and the GEIS on a schedule that allows revisions, if required, every 10 years. This review will be initiated approximately 7 years after the completion of the previous revision cycle.

In addition to the changes involving public participation, this final rule also contains several changes regarding the scope of analysis and conclusions in the rule and GEIS. The conditional cost-benefit balance has been removed from the GEIS and the rule. In place of the cost-benefit balancing, the NRC will use a new standard that will require a determination of whether or not the adverse environmental impacts of license renewal are so great, compared with the set of alternatives, that preserving the option of license renewal for future decisionmakers would be unreasonable. The final amendment also eliminates NRC's consideration of the need for generating capacity and the preparation of power demand forecasts for license renewal applications. The NRC acknowledges the primacy of State regulators and utility officials in defining energy requirements and determining the energy mix within their jurisdictions. Therefore, the issue of need for power and generating capacity will no longer be considered in NRC's license renewal decisions. The final GEIS has been revised to include an explicit statement of purpose and need for license renewal consistent with this acknowledgment. Lastly, the final rule has eliminated the consideration of utility economics from license renewal reviews under the National Environmental Policy Act (NEPA) except when such benefits and costs are either essential for a determination regarding the inclusion of an alternative in the range of alternatives considered or relevant to mitigation. These and other features of the final rule are explained in detail below.

The NRC is soliciting public comment on this rule for a period of 30 days. In developing any comment specific attention should be given to the treatment of low-level waste storage and disposal impacts, the cumulative radiological effects from the uranium fuel cycle, and the effects from the disposal of high-level waste and spent fuel. Absent a determination by the NRC that the rule should be modified, based on comments received, the final rule shall be effective on August 5, 1996.

II. Rulemaking History

In 1986, the NRC initiated a program to develop license renewal regulations and associated regulatory guidance in anticipation of applications for the renewal of nuclear power plant operating licenses. A solicitation for comments on the development of a policy statement was published in the Federal Register on November 6, 1986 (51 FR 40334). However, the Commission decided to forgo the development of a policy statement and to proceed directly to rulemaking. An advance notice of proposed rulemaking was published on August 29, 1988 (53 FR 32919). Subsequently, the NRC determined that, in addition to the development of license renewal regulations focused on the protection of health and safety, an amendment to its environmental protection regulations in 10 CFR part 51 was warranted.

On October 13, 1989 (54 FR 41980), the NRC published a notice of its intent to hold a public workshop on license renewal on November 13 and 14, 1989. One of the workshop sessions was devoted to the environmental issues associated with license renewal and the possible merit of amending 10 CFR part 51. The workshop is summarized in NUREG/CP–0108, ''Proceedings of the Public Workshop on Nuclear Power Plant License Renewal'' (April 1990). Responses to the public comments submitted after the workshop are summarized in NUREG–1411, ''Response to Public Comments Resulting from the Public Workshop on Nuclear Power Plant License Renewal'' (July 1990).

On July 23, 1990, the NRC published an advance notice of proposed rulemaking (55 FR 29964) and a notice of intent to prepare a generic environmental impact statement (55 FR 29967). The proposed rule was published on September 17, 1991 (56 FR 47016). The same Federal Register notice described the supporting documents that were available and announced a public workshop to be held on November 4–5, 1991. The supporting documents for the proposed rule included:

(1) NUREG–1437, ''Draft Generic Environmental Impact Statement for License Renewal of Nuclear Plants'' (August 1991);

(2) NUREG–1440, ''Regulatory Analysis of Proposed Amendments to Regulations Concerning the Environmental Review for Renewal of Nuclear Power Plant Operating Licenses: Draft Report for Comment'' (August 1991);

(3) Draft Regulatory Guide DG–4002, Proposed Supplement 1 to Regulatory Guide 4.2, ''Guidance for the Preparation of Supplemental Environmental Reports in Support of an Application To Renew a Nuclear Power Station Operating License'' (August 1991); and

(4) NUREG–1429, ''Environmental Standard Review Plan for the Review of License Renewal Applications for Nuclear Power Plants: Draft Report for Comment'' (August 1991).

After the comment period, the NRC exchanged letters with the Council on Environmental Quality (CEQ) and the Environmental Protection Agency (EPA) to address their concerns about procedural aspects of the proposed rule. The Commission also decided that the staff should discuss with the States the concerns raised in comments by a number of States that certain features of the proposed rule conflicted with State regulatory authority over the need for power and utility economics. To facilitate these discussions, the NRC staff developed an options paper entitled ''Addressing the Concerns of States and Others Regarding the Role of Need for Generating Capacity, Alternative Energy Sources, Utility Costs, and Cost-Benefit Analysis in NRC Environmental Reviews for Relicensing Nuclear Power Plants: An NRC Staff Discussion Paper.'' A Federal Register notice published on January 18, 1994 (59 FR 2542) announced the scheduling of three regional workshops during February 1994 and the availability of the options paper. A fourth public meeting on the State concerns was held in May 1994 in order for the NRC staff to better understand written proposals that had been submitted by two industry organizations after the regional workshops. After considering the comments from the workshops and the written comments, the NRC staff issued a proposed supplement to the proposed rule published on July 25, 1994 (59 FR 37724), that it believed would resolve the States' concerns regarding the Commission's consideration of need for power and utility economics. Comments were requested on this proposal. The discussion below contains an analysis of these comments and other comments submitted in response to the proposed rule.

III. Analysis of Public Comments

The analysis of public comments and the NRC's responses to these comments are documented in NUREG–1529, ''Public Comments on the Proposed 10 CFR part 51 Rule for Renewal of Nuclear Power Plant Operating Licenses and Supporting Documents: Review of Concerns and NRC Staff Response'' (May 1996). The extent of comments received during the various stages of the rulemaking process and the principal concerns raised by the commenters, along with the corresponding NRC responses to these concerns, are discussed below.

A. Commenters

In response to the Federal Register notice on the proposed rule published on September 17, 1991 (56 FR 47016), 68 organizations and 49 private citizens submitted written comments. The 68 organizations included 5 Federal agencies; 26 State, regional, and local agencies; 19 nuclear industry organizations and engineering firms; 3 law firms; and 15 public interest groups. Before the close of the initial comment period, the NRC conducted a 2-day workshop on November 4–5, 1991, in Arlington, Virginia, to discuss the proposed rule. Representatives from Federal agencies, State agencies, utilities, engineering firms, law firms, and public interest groups attended the workshop. Workshop panelists included the NRC staff as well as representatives from the Department of Energy (DOE), Department of Interior (DOI), Environmental Protection Agency (EPA), Council on Environmental Quality (CEQ), several State agencies, the nuclear industry, and public interest groups.

In February 1994, the NRC conducted three public meetings to solicit views on the NRC staff's options for addressing the need for generating capacity, alternative energy sources, economic costs, and cost-benefit analysis in the proposed rule. The intent to hold public meetings and the availability of the options paper was noticed in the Federal Register on January 12, 1994 (59 FR 2542). Written comments were also solicited on the options paper. The public meetings were held in Rockville, Maryland; Rosemont, Illinois; and Chicopee, Massachusetts.

Representatives from several States, the National Association of Regulatory Utility Commissioners (NARUC), the nuclear industry, and public interest groups actively participated. Nineteen separate written comments were also submitted, primarily by the States and the nuclear industry. In their submittals, the Nuclear Energy Institute (NEI), formerly known as the Nuclear Management and Resources Council (NUMARC), and Yankee Atomic Electric Company (YAEC) each proposed an approach to handling the issues of need for generating capacity and alternative energy sources in the rule. For the NRC staff to better understand these proposals, an additional public meeting was held with NEI and YAEC on May 16, 1994, in Rockville, Maryland.

After considering the public comments on the NRC staff's options paper, the NRC issued a proposed supplement to the proposed rule; it was published in the Federal Register on July 25, 1994 (59 FR 37724). The proposed supplement set forth the NRC staff's approach to the treatment of need for generating capacity and alternative energy sources, as well as the staff's revision to the purpose of and need for the proposed action (i.e., license renewal), which was intended to satisfy the States' concerns and to meet NEPA requirements. Twenty separate written comments were received in response to this solicitation from Federal and State agencies, the nuclear industry, a public interest group, and two private citizens.

B. Procedural Concerns

The commenters on the proposed rule raised significant concerns regarding the following procedural aspects of the rule:

(1) State and public participation in the license renewal process and the periodic assessment of the GEIS findings;

(2) The use of economic costs and cost-benefit balancing; and

(3) Consideration of the need for generating capacity and alternative energy sources in the environmental review of license renewal applications.

Each of these concerns and the NRC response is discussed below.

1. Public Participation and the Periodic Assessment of the Rule and the GEIS

Concern. Many commenters criticized the draft GEIS finding that 80 of 104 environmental issues could be generically applied to all plants and, therefore, would not be subject to plant-specific review at the time of license renewal. As a consequence, these commenters believe they are being denied the opportunity to participate in the license renewal process. Moreover, they pointed out that the site-specific nature of many important environmental issues does not justify a generic finding, particularly when the finding would have been made 20 years in advance of the decision to renew an operating license. The commenters believe that only a site-specific EIS to support a license renewal decision would satisfy NEPA requirements.

Federal and State agencies questioned how new scientific information could be folded into the GEIS findings because the GEIS would have been performed so far in advance of the actual renewal of an operating license. There were differing views on exactly how the NRC should address this question. A group of commenters, including CEQ and EPA, noted that the rigidity of the proposed rule hampers the NRC's ability to respond to new information or to different environmental issues not listed in the proposed rule. They believe that incorporation of new information can only be achieved through the process of amending the rules. One commenter recommended that, if the NRC decides to pursue the approach of making generic findings based on the GEIS, the frequency of review and update should be specifically stated in the rule. Recommendations on the frequency of the review ranged from 2 years to 5 years.

Response. In SECY–93–032, February 9, 1993, the NRC staff reported to the Commission their discussions with CEQ and EPA regarding the concerns these agencies raised, which were also raised by other commenters, about limiting public comment and the consideration of significant new information in individual license renewal environmental reviews. The focus of the commenters concerns is the limited nature of the site-specific reviews contemplated under the proposed rule. In response, the NRC has reviewed the generic conclusions in the draft rule, expanded the opportunity for site-specific review, and confirmed that what remains as generic is so. Also, the framework for consideration of significant new information has been revised and expanded.

The major changes adopted as a result of these discussions are as follows:

1. The NRC will prepare a supplemental site-specific EIS, rather than an environmental assessment (as initially proposed), for each license renewal application. This SEIS will be a supplement to the GEIS. Additionally, the NRC will review comments on the draft SEIS and determine whether such comments introduce new and significant information not considered in the GEIS analysis. All comments on the applicability of the analyses of impacts codified in the rule and the analysis contained in the draft supplemental EIS will be addressed by NRC in the final supplemental EIS in accordance with 40 CFR 1503.4, regardless of whether the comment is directed to impacts in Category 1 or 2. Such comments will be addressed in the following manner:

a. NRC's response to a comment regarding the applicability of the analysis of an impact codified in the rule to the plant in question may be a statement and explanation of its view that the analysis is adequate including, if applicable, consideration of the significance of new information. A commenter dissatisfied with such a response may file a petition for rulemaking under 10 CFR 2.802. If the commenter is successful in persuading the Commission that the new information does indicate that the analysis of an impact codified in the rule is incorrect in significant respects (either in general or with respect to the particular plant), a rulemaking proceeding will be initiated.

b. If a commenter provides new information which is relevant to the plant and is also relevant to other plants (i.e., generic information) and that information demonstrates that the analysis of an impact codified in the final rule is incorrect, the NRC staff will seek Commission approval to either suspend the application of the rule on a generic basis with respect to the analysis or delay granting the renewal application (and possibly other renewal applications) until the analysis in the GEIS is updated and the rule amended. If the rule is suspended for the analysis, each supplemental EIS would reflect the corrected analysis until such time as the rule is amended.

c. If a commenter provides new, site-specific information which demonstrates that the analysis of an impact codified in the rule is incorrect with respect to the particular plant, the NRC staff will seek Commission approval to waive the application of the rule with respect to that analysis in that specific renewal proceeding. The supplemental EIS would reflect the corrected analysis as appropriate.

2. The final rule and the GEIS will not include conditional cost-benefit conclusions or conclusions about alternatives. Conclusions relative to the overall environmental impacts including cumulative impacts will be left entirely to each site-specific SEIS.

3. After consideration of the changes from the proposed rule to the final rule and further review of the environmental issues, the NRC has concluded that it is

adequate to formally review the rule and the GEIS on a schedule that allows revisions, if required, every 10 years. The NRC believes that 10 years is a suitable period considering the extent of the review and the limited environmental impacts observed thus far, and given that the changes in the environment around nuclear power plants are gradual and predictable with respect to characteristics important to environmental impact analyses. This review will be initiated approximately 7 years after completion of the last cycle. The NRC will conduct this review to determine what, if anything, in the rule requires revision.

Concern. As part of their comments on the July 1994 Federal Register notice, NEI, several utilities, and the DOE asked that the NRC reconsider its understanding with CEQ and EPA regarding the preparation of a site-specific supplemental EIS for each license renewal action. These commenters supported an approach that would allow the preparation of an environmental assessment for reviewing the environmental impacts of license renewal.

Response. The NRC does not agree with this position. The NRC believes that it is reasonable to expect that an assessment of the full set of environmental impacts associated with an additional 20 years of operation of any plant would not result in a ''finding of no significant impact.'' Therefore, the review for any plant would involve an environmental impact statement.

2. Economic Costs and Cost-Benefit Balancing

Concern. State, Federal, and utility representatives expressed concern about the use of economic costs and cost-benefit balancing in the proposed rule and the draft GEIS. Commenters criticized the NRC's heavy emphasis on economic analysis and the use of economic decision criteria. They argued that the regulatory authority over utility economics falls within the States' jurisdiction and to some extent within the jurisdiction of the Federal Energy Regulatory Commission. Commenters also believe that the cost-benefit balancing used in the proposed rule and the draft GEIS went beyond NEPA requirements and CEQ regulations (40 CFR Parts 1500 to 1508). They noted that CEQ regulations interpret NEPA to require only an assessment of the cumulative effects of a proposed Federal action on the natural and man-made environment.

Response. In response to these concerns, the NRC has eliminated the use of cost-benefit analysis and consideration of utility economics in its NEPA review of a license renewal application except when such benefits and costs are either essential for a determination regarding the inclusion of an alternative in the range of alternatives considered or relevant to mitigation. As discussed in more detail in the following section, the NRC recognizes that the determination of the economic viability of continuing the operation of a nuclear power plant is an issue that should be left to appropriate State regulatory and utility officials.

3. Need for Generating Capacity and Alternative Energy Sources

Concern. In their comments on the proposed rule and the draft GEIS, several States expressed concern that the NRC's analysis of need for generating capacity would preempt or prejudice State energy planning decisions. They argued that the determination of need for generating capacity has always been the States' responsibility. Recommendations on how to address this issue ranged from withdrawing the proposed rule to changing the categorization of the issue so that a site-specific review can be performed, thus allowing for meaningful State and public participation. Almost all the concerned States called on the NRC to modify the rule to state explicitly that NRC's analysis does not preempt a State's jurisdiction over the determination of need for generating capacity.

Regarding the issue of alternative energy sources, several commenters contended that the site-specific nature of the alternatives to license renewal did not justify the generic finding in the GEIS. One significant concern about this finding is the States' perception that a generic finding, in effect, preempts the States' responsibility to decide on the appropriate mix of energy alternatives in their respective jurisdictions.

Three regional public meetings were held during the February 1994 to discuss the concerns of the States. At these meetings, and later in written comments, the State of New York proposed an approach to resolve the problem. The approach was endorsed by several other States. This approach had three major conditions:

(1) A statement in the rule that the NRC's findings on need and alternatives are only intended to satisfy the NEPA requirements and do not preclude the States from making their own determination with respect to these issues;

(2) The designation of the need for generating capacity and alternative energy sources as Category 3 (i.e., requiring site-specific evaluation); and

(3) A requirement that all site-specific EISs and relicensing decisions reference State determinations of need for generating capacity and alternative energy sources, and that they defer to those State determinations to the maximum extent possible.

Response. After consideration, the NRC staff did not accept all elements of the States' approach because the approach would have continued to require the NRC to consider the need for generating capacity and utility economics as part of its environmental analysis. In addition, the approach would have required the NRC to develop guidelines for determining the acceptability of State economic analyses, which some States may have viewed as an intrusion on their planning process.

The NRC staff developed and recommended another approach, which was published on July 25, 1994 (59 FR 37724), after consideration of information gathered at the regional meetings and from the written comments. This approach, which borrows some elements from NEI and YAEC proposals, has five major features:

(1) Neither the rule nor the GEIS would contain a consideration of the need for generating capacity or other issues involving the economic costs and benefits of license renewal and of the associated alternatives;

(2) The purpose and need for the proposed action (i.e., license renewal) would be defined as preserving the continued operation of a nuclear power plant as a safe option that State regulators and utility officials may consider in their future planning actions;

(3) The only alternative to the proposed action would be the ''no-action'' alternative, and the environmental consequences of this alternative are the impacts of a range of energy sources that might be used if a nuclear power plant operating license were not renewed;

(4) The environmental review for license renewal would include a comparison of the environmental impacts of license renewal with impacts of the range of energy sources that may be chosen in the case of ''no action''; and

(5) The NRC's NEPA decision standard for license renewal would require the NRC to determine whether the environmental impacts of license renewal are so great that preserving the option of license renewal for future decisionmakers would be unreasonable.

The statement that the use of economic costs will be eliminated in this approach refers to the ultimate NEPA decision regarding the comparison of alternatives and the proposed action. This approach does not preclude a consideration of economic costs if these costs are essential to a determination regarding the inclusion of an alternative in the range of alternatives considered (i.e., an alternative's exorbitant cost could render it nonviable and unworthy of further consideration) or relevant to mitigation of environmental impacts. Also, the two local tax issues and the two economic structure issues under socioeconomics in the table would be removed from consideration when applying the decision standard.

Concern. Comments received from several States on the NRC staff's July 1994 recommended approach ranged from rejection to endorsement. Some States supported the three conditions proposed by the State of New York. Several States were still concerned about whether a meaningful analysis of need for generating capacity and alternative energy sources could be undertaken 20 years ahead of time. One State asked that the proposed rule be withdrawn. Another State wanted the proposed rule to be reissued for public comment. CEQ supported the approach proposed by the State of New York. CEQ believed that the NRC's recommended approach was in conflict with the NEPA process because the proposed statement of purpose and need for the proposed action was too narrow and did not provide for an appropriate range of alternatives to the underlying need for the proposed action. CEQ wanted the NRC to address other energy sources as separate alternatives, rather than as consequences of the no-action alternative. Moreover, CEQ stated that the proposed decision standard places a ''weighty and improper burden of proof'' on consideration of the alternative. The EPA endorsed CEQ's comments. In general, the nuclear industry was supportive of the recommended approach. However, NEI and the utilities strongly expressed the opinion that, with the redefined statement of purpose and need, alternative energy sources would no longer be alternatives to the proposed action and, therefore, need not be considered.

Response. After consideration of the comments received on the Commission's July 1994 proposal, the Commission has modified and clarified its approach in order to address the concerns of CEQ relative to consideration of appropriate alternatives and the narrow definition of purpose and need. These modifications and clarifications addressed the States' concerns relative to treatment of need for generating capacity and alternatives. Specifically, the Commission has clarified the purpose and need for license renewal in the GEIS as follows:

> The purpose and need for the proposed action (renewal of an operating license) is to provide an option that allows for power generation capability beyond the term of a current nuclear power plant operating license to meet future system generating needs, as such needs may be determined by State, utility, and, where authorized, Federal (other than NRC) decisionmakers.

Using this definition of the purpose of and need for the proposed action, which stresses options for the generation of power, the environmental review will include a characterization of alternative energy sources as being the alternatives to license renewal and not merely the consequences of the no-action alternative and, thus, it addresses CEQ's concern that the scope of the alternatives analysis is unacceptably restricted.

With respect to the States' concerns regarding need for generating capacity analysis, the NRC will neither perform analyses of the need for power nor draw any conclusions about the need for generating capacity in a license renewal review. This definition of purpose and need reflects the Commission's recognition that, absent findings in the safety review required by the Atomic Energy Act of 1954, as amended, or in the NEPA environmental analysis that would lead the NRC to reject a license renewal application, the NRC has no role in the energy planning decisions of State regulators and utility officials. From the perspective of the licensee and the State regulatory authority, the purpose of renewing an operating license is to maintain the availability of the nuclear plant to meet system energy requirements beyond the term of the plant's current license. The underlying need that will be met by the continued availability of the nuclear plant is defined by various operational and investment objectives of the licensee. Each of these objectives may be dictated by State regulatory requirements or strongly influenced by State energy policy and programs. In cases of interstate generation or other special circumstances, Federal agencies such as the Federal Energy Regulatory Commission (FERC) or the Tennessee Valley Authority (TVA) may be involved in making these decisions. The objectives of the various entities involved may include lower energy cost, increased efficiency of energy production and use, reliability in the generation and distribution of electric power, improved fuel diversity within the State, and environmental objectives such as improved air quality and minimized land use.

The consideration of alternatives has been shifted to the site-specific review. The rule contains no information or conclusions regarding the environmental impacts of alternative energy sources, it only indicates that the environmental impact of alternatives will be considered during the individual plant review. However, the GEIS contains a discussion of the environmental impacts of alternative energy sources based on currently available information. The information in the GEIS is available for use by the NRC and the licensee in performing the site-specific analysis of alternatives and will be updated as appropriate. For individual plant reviews, information codified in the rule, information developed in the GEIS, and any significant new information introduced during the plant-specific review, including any information received from the State, will be considered in reaching conclusions in the supplemental EIS. The NRC's site-specific comparison of the impacts of license renewal with impacts of alternative energy sources will involve consideration of information provided by State agencies and other members of the public. This approach should satisfy the States' concerns relative to a meaningful analysis of alternative energy sources.

The Commission disagrees with CEQ's assertion that the new decision standard is inappropriate. Under this decision standard, the NRC must determine if the adverse environmental impacts of license renewal are so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable. The Commission expects that license renewal would be denied only if the expected environmental effects of license renewal significantly exceed all or almost all alternatives. The Commission believes that this is a reasonable approach to addressing the issue of environmental impacts of license renewal, given NRC's limited role in the area of energy systems planning. The operation of a nuclear power plant beyond its initial license term involves separate regulatory actions, one taken by the utility and the NRC, and the other taken by the utility and the State regulatory authorities. The decision standard would be used by NRC to determine whether, from an environmental perspective, it is reasonable to renew the operating license and allow State and utility decisionmakers the option of considering a currently operating nuclear power plant as an alternative for meeting future energy needs. The test of reasonableness focuses on an analysis of whether the environmental impacts anticipated for continued operation during the term of the renewed license reasonably compare with the impacts that are expected from the set of alternatives considered for meeting generating requirements. The NRC would reject a license renewal application if the analysis demonstrated that the adverse environmental impacts of the individual license renewal were so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable.

After the NRC makes its decision based on the safety and environmental considerations, the final decision on whether or not to continue operating the nuclear plant will be made by the utility, State, and Federal (non-NRC) decisionmakers. This final decision will be based on economics, energy reliability goals, and other objectives over which the other entities may have jurisdiction. The NRC has no authority or regulatory control over the ultimate selection of future energy alternatives. Likewise, the NRC has no regulatory power to ensure that environmentally superior energy alternatives are used in the future. Given the absence of the NRC's authority in the general area of energy planning, the NRC's rejection of a license renewal application based on the existence of a single superior alternative does not guarantee that such an alternative will be used. In fact, it is conceivable that the rejection of a license renewal application by the NRC in favor of an individual alternative may lead to the implementation of another alternative that has even greater environmental impacts than the proposed action, license renewal.

Given the uncertainties involved and the lack of control that the NRC has in the choice of energy alternatives in the future, the Commission believes that it is reasonable to exercise its NEPA authority to reject license renewal applications only when it has determined that the impacts of license renewal sufficiently exceed the impacts of all or almost all of the alternatives that preserving the option of license renewal for future decision makers would be unreasonable. Because the objectives of the utility and State decisionmakers will ultimately be the determining factors in whether a nuclear power plant will continue to operate, NRC's proposed decision standard is appropriate. The decision standard will not affect the scope or rigor of NRC's analyses, including the consideration of the environmental impacts relevant to the license renewal decision and associated alternatives. The NRC staff believes that, under the circumstances, the decision standard does not place ''a weighty and improper burden of proof'' on other alternatives as CEQ claims.

With respect to the industry's desire to eliminate consideration of alternative energy sources, the Commission does not agree. The Commission does not support the views of NEI and others that alternative energy sources need not be considered in the environmental review for license renewal. The Commission is not prepared to state that no nuclear power plant will fall well outside the range of other reasonably available alternatives far in advance of an actual relicensing decision. Following NEI's suggestion would not lead to a meaningful set of alternatives with which to compare a proposed action. The Commission has always held the view that alternative sources of energy should be compared with license renewal and continued operation of a nuclear power plant.

Lastly, the Commission does not believe it is necessary to reissue this rule for public comment as a State commenter requested. The Commission has taken many measures to involve the public concerning the resolution of public comments on the proposed rule. The Commission has conducted a number of public meetings and published for public comment its recommended procedural revisions to the proposed rule. The Commission believes that modifications made to the proposed rule reflect the logical outgrowth of the proposed rule based on the public comments received by the Commission.

C. Technical Concerns

1. Category and Impact Magnitude Definitions

Concerns. Many commenters expressed concern that the category definitions and the impact-significance definitions were ambiguous and appeared somewhat interconnected. The EPA expressed concern that mitigation of adverse impacts was not addressed adequately.

Commenters expressed a number of concerns about the use of the applicability categories and the magnitude-level categories. With respect to the applicability categories, concerns ranged from a general concern that Category 1 precludes or hinders public involvement in an issue at the time of the plant-specific review to specific concerns about the technical adequacy of the analysis supporting a Category 1 finding for an issue. Several commenters believed that the definitions create confusion, especially as to whether the finding of small impact and Category 1 are interdependent. The GEIS appears to use Category 1 and ''small'' interchangeably. Concern was also expressed that the requirement to consider mitigative actions was inadequately addressed in the draft GEIS and proposed rule.

Response. To reduce potential confusion over the definitions, the use of the categories, and the treatment of mitigation within the context of the categorization scheme, the NRC has revised the definitions to eliminate any ambiguity as to how they are used. Further, the GEIS has been modified to clearly state the reasons behind the category and magnitude findings.

In order to facilitate understanding of the modifications to the GEIS, the previous approach is discussed as follows. In the proposed rule and the draft GEIS, findings about the environmental impact associated with each issue were divided into three categories of applicability to individual plant reviews. These categories were:

- Category 1: A generic conclusion on the impact has been reached for all affected nuclear power plants.
- Category 2: A generic conclusion on the impact has been reached for affected nuclear power plants that fall within defined bounds.
- Category 3: A generic conclusion on the impact was not reached for any affected nuclear power plants.

The significance of the magnitude of the impact for each issue was expressed as one of the three following levels.

- *Small* impacts are so minor that they warrant neither detailed investigation nor consideration of mitigative actions when such impacts are negative.
- *Moderate* impacts are likely to be clearly evident and usually warrant consideration of mitigation alternatives when such impacts are negative.
- *Large* impacts involve either a severe penalty or a major benefit, and mitigation alternatives are always considered when such impacts are negative.

With respect to the categories of applicability, under the proposed rule applicants would have:

(1) Not provided additional analyses of Category 1 issues;

(2) Not provided additional analyses if their plant falls within the bounds

defined in the rule for a Category 2 issue;

(3) Provided additional plant-specific analyses if their plant does not fall within the bounds defined in the rule for a Category 2 issue; and

(4) Provided plant-specific analyses of Category 3 issues.

In order to address the comments on these magnitude and category definitions, the GEIS has been modified to clearly state the reasons behind the category and magnitude findings.

The revised definitions are listed below.

• Category 1: For the issue, the analysis reported in the Generic Environmental Impact Statement has shown:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristic;

(2) A single significance level (i.e., small, moderate, or large) has been assigned to the impacts (except for collective off site radiological impacts from the fuel cycle and from high level waste and spent fuel disposal); and

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

The generic analysis of the issue may be adopted in each plant-specific review. Issues for which the impact was found to be favorable were also defined to be Category 1 issues.

• Category 2: For the issue, the analysis reported in the GEIS has shown that one or more of the criteria of Category 1 cannot be met and, therefore, additional plant-specific review is required.

If, for an environmental issue, the three Category 1 criteria apply to all plants, that issue is Category 1 and the generic analysis should be used in a license renewal review for all plant applications. If the three Category 1 criteria apply to a subset of plants that are readily defined by a common plant characteristic, notably the type of cooling system, the population of plants is partitioned into the set of plants with the characteristic and the set without the characteristic. For the set of plants with the characteristic, the issue is Category 1 and the generic analysis should be used in the license renewal review for those plants. For the set of plants without the characteristic, the issue is Category 2 and a site-specific analysis for that issue will be performed as part of the license renewal review. The review of a Category 2 issue may focus on the particular aspect of the issue that causes the Category 1 criteria not to be met. For example, severe accident mitigation under the issue ''severe accidents'' is the focus for a plant-specific review because the other aspects of the issue, specifically the offsite consequences, have been adequately addressed in the GEIS. With the revised definitions, the two issues previously designated as Category 3 are now designated Category 2. For an issue to be a Category 1, current mitigation practices and the nature of the impact were considered and a determination was made that it is unlikely that additional measures will be sufficiently beneficial. In the GEIS, in discussing the impacts for each issue, consideration was given to what is known about current mitigation practices.

The definitions of the significance level of an environmental impact have been revised to make the consideration of the potential for mitigating an impact separate from the analysis leading to a conclusion about the significance level of the impact. Further, the significance level of an impact is now more clearly tied to sustaining specific attributes of the affected resource that are important to its viability, health or usefulness. General definitions of small, moderate and large significance levels are given below. These definitions are adapted to accommodate the resource attributes of importance for each of the environmental issues in the GEIS. The definition of ''small'' clarifies the meaning of the term as it applies to radiological impacts. The definition of ''small'' in the proposed rule did not logically apply to such impacts.

The general definitions of significance level are:

• Small: For the issue, environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource. For the purposes of assessing radiological impacts, the Commission has concluded that those impacts that do not exceed permissible levels in the Commission's regulations are considered small.

• Moderate: For the issue, environmental effects are sufficient to alter noticeably but not to destabilize important attributes of the resource.

• Large: For the issue, environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

The discussion of each environmental issue in the GEIS includes an explanation of how the significance category was determined. For issues in which probability of occurrence is a key consideration (i.e., accident consequences), the probability of occurrence has been factored into the determination of significance. The determination of the significance category was made independently of the consideration of the potential benefit of additional mitigation.

The major concerns (organized by topical areas) about the environmental issues examined in the draft GEIS and the NRC staff's response to those concerns are summarized next.

2. Surface Water Quality

Concern. Several commenters expressed concerns related to the National Pollutant Discharge Elimination System (NPDES) permitting process for surface water discharge. They believe that the NRC may have overlooked its legal obligation to comply with Section 401 of the Clean Water Act (CWA). Their recommendations included withholding approval for license renewal until a facility has complied with Section 401 and treating license renewal as an opportunity for a new NEPA review. On the other hand, other commenters recommended decoupling the NRC relicensing process from the NPDES permitting process.

Response. In issuing individual license renewals, the Commission will comply, as has been its practice, with the provisions of Section 401 of the Federal Water Pollution Control Act (see 10 CFR 51.45(d) and 51.71(c)). In addition, pursuant to Section 511(c) of the Federal Water Pollution Control Act of 1972, the Commission cannot question or reexamine the effluent limitations or other requirements in permits issued by the relevant permitting authorities. Nevertheless, compliance with the environmental quality standards and requirements of these permits does not negate the requirement for the Commission to consider all environmental effects of the proposed action. Accordingly, the Commission has not only taken existing permits into account in its analysis of the water quality impacts of license renewal but has also considered information on actual operating impacts collected from individual plants, State and Federal regulatory agencies, and published literature. As a result of this analysis, the Commission has concluded that the environmental impacts on surface water quality are small for those effluents subject to existing permit or certification requirements. A total decoupling of the license renewal process and the NPDES permitting process is not appropriate because, for issues with incomplete Clean Water Act determinations, the NRC cannot complete its weighing and balancing of impacts without independently addressing the issues.

Concern. Several commenters raised concerns that various issues within the Surface Water Quality topic should be Category 2 or 3 issues. These included water use conflicts as experienced in Arizona and the Midwest, thermal stratification and salinity gradients associated with once-through cooling systems, and the toxicity of biofouling compounds.

Response. Regarding the water use conflicts, the NRC has considered the impacts of water use during the renewal period and has concluded that these impacts are small for plants with a once-through cooling system and that this is a Category 1 issue for those plants. However, this issue is designated Category 2 for plants with cooling towers and cooling ponds because, for those plants, the impacts might be moderate (they could also be small). In either case, pursuant to 10 CFR 51.45(d), an applicant for license renewal must identify and indicate in its environmental report the status of State and local approvals regarding water use issues. For those reactor sites where thermal stratification or salinity gradient was found to be the most pronounced, the issues were reviewed during preparation of the GEIS and found to be acceptable by the States within the NPDES process. No change in the categorization in the GEIS would be required. Similarly, the NPDES permit for a facility establishes allowable discharges, including biocides. The NRC has no indication that residual environmental impacts would occur as a result of license renewal activities at any nuclear plant site other than perhaps water use conflicts arising at plants with cooling ponds or cooling towers using make-up water from a small river with low flow. For those plants, this issue is Category 2.

3. Aquatic Ecology

Concern. A number of comments regarding the ecological impact of cooling water withdrawal from aquatic bodies were received. Specific concerns included fish kills associated with the entrainment and impingement of fish within once-through and cooling pond cooling systems, the use of chlorine and molluscicides to control mussel and clam growth, and the long-term effects of heavy metal discharges from plants with copper-nickel condenser tubes. Another commenter noted that license extension affords the opportunity to review the intake and discharge configuration of plant cooling water systems, since the best available technology that is economically available may be different given the additional 20 years of plant operating life.

Response. The Commission has considered the impacts of license renewal on aquatic ecology and, in doing so, has reviewed existing NPDES permits and other information. Based on this analysis, the Commission has concluded that these impacts are small with the exception that plants with once-through cooling and cooling ponds may have larger effects associated with entrainment of fish and shellfish in early life stages, impingement, and heat shock. Agencies responsible for existing permits are not constrained from reexamining the permit issues if they have reason to believe that the basis for their issuance is no longer valid. The Commission does not have authority under NEPA to impose an effluent limitation other than those established in permits issued pursuant to the Clean Water Act. The problem of the long-term effects of heavy metal discharges from plants with copper-nickel condenser tubes has been found at only one plant. The affected condenser tubes have been replaced with tubing of a more corrosion-resistant material.

Concern. A commenter pointed out that the issue of riparian zones should be addressed in the GEIS because the vegetation region along a water course can be affected by water withdrawal and is important in maintaining the habitat.

Response. The NRC agrees with the importance of addressing the impacts of license renewal on the riparian habitat. The final GEIS provides a discussion of the riparian habitat as an important resource and the potential effects of consumptive water use on riparian zones.

4. Groundwater Use and Quality

Concern. Several commenters indicated that groundwater issues should be reviewed on a site-specific basis because of groundwater use conflicts (in particular, the effect on aquifer recharge of using surface water for cooling water), opportunities for saltwater intrusion, and concerns over tritium found in wells at one site. On the other hand, a commenter requested that the issue of groundwater use for cooling tower makeup water be changed from Category 2 to Category 1 because the issue is based solely on data from Ranney wells at the Grand Gulf Nuclear Station, where tests have shown that the elevation of the water plain around Grand Gulf is not dropping.

Response. Based on consideration of comments, the issue of groundwater use conflicts resulting from surface water withdrawals for cooling tower makeup water or cooling ponds is now Category 2 for plants withdrawing surface water from small water bodies during low flow conditions. The GEIS has identified a potential reduction in aquifer recharge as a result of competing water use. These conflicts are already a concern at two closed-cycle nuclear power plants. The NRC does not agree that saltwater intrusion should be considered a Category 2 issue. When saltwater intrusion has been a problem, the major cause has been the large consumption of groundwater by agricultural and municipal users. Groundwater consumption by nuclear power plants is small by comparison and does not contribute significantly to the saltwater intrusion problem. With regard to traces of tritium found in the groundwater at one nuclear power plant, the tritium was attributed to a modification in the plant's inlet and discharge canal that did not take into consideration a unique situation in topology and groundwater flow. The releases were minor and the situation has been corrected.

Regarding the issue of the use of groundwater for cooling water makeup, the NRC has designated this issue as Category 2 even though only the Grand Gulf Nuclear Station is currently using Ranney wells to withdraw groundwater. This water intake does not conflict with other groundwater uses in the area. It is not possible to predict whether or not water use conflicts will occur at the Grand Gulf facility in the future. It is also not possible to determine the significance of the environmental impacts associated with Ranney well use at other nuclear plants that may choose to adopt this method in the future.

5. Terrestrial Ecology

Concern. Several commenters recommended that the issue of bird mortality resulting from collisions with transmission lines, towers, or cooling towers be characterized as a Category 2 issue. Such a characterization would provide for a review of mitigation at those plants with cooling towers that do not have illumination and for power plant transmission lines that transect major flyways or that cross wetlands used by large concentrations of birds.

Response. The NRC does not agree with this recommendation. The GEIS cites several studies that conclude that bird mortalities resulting from collision with transmission lines, towers, or cooling towers are not significantly reducing bird populations. Mitigation measures in place, such as safety lights, were found adequate and additional measures were not warranted. Therefore, the issue remains a Category 1 issue because refurbishment will not involve construction of any additional transmission lines or natural draft cooling towers.

Concern. One commenter expressed concern that the GEIS analysis of land use did not adequately encompass the impact of onsite spent fuel storage on land use and that the Category 1 finding is questionable. A specific concern was the potential need for the construction of additional spent fuel storage facilities associated with the license renewal term, along with their associated impacts on the terrestrial environment.

Response. The NRC does not agree that there is a need to change the Category 1 determination for onsite land use. Waste management operations could require the construction of additional storage facilities and thus adversely affect land use and terrestrial ecology. However, experience has shown that the land requirements would be relatively small (less than 9 acres), impacts to land use and terrestrial ecology would also be relatively small, and the land that may be used is already possessed by the applicant; thus, its basic use would not be altered. Onsite land use is Category 1. Terrestrial ecology with disturbance of sensitive habitat is treated as a separate issue and is Category 2.

6. Human Health

Concern. In the human health section of the GEIS, the radiological impacts of plant refurbishment and continued operations during the license renewal term to workers and the general public were examined. Several commenters indicated that it was inappropriate to compare the radiation exposures associated with license renewal to natural background levels. These commenters believed that the appropriate argument should be that the risks associated with the additional exposures are so small that no additional mitigative measures are required.

Response. The NRC agrees that the assessment of radiation exposure should not be simply a comparison with background radiation. In response to comments on the draft generic environmental impact statement and the proposed rule, the standard defining a small radiological impact has changed from a comparison with background radiation to sustained compliance with the dose and release limits applicable to the various stages of the fuel cycle. This change is appropriate and strengthens the criterion used to define a small environmental impact for the reasons that follow. The Atomic Energy Act requires the Nuclear Regulatory Commission to promulgate, inspect and enforce standards that provide an adequate level of protection of the public health and safety and the environment. The implementation of these regulatory programs provides a margin of safety. A review of the regulatory requirements and the performance of facilities provides the bases to project continuation of performance within regulatory standards. For the purposes of assessing radiological impacts, the Commission has concluded that impacts are of small significance if doses to individuals and releases do not exceed the permissible levels in the Commission's regulations.

With respect to whether additional mitigative measures are required, it should be noted that in 10 CFR parts 20 and 50 there are provisions that radiological impacts associated with plant operation be reduced to levels as low as reasonably achievable (ALARA).

Concern. Several commenters indicated that the GEIS needs a broader treatment of uncertainty as it relates to human health issues.

Response. The NRC agrees that there is considerable uncertainty associated with health effects, especially at low occupational and public dose levels, and particularly with respect to electromagnetic fields. Health effect estimates from radiation exposures are based on the best scientific evidence available and are considered to be conservative estimates. Several sections of the GEIS have been expanded to more thoroughly explain how predicted impacts could be affected by changes in scientific information or standards.

Concern. One commenter indicated that, in the GEIS and the proposed rule, risk coefficients should have been used for chemicals and radiation to obtain upper bound risk estimates of cancer incidence.

Response. The NRC does not agree with this comment. In making comparisons of alternatives, comparisons of the central or best estimates of impacts are consistent with NEPA requirements because they provide the fairest determination. The GEIS is written using current, Commission-approved risk estimators.

Concern. Two commenters expressed concern regarding the GEIS conclusion that the impact of radiation exposure to the public is small, citing a study done by the Massachusetts Department of Public Health (MDPH). This study concluded that adults who live within 10 miles of the Pilgrim Nuclear Power Plant have a risk of contracting leukemia four times greater than other individuals.

Response. The NRC staff reviewed the MDHP study and compared it with various other studies. The results of the study have been contradicted by a National Cancer Institute (NCI) study entitled ''Cancer in Populations Living Near Nuclear Facilities'' (July 1990). The NCI study, which included the Pilgrim plant in its analysis, found no reason to suggest that nuclear facilities may be linked causally with excess deaths from leukemia or from other cancers. The findings of the NCI study are consistent with the findings of several similar epidemiological studies in foreign countries and with the latest conclusions of expert bodies such as the National Research Council's Committee on the Biological Effects of Ionizing Radiation. The NRC continues to base its assessment of the health effects of ionizing radiation on the overall body of scientific knowledge and on the recommendations of expert groups.

7. Socioeconomics

Concern. A commenter concerned with historic preservation pointed out that this issue must be addressed through compliance with the National Historic Preservation Act (NHPA) and cannot be resolved generically.

Response. The NRC agrees with this comment. Historical and archaeological impacts have been changed from a Category 1 to a Category 2 issue (that is, it must be evaluated site-specifically). Consultation with State historical preservation offices and other Government agencies, as required by NHPA, must be undertaken to determine whether protected historical or archaeological resources are in areas that might be disturbed during refurbishment activities and operation during the renewal period.

Concern. Several commenters indicated that transportation issues associated with refurbishment activities should be changed from Category 3 to Category 2 because the impacts will be insignificant in the majority of cases. One recommendation was to use a level of service (LOS) determination for specific plants as the bounding criterion. The analysis would require that LOS be determined for that part of the refurbishment period during which traffic not related to the plant is expected to be the heaviest. Another recommendation was to establish bounding criteria based on past major routine outages.

Response. The NRC agrees that use of the LOS approach may prove to be acceptable. Transportation still must be reviewed on a plant-specific basis, that is, it is a Category 2 issue (based on the revised definition).

Concern. There were recommendations to make the housing impacts during refurbishment a Category 1 issue instead of Category 2. One commenter noted that the construction period data used in the analysis appears to overestimate the impact on housing.

Response. The NRC does not agree that this should be a Category 1 issue. Although negligible housing impacts are anticipated for most license renewals, significant housing impacts have occurred during a periodic plant outage at one of the case plants studied for the analysis. This issue is now a Category 2 issue because moderate and large impacts on housing are possible depending on local conditions (e.g., areas with extremely slow population growth or areas with growth control measures that limit housing development).

8. The Uranium Fuel Cycle and Solid Waste Management

Concern. Wide-ranging concerns were expressed in the comments on the proposed rule and the draft GEIS about the treatment of storage and disposal of low-level waste (LLW), mixed waste, spent fuel, nonradiological waste, and the transportation of fuel and waste to and from nuclear power plants as a consequence of license renewal. Concern was expressed about the uncertain availability of disposal facilities for LLW, mixed waste, and spent fuel; the prospect of generation and onsite storage of an additional 20 years output of waste; and the resulting pressure that would be put on the States to provide LLW disposal facilities. Various commenters expressed concern about the adequacy of the treatment of the cost of waste management and the implications for the economic viability of license renewal. Numerous comments were provided on updating and clarifying data on waste management presented in the draft GEIS. Finally, various questions were raised about the applicability of Table S–3 (10 CFR 51.51 Uranium fuel cycle environmental data—Table S–3, Table of Uranium Fuel Cycle Environmental Data) to the management of waste generated as a result of license renewal.

With regard to spent fuel, several commenters expressed concern that dry cask storage is not a proven technology and that onsite storage of spent fuel from an additional 20 years of plant operation will present environmental and safety problems. Therefore, onsite storage of spent fuel should be considered on a site-specific basis within a plant license renewal review.

Response. The Commission acknowledges that there is uncertainty in the schedule of availability of disposal facilities for LLW, mixed waste, and spent fuel. However, the Commission believes that there is sufficient understanding of and experience with the storage of LLW, mixed waste, and spent fuel to conclude that the waste generated at any plant as a result of license renewal can be stored safely and without significant environmental impacts before permanent disposal. In addition, the Commission concluded that the classification of storage and ultimate disposal as a Category 1 issue is appropriate because States are proceeding, albeit slowly, with the development of new disposal facilities; LLW and mixed waste have been and can be safely stored at reactor sites until new disposal capacity becomes available. Analyses to support this conclusion are presented in Chapter 6 of the final GEIS (NUREG–1437). The following summary of the responses to comments emphasizes the main features of these analyses.

In the draft GEIS, the environmental data in Table S–3 were discussed with respect to applicability during the license renewal period and supplemented with an analysis of the radiological release and dose commitment data for radon-222 and technetium-99. The proposed rule would have had this discussion apply to each plant at the time of its review for license renewal.

Further, in the draft GEIS, Chapter 6, ''Solid Waste Management,'' covered the generation of LLW, mixed waste, spent fuel, and nonradiological waste as a result of license renewal; the transportation of the radiological waste; and the environmental impacts of waste management, including storage and disposal. The findings that were to have been codified in the rule were that, for nonradiological waste, mixed waste, spent fuel, and transportation, the environmental impacts are of small significance and that the analysis in the GEIS applies to each plant (Category 1). For LLW, the finding that would have been codified in the rule was that, if an applicant does not have access to a low-level radioactive waste disposal facility through a low-level waste compact or an unaffiliated State, the applicant must present plans for interim waste storage with an assessment of potential ecological habitat destruction caused by construction activities (Category 2).

In response to the questions about the applicability of Table S–3 to the management of waste associated with license renewal and to the various comments challenging the treatment of the several forms of waste in the draft GEIS and in the proposed rule, the discussion of Table S–3 has been moved from Section 4.8 of the draft GEIS to Chapter 6 of the final GEIS in order to provide a more integrated assessment of the environmental impacts associated with waste management as a consequence of license renewal. Also in response to various comments, the discussion of Table S–3 and of each of the types of waste has been expanded.

Supplemental data are presented in Chapter 6 of the final GEIS in order to extend the coverage of the environmental impacts of the uranium fuel cycle presented in the current Table S–3 and of transportation of radioactive waste presented in the current Table S–4 to radon-222, technetium-99, higher fuel enrichment, and higher fuel burnup. In part, the current Table S–3 and the data supplementing it cover environmental impacts of:

(1) Onsite storage of spent fuel assemblies in pools for 10 years, packaging and transportation to a Federal repository, and permanent disposal; and

(2) Short-term storage onsite of LLW, packaging and transportation to a land-burial facility, and permanent disposal.

The following conclusions have been drawn with regard to the environmental impacts associated with the uranium fuel cycle.

The radiological and nonradiological environmental impacts of the uranium fuel cycle have been reviewed. The review included a discussion of the values presented in Table S–3, an assessment of the release and impact of ^{222}Rn and of ^{99}Tc, and a review of the regulatory standards and experience of fuel cycle facilities. For the purpose of assessing the radiological impacts of license renewal the Commission uses the standard that the impacts are of small significance if doses and releases do not exceed permissible levels in the Commission's regulations. Given the available information regarding the compliance of fuel cycle facilities with applicable regulatory requirements, the Commission has concluded that, other than for the disposal of spent fuel and high-level waste, these impacts on individuals from radioactive gaseous and liquid releases will remain at or below the Commission's regulatory limits. Accordingly, the Commission concludes that offsite radiological impacts of the fuel cycle (individual effects from other than the disposal of spent fuel and high-level waste) are small. ALARA efforts will continue to apply to fuel cycle activities. This is a Category 1 issue.

The radiological impacts of the uranium fuel cycle on human populations over time (collective effects) have been considered within the framework of Table S–3. The 100 year environmental dose commitment to the U.S. population from the fuel cycle, high level waste and spent fuel disposal excepted, is calculated to be about 14,800 man-rem, or 12 cancer fatalities, for each additional 20 year power reactor operating term. Much of this, especially the contribution of radon releases from mines and tailing piles, consists of tiny doses summed over large populations. This same dose calculation can theoretically be extended to include many tiny doses over additional thousands of years as well as doses outside the U.S. The result of such a calculation would be thousands of cancer fatalities from the fuel cycle, but this result assumes that even tiny doses have some statistical adverse health effect which will not ever be mitigated (for example no cancer cure in the next thousand years), and that these dose projections over thousands of years are meaningful. However these assumptions are questionable. In particular, science cannot rule out the possibility that there will be no cancer fatalities from these tiny doses. For perspective, the doses are very small fractions of regulatory limits, and even smaller fractions of natural background exposure to the same populations. No standards exist that can be used to reach a conclusion as to the significance of the magnitude of the collective radiological effects. Nevertheless, some judgement as to the regulatory NEPA implication of this issue should be made and it makes no sense to repeat the same judgement in every case. The Commission concludes that these impacts are acceptable in that these impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR part 54 should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the collective effects of the fuel cycle, this issue is considered Category 1. For other Category 1 issues, the impacts will be considered at the individual renewal stage as a means of judging the total impact of an individual license renewal decision. However, the Commission has already judged the impact of collective effects of the fuel cycle as part of this rule.

There are no current regulatory limits for off-site releases of radionuclides for the current candidate repository site. However if we assume that limits are developed along the lines of the 1995 National Academy of Sciences (NAS) report, and that in accordance with the Commission's Waste Confidence Decision, a repository can and likely will be developed at some site which will comply with such limits, peak doses to virtually all individuals will be 100 millirem per year or less. However, while the Commission has reasonable confidence that these assumptions will prove correct there is considerable uncertainty since the limits are yet to be developed, no repository application has been completed or reviewed, and uncertainty is inherent in the models used to evaluate possible pathways to the human environment. The National Academy report indicated that 100 millirem per year should be considered as a starting point for limits for individual doses, but notes that some measure of consensus exists among national and international bodies that the limits should be a fraction of the 100 millirem per year. The lifetime individual risk from 100 millirem per year dose limit is about 3×10^{-3}. Doses to populations from disposal cannot now (or possibly ever) be estimated without very great uncertainty. Estimating cumulative doses to populations over thousands of years is more problematic. The likelihood and consequences of events that could seriously compromise the integrity of a deep geologic repository were evaluated by the Department of Energy in the ''Final Environmental Impact Statement: Management of Commercially Generated Radioactive Waste,'' October 1980. The evaluation estimated the 70-year whole-body dose commitment to the maximum individual and to the regional population resulting from several modes of breaching a reference repository in the year of closure, after 1,000 years, after 100,000 years, and after 100,000,000 years. The release scenarios covered a wide range of consequences from the limited consequences of humans accidentally drilling into a waste package in the repository to the catastrophic release of the repository inventory by a direct meteor strike. Subsequently, the NRC and other Federal agencies have expended considerable effort to develop models for the design and for the licensing of a high level waste repository, especially for the candidate repository at Yucca Mountain. More meaningful estimates of doses to population may be possible in the future as more is understood about the performance of the proposed Yucca Mountain repository. Such estimates would involve very great uncertainty, especially with respect to cumulative population doses over thousands of years. The standard proposed by the NAS is a limit on maximum individual dose. The relationship of potential new regulatory requirements, based on the NAS report, and cumulative population impacts has not been determined, although the report articulates the view that protection of individuals will adequately protect the population for a repository at Yucca Mountain. However, EPA's generic repository standards in 40 CFR part 191 generally provide an indication of the order of magnitude of cumulative risk to population that could result from the licensing of a Yucca Mountain repository, assuming the ultimate standards will be within the range of standards now under consideration. The standard in 40 CFR part 191 protects the population by imposing ''containment requirements'' that limit the cumulative amount of radioactive material released over 10,000 years. The cumulative release limits are based on EPA's population impact goal of 1,000 premature cancer deaths world-wide for a 100,000 metric tonne (MTHM) repository.

Nevertheless, despite all the uncertainty surrounding the effects of the disposal of spent fuel and high-level waste, some judgement as to the regulatory NEPA implications of these matters should be made and it makes no sense to repeat the same judgement in every case. Even taking the uncertainties into account, the Commission concludes that these impacts are acceptable in that these impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR part 54 should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the impacts of spent fuel and high-level waste disposal, this issue is considered Category 1. Excepting the collective effects previously discussed, for other Category 1 issues, the impacts will be considered at the individual renewal stage as a means of judging the total impact of an individual license renewal decision. However, the Commission has already judged the impacts of high level waste disposal as part of this rule.

With respect to the nonradiological impact of the uranium fuel cycle, data concerning land requirements, water requirements, the use of fossil fuel, gaseous effluent, liquid effluent, and tailings solutions and solids, all listed in Table S–3, have been reviewed to determine the significance of the environmental impacts of a power reactor operating an additional 20 years. The nonradiological impacts attributable to the relicensing of an individual power reactor are found to be of small significance. License renewal of an individual plant is so indirectly connected to the operation of fuel cycle facilities that it is meaningless to address the mitigation of impacts identified above. This is a Category 1 issue.

Table S–3 does not take into account long-term onsite storage of LLW, mixed waste, and storage of spent fuel assemblies onsite for longer than 10 years, nor does it take into account impacts from mixed waste disposal. The environmental impacts of these aspects of onsite storage are also addressed in Chapter 6 of the final GEIS and the findings are included in the final rule in Table B–1 of appendix B to 10 CFR part 51.

Chapter 6 of the GEIS discusses the impacts of offsite disposal of LLW and mixed waste and concludes that impacts will be small. The conclusion that impacts will be small is based on the regulations and regulatory programs in place (e.g., 10 CFR part 61 for LLW and 40 CFR parts 261, 264, and 268 for hazardous waste), experience with existing sites, and the expectation that NRC, EPA, and the States will ensure that disposal will occur in compliance with the applicable regulations.

The Low-Level Radioactive Waste Policy Act of 1980 (LLRWPA) made the States responsible for the disposal of commercially generated LLW. At present, 9 compacts have been formed, representing 42 States. The Texas Compact (Texas, Maine, and Vermont) is pending before the U.S. Congress.

New LLW disposal facilities in the host States of California, North Carolina, and Texas are forecast to be operational between 1997 and 1998. Facilities in the host States of Connecticut, Illinois, Massachusetts, Nebraska, New Jersey, Pennsylvania, and New York are scheduled for operation between 1999 and 2002. Envirocare, in Utah, takes limited types of waste from certain generators.

There are uncertainties in the licensing process and in the length of time needed to resolve technical issues, but in NRC's view there are no unsolvable technical issues that will inevitably preclude successful development of new sites or other off-site disposal capacity for LLW by the time they will be needed. For example, in California, the proposed Ward Valley LLW disposal facility was unexpectedly delayed by the need to resolve technical issues raised by several scientists independent of the project after the license was issued. These issues were recently reviewed and largely resolved by an independent review group. In North Carolina, Texas, and Nebraska, the license application review period has been longer than is required by the LLRWPA, but progress continues to be made.

The State's LLW responsibilities include providing disposal capacity for mixed LLW. Mixed waste disposal facility developers face the same types of challenges as LLW site developers plus difficulties with dual regulation and small volumes. However, in NRC's view there are no technical reasons why offsite disposal capacity for all types of mixed waste should not become available when needed. NRC and EPA have developed guidance on the siting of mixed waste disposal facilities as well as a conceptual design for a mixed waste disposal facility. A disposal facility for certain types of mixed waste is operated by Envirocare in Utah. States have begun discussions with DOE about accepting commercial mixed waste for treatment and disposal at DOE facilities. Although these discussions have yet to result in DOE accepting commercial mixed waste at DOE facilities, it appears that progress is being made toward DOE's eventual acceptance of some portion of commercial mixed waste at its facilities.

While the NRC understands that there have been delays and that uncertainties exist such as those just discussed, the Commission concludes that there is reasonable assurance that sufficient LLW and mixed LLW disposal capacity will be made available when needed so that facilities can be decommissioned consistent with NRC decommissioning requirements. This conclusion, coupled with the expected small impacts from both storage and disposal justify classification of LLW and mixed waste disposal as Category 1 issues.

The GEIS addresses the matter of extended onsite storage of both LLW and mixed waste from refurbishment and operations for a renewal period of up to 20 years. Summary data are provided and radiological and nonradiological environmental impacts are addressed. The analysis considers:

(1) The volumes of LLW and mixed waste that may be generated from license renewal;

(2) Specific requirements under the existing regulatory framework;

(3) The effectiveness of the regulations in maintaining low average doses to members of the public and to workers; and

(4) Nonradiological impacts, including land use, fugitive dust, air quality, erosion, sedimentation, and disturbance of ecosystems.

In addition, under 10 CFR 50.59, licensees are allowed to make changes to their facilities as discussed in the final safety analysis report without NRC permission if the evaluation indicates that a change in the technical specifications is not required or that an unreviewed safety question does not exist. Licensees would have to ensure that any new LLW activities would not represent an unreviewed safety question for routine operations or for conditions that might arise from potential accidents. Both onsite and offsite impacts would have to be considered. If a LLW or mixed waste activity fails either of the two tests in 10 CFR 50.59, a license amendment is required. Subject to the two possible review requirements just noted, the Commission finds that continued onsite storage of both LLW and mixed waste resulting from license renewal will have small environmental impacts and will require no further review within the license renewal proceeding.

The GEIS addresses extended onsite storage of spent fuel during a renewal period of up to 20 years. The Commission has studied the safety and environmental effects of the temporary storage of spent fuel after cessation of reactor operation and has published a generic determination of no significant environmental impact (10 CFR 51.23). The environmental data on storing spent fuel onsite in a fuel pool for 10 years before shipping for offsite disposal have been assessed and reported in NUREG–0116, ''The Environmental Survey of the Reprocessing and Waste Management Portions of the LWR Fuel Cycle'' (October 1976), and published in the Commission's regulations (10 CFR 51.51). Environmental assessments (EA) for expanding the fuel pool storage capacity have been conducted for numerous plants. In each case, a finding of no significant environmental impact was reached.

Radioactive exposures, waste generation, and releases were evaluated and found to be small. The only nonradiological effluent from waste storage is additional heat from the plant that was found to have a negligible effect on the environment. Accidents were evaluated and were found to have insignificant effects on the environment. Dry cask storage at an independent spent fuel storage installation (ISFSI) is another technology used to store under a general license. The environmental impacts of allowing onsite dry cask storage under a general license were assessed in an EA and found to be insignificant. Further, the Commission has conducted EAs for seven specific licensed ISFSIs and has reached a finding of no significant environmental impact for each site. Each EA addressed the impacts of construction, use, and decommissioning. Potential impacts that were assessed include radiological impacts, land use, terrestrial resources, water use, aquatic resources, noise, air quality, socioeconomics, radiological impacts during construction and routine operation, and radiological impacts of off-normal events and accidents. Trends in onsite spent fuel storage capacity and the volume of spent fuel that will be generated during an additional 20 years of operation are considered in the GEIS. Spent fuel storage capacity requirements can be adequately met by ISFSIs without significant environmental impacts. The environmental impacts of onsite storage of spent fuel at all plants have been adequately assessed in the GEIS for the purposes of an environmental review and agency decision on renewal of an operating license; thus, no further review within the license renewal proceeding is required. This provision is relative to the license renewal decision and does not alter existing Commission licensing requirements specific to on-site storage of spent fuel.

The environmental impacts from the transportation of fuel and waste attributable to license renewal are found to be small when they are within the range of impacts of parameters identified in Table S–4. The estimated radiological effects are within regulatory standards. The nonradiological impacts are those from periodic shipments of fuel and waste by individual trucks or rail cars and thus would result in infrequent and localized minor contributions to traffic density. Programs designed to further reduce risk, which are already in place, provide for adequate mitigation. Recent, ongoing efforts by the Department of Energy to study the impacts of waste transportation in the context of the multi-purpose canister (see, 60 FR 45147, August 30, 1995) suggest that there may be unresolved issues regarding the magnitude of cumulative impacts from the use of a single rail line or truck route in the vicinity of the repository to carry all spent fuel from all plants. Accordingly, NRC declines to reach a Category 1 conclusion on this issue at this time. Table S–4 should continue to be the basis for case-by-case evaluation of transportation impacts of fuel and waste until such time as a detailed analysis of the environmental impacts of transportation to the proposed repository at Yucca Mountain becomes available.

9. Accidents

Concern. Several commenters expressed concerns regarding the appropriateness of the severe accident determination in the GEIS and with the treatment of severe accident mitigation design alternatives (SAMDAs) for license renewal. A group of commenters identified areas of concern that they believe justify severe accidents being classified as a Category 3 issue. The areas included seismic risks to nuclear power plants and site-specific evacuation risks. Several commenters questioned whether the analyses of the environmental impacts of accidents were adequate to make a Category 1 determination for the issue of severe accidents. The contention is that a bounding analysis would be established only if plant-specific analyses were performed for every plant, which was not the case. Instead, the GEIS analysis made use of a single generic source term for each of the two plant types.

Response. The Commission believes that its analysis of the impacts of severe accidents is appropriate. The GEIS provides an analysis of the consequences of severe accidents for each site in the country. The analysis adopts standard assumptions about each site for parameters such as evacuation speeds and distances traveled, and uses site-specific estimates for parameters such as population distribution and meteorological conditions. These latter two factors were used to evaluate the exposure indices for these analyses. The methods used result in predictions of risk that are adequate to illustrate the general magnitude and types of risks that may occur from reactor accidents. Regarding site-evacuation risk, the radiological risk to persons as they evacuate is taken into account within the individual plant risk assessments that form the basis for the GEIS. In addition, 10 CFR Part 50 requires that licensees maintain up-to-date emergency plans. This requirement will apply in the license renewal term as well as in the current licensing term.

As was done in the GEIS analysis, the use of generic source terms (one set for PWRs and another for BWRs) is consistent with the past practice that has been used and accepted by the NRC for individual plant Final Environmental Impact Statements (FEISs). The purpose of the source term discussion in the GEIS is to describe whether or not new information on source terms developed after the completion of the most recent FEISs indicates that the source terms used in the past under-predict environmental consequences. The NRC has concluded that analysis of the new source term information developed over the past 10 years indicates that the expected frequency and amounts of radioactive release under severe accident conditions are less than that predicted using the generic source terms. A summary of the evolution of this research is provided in NUREG–1150, ''Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants'' (December 1990), and its supporting documentation. Thus, the analyses performed for the GEIS represent adequate, plant-specific estimates of the impacts from severe accidents that would generally over-predict, rather than under-predict, environmental consequences. Therefore, the GEIS analysis of the impacts of severe accidents for license renewal is retained and is considered applicable to all plants.

Based on an evaluation of the comments, the Commission has reconsidered its previous conclusion in the draft GEIS concerning site-specific consideration of severe accident mitigation. The Commission has determined that a site-specific consideration of alternatives to mitigate severe accidents will be required at the time of license renewal unless a previous consideration of such alternatives regarding plant operation has been included in a final environmental impact statement or a related supplement. Because the third criterion required to make a Category 1 designation for an issue requires a generic consideration of mitigation, the issue of severe accidents must be reclassified as a Category 2 issue that requires a consideration of severe accident mitigation alternatives, provided this consideration has not already been completed. The Commission's reconsideration of the issue of severe accident mitigation for license renewal is based on the Commission's NEPA regulations that require a consideration of mitigation alternatives in its environmental impact statements (EISs) and supplements to EISs, as well as a previous court decision that required a review of severe mitigation alternatives (referred to as SAMDAs) at the operating license stage. See, *Limerick Ecology Action* v. *NRC,* 869 F.2d 719 (3d Cir. 1989).

Although the Commission has considered containment improvements for all plants pursuant to its Containment Performance Improvement (CPI) program, which identified potential containment improvements for site-specific consideration by licensees, and the Commission has additional ongoing regulatory programs whereby licensees search for individual plant vulnerabilities to severe accidents and consider cost-beneficial improvements, these programs have not yet been completed. Therefore, a conclusion that severe accident mitigation has been generically considered for license renewal is premature.

The Commission believes it unlikely that any site-specific consideration of severe accident mitigation alternatives for license renewal will identify major plant design changes or modifications that will prove to be cost-beneficial for reducing severe accident frequency or consequences. This Commission expectation regarding severe accident mitigation improvements is based on the analyses performed to date that are discussed below.

The Commission's CPI program examined each of the five U.S. containment types to determine potential failure modes, potential plant improvements, and the cost-effectivenesses of such improvements. As a result of this program, only a few containment improvements were found to be potentially beneficial and were either identified for further NRC research or for individual licensee evaluation.

In response to the *Limerick* decision, an NRC staff consideration of SAMDAs was specifically included in the Final Environmental Impact Statement for the Limerick 1 and 2 and Comanche Peak 1 and 2 operating license reviews, and in the Watts Bar Supplemental Final Environmental Statement for an operating license. The alternatives evaluated in these analyses included the items previously evaluated as part of the CPI Program, as well as improvements identified through other risk studies and analyses. No physical plant modifications were found to be cost-beneficial in any of these severe accident mitigation considerations. Only plant procedural changes were identified as being cost-beneficial. Furthermore, the Limerick analysis was for a high-population site. Because risk is generally proportional to the population around a plant, this analysis suggests that other sites are unlikely to identify significant plant modifications that are cost-beneficial.

Additionally, each licensee is performing an individual plant examination (IPE) to look for plant vulnerabilities to internally initiated events and a separate IPE for externally initiated events (IPEEE). The licensees were requested to report their results to the Commission. Seventy-eight IPE submittals were received and seventy-five IPEEE submittals will be received, covering all operating plants in the United States. These examinations consider potential improvements to reduce the frequency or consequences of severe accidents on a plant-specific basis and essentially constitute a broad search for severe accident mitigation alternatives. The NRC staff is conducting a process review of each plant-specific IPE submittal and IPEEE submittal. To date, all IPE submittals have received a preliminary review by the NRC with 46 out of 78 completed; for the IPEEE submittals, 24 of the 75 are under review. These IPEs have resulted in a number of plant procedural or programmatic improvements and some plant modifications that will further reduce the risk of severe accidents.

In conclusion, the GEIS analysis of severe accident consequences and risk is adequate, and additional plant-specific analysis of these impacts is not required. However, because the ongoing regulatory program related to severe accident mitigation (i.e., IPE and IPEEE) has not been completed for all plants and consideration of severe accident mitigation alternatives has not been included in an EIS or supplemental EIS related to plant operations for all plants, a site-specific consideration of severe accident mitigation alternatives is required at license renewal for those plants for which this consideration has not been performed. The Commission expects that if these reviews identify any changes as being cost beneficial, such changes generally would be procedural and programmatic fixes, with any hardware changes being only minor in nature and few in number. NRC staff considerations of severe accident mitigation alternatives have already been completed and included in an EIS or supplemental EIS for Limerick, Comanche Peak, and Watts Bar. Therefore, severe accident mitigation alternatives need not be reconsidered for these plants for license renewal.

Based on the fact that a generic consideration of mitigation is not performed in the GEIS, a Category 1 designation for severe accidents cannot be made. Therefore, the Commission has reclassified severe accidents as a Category 2 issue, requiring only that alternatives to mitigate severe accidents be considered for those plants that have not included such a consideration in a previous EIS or supplemental EIS. The Commission notes that upon completion of its IPE/IPEEE program, it may review the issue of severe accident mitigation for license renewal and consider, by separate rulemaking, reclassifying severe accidents as a Category 1 issue.

The Commission does not intend to prescribe by rule the scope of an acceptable consideration of severe accident mitigation alternatives for license renewal nor does it intend to mandate consideration of alternatives identical to those evaluated previously. In general, the Commission expects that significant efficiency can be gained by using site-specific IPE and IPEEE results in the consideration of severe accident mitigation alternatives. The IPEs and IPEEEs are essentially site-specific PRAs that identify probabilities of core damage (Level 1 PRA) and include assessments of containment performance under severe accident conditions that identify probabilities of fission product releases (Level 2). As discussed in Generic Letter 88–20, ''Individual Plant Examination for Severe Accident Vulnerabilities'' (November 23, 1988), one of the important goals of the IPE and IPEEE was to reduce the overall probabilities of core damage and fission product releases as necessary by modifying hardware and procedures to help prevent or mitigate severe accidents.

Although Level 3 PRAs have been used in SAMDA analyses to generate site-specific offsite dose estimates so that the cost-benefit of mitigation alternatives could be determined, the Commission does not believe that site-specific Level 3 PRAs are required to determine whether an alternative under consideration will provide sufficient benefit to justify its cost. Licensees can use other quantitative approaches for assigning site-specific risk significance to IPE results and judging whether a mitigation alternative provides a sufficient reduction in core damage frequency (CDF) or release frequency to warrant implementation. For example, a licensee could use information provided in the GEIS analysis (exposure indices, wind frequencies, and demographics) to translate the dominant contributors to CDF and the large release frequencies from the IPE/IPEEE results into dose estimates so that a cost-benefit determination can be performed. In some instances, a consideration of the magnitude of reduction in the site-specific CDF and release frequencies alone (i.e., no conversion to a dose estimate) may be sufficient to conclude that no significant reduction in off-site risk will be provided and, therefore, implementation of a mitigation alternative is not warranted. The Commission will review each severe accident mitigation consideration provided by a license renewal applicant on its merits and determine whether it constitutes a reasonable consideration of severe accident mitigation alternatives.

10. Decommissioning

Concern. Several commenters requested further clarification of the NRC's position regarding decommissioning requirements, especially whether the total impacts address returning the site to green field conditions.

Response. The decommissioning chapter of the GEIS analyzes the impact that an additional 20 years of plant operation would have on ultimate plant decommissioning; it neither serves as the generic analysis of the environmental impacts associated with decommissioning nor establishes decommissioning requirements. An analysis of the expected impacts from plant decommissioning was previously provided in NUREG–0586, ''Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities'' (August 1988). The analysis in the GEIS for license renewal examines the physical requirements and attendant effects of decommissioning after a 20-year license renewal compared with decommissioning at the end of 40 years of operation and finds little difference in effects.

With respect to returning a site to green field condition, the Commission defines decommissioning as the safe removal of a nuclear facility from service, the reduction of residual contamination to a level that permits release of the property for unrestricted use, and termination of the license. Therefore, the question of restoring the land to a green field condition, which would require additional demolition and site restoration beyond addressing residual contamination and radiological effects, is outside the current scope of the decommissioning requirements. Moreover, consistent with the Commission's conclusion that license renewal is not expected to affect future decommissioning, any requirement relative to returning a site to a green field and the attendant effects of such a requirement would also not be affected by an additional 20 years of operation. Therefore, the issue of returning a site to pre-construction conditions is beyond the scope of license renewal review.

Concern. Several commenters expressed concern that, because a residual radioactivity rule is still not in place, the LLW estimates should be reexamined.

Response. The NRC does have criteria in place for the release of reactor facilities to unrestricted access following decommissioning. These include the guidance in Regulatory Guide 1.86, ''Termination of Operating Licenses for Nuclear Reactors'' (which provides guidance for surface contamination), dose rate limits from gamma-emitting radionuclides included in plant technical specifications, and requirements for keeping residual contamination as low as reasonably achievable (ALARA) as included in 10 CFR part 20. These criteria were used in developing NUREG–0586, the final GEIS on decommissioning of nuclear facilities, which was published in August of 1988. One conclusion from the analysis conducted for NUREG–0586 was that waste volumes from decommissioning of reactors are not highly sensitive to the radiological criteria. A proposed rule dated August 22, 1994, would codify radiological criteria for unrestricted release of reactors and other nuclear facilities and for termination of a facility license following decommissioning. NUREG–1496, the draft GEIS for the proposed rule on radiological criteria, included analyses of a range of radiological release criteria and confirmed the earlier conclusions that waste volumes from decommissioning of reactors are not sensitive to the residual radiological criteria within the range likely to be selected. This range included residual dose levels comparable to the radiological criteria currently being used for reactor decommissioning. Based on the insensitivity of the waste volume from reactor decommissioning to the radiological criteria, the Commission continues to believe, as concluded in the decommissioning section of the GEIS, that the contribution to environmental impacts of decommissioning from license renewal are small. The Commission further concludes that these impacts are not expected to change significantly as a result of the ongoing rulemaking. Therefore, the determinations in the GEIS remain appropriate.

11. Need for Generating Capacity

Concern. In addition to the major procedural concern discussed earlier about the treatment of need for generating capacity, several commenters raised concerns about the power demand projections used in the GEIS. Some commenters noted that any determination of need quickly becomes dated and, therefore, the demand for and the source of electrical power at the time of license renewal cannot be accurately predicted at this time. Moreover, they believe that the NRC's analysis is not definitive enough to remain unchallenged for 40 years. Another commenter criticized the analysis because it focused only on energy requirements without making appropriate distinctions between energy and peak capacity requirements, plant availability, and capacity factors.

Response. The NRC has determined that a detailed consideration of the need for generating capacity is inappropriate in the context of consideration of the environmental impacts of license renewal. Thus, the NRC will limit its NEPA review of license renewal applications to the consideration of the environmental impacts of license renewal compared with those of other available generating sources. Hence, the concerns regarding demand projections used in the draft GEIS are no longer an issue and they have been removed from the GEIS.

12. Alternatives to License Renewal

Concern. In addition to the procedural concern discussed earlier about the treatment of alternative energy sources as a Category 1 issue, several commenters expressed concerns about the comparison and analysis of alternative energy sources, as well as the economic analysis approach used in the draft GEIS. Consistent with their arguments against the Category 1 designation of alternatives, the commenters questioned the approach adopted in the GEIS of comparing only single alternative energy sources to license renewal. They believe that the NRC's failure to consider a mix of alternatives ignores the potential for other alternative sources of power that are available to different regions of the nation, such as demand-side management, cogeneration, purchased power from Canada, biomass, natural gas, solar energy, and wind power. They also indicated that this approach neglects a utility's ability to serve its customers with a portfolio of supply that is based on load characteristics, cost, geography, and other considerations, and fails to consider the collective impact of the alternatives. Furthermore, the possible technological advances in renewable energy sources over the next 40 years are not addressed.

One commenter argued that designating the issue of alternative energy sources as Category 1 allows a license renewal applicant not to consider the additional requirement of economic threshold analysis. Relative to the economic analysis of the alternatives to license renewal, another commenter questioned the proposed requirement for the license renewal applicant to demonstrate that the ''replacement of equivalent generating capacity by a coal-fired plant has no demonstrated cost advantage over the individual nuclear power plant license renewal.''

According to the commenter, this requirement would force the applicant to perform an economic analysis of an alternative to license renewal. The commenter further argued that NEPA does not require an economic consideration.

Response. In response to these concerns, the final rule no longer requires a cost comparison of alternative energy sources relative to license renewal. Furthermore, the alternative energy sources discussed in the final GEIS include energy conservation and energy imports as well as the other sources discussed by the commenters. An analysis of the environmental impacts of alternative energy sources is included in the GEIS but is not codified in 10 CFR part 51.

The NRC believes that its consideration of alternatives in the GEIS is representative of the technologies available and the associated environmental impacts. With regard to consideration of a mix of alternative sources, the Commission recognizes that combinations of various alternatives may be used to replace power generation from license renewal.

13. License Renewal Scenario

Concern. Several commenters raised concerns related to the license renewal scenario evaluation methodology as implemented in the GEIS. The fundamental issues were the degree of conservatism built into the scenario and the appropriateness of an upper bound type approach in characterizing the refurbishment activities (and associated costs) in light of NEPA requirements to determine reasonable estimates of the environmental impacts of Federal actions.

Regarding the concerns that the refurbishment schedules and scenarios developed for the GEIS were too conservative, several commenters indicated that many of the activities slated for completion during the extended refurbishment before license renewal would actually be completed by many facilities during the course of the current licensing term. The effect of having only one major outage instead of leveling work over three or four outages could lead to an over-estimate of the refurbishment activities and costs that any particular plant would expect to see.

Response. In response to this concern, the NRC has revised the GEIS to include two license renewal program scenarios. The first scenario refers to a ‘‘typical’’ license renewal program and is intended to be representative of the type of programs that many plants seeking license renewal might implement. The second scenario retains the original objective of establishing an upper bound of the impacts likely to be generated at any particular plant. The typical scenario is useful for estimating impacts at plants that have been well maintained and have already undertaken most major refurbishment activities necessary for operation beyond the current licensing term. The conservative scenario estimates continue to be useful for estimating the maximum impacts likely to result from license renewal.

The revised approach of providing two separate license renewal scenarios also alleviates the concern about the use of a bounding scenario for license renewal activities. The NRC acknowledges that some applicants for license renewal may not be required to perform certain major refurbishment or replacement activities and, therefore, may have fewer or shorter outages. However, the two scenarios described in the GEIS are neither unrealistic nor overconservative in representing the range of activities that could be expected for license renewal and the possible schedule for performing these activities.

14. Environmental Justice

On February 11, 1994, the President issued Executive Order (E.O.) 12898, ‘‘Federal Actions To Address Environmental Justice in Minority Populations and Low-Income Populations’’ (59 FR 7629, February 16, 1994). This order requires each Federal agency to make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low income populations. The Commission will endeavor to carry out the measures set forth in the executive order by integrating environmental justice into NRC's compliance with the National Environmental Policy of 1969 (NEPA), as amended. E.O. 12898 was issued after publication of the proposed rule and the receipt of comments on the proposed rule. As a result, no comments were received regarding environmental justice reviews for license renewal. Therefore, a brief discussion of this issue relative to license renewal is warranted.

As called for in Section 1–102 of E.O. 12898, the EPA established a Federal interagency working group to, among other things, ‘‘* * * provide guidance to Federal agencies or criteria for identifying disproportionately high and adverse human health or environmental effects on minority populations and low-income populations * * *.’’ The CEQ was assigned to provide this guidance to enable agencies to better comply with E.O. 12898. Until the CEQ guidance is received, the Commission intends to consider environmental justice in its evaluations of individual license renewal applications. Greater emphasis will be placed on discussing impacts on minority and low-income populations when preparing NEPA documents such as EISs, supplemental EISs, and, where appropriate, EAs. Commission requirements regarding environmental justice reviews will be reevaluated and may be revised after receipt of the CEQ guidance.

IV. Discussion of Regulatory Requirements

A. General Requirements

In this final rule, the regulatory requirements for performing a NEPA review for a license renewal application are similar to the NEPA review requirements for other major plant licensing actions. Consistent with the current NEPA practice for major plant licensing actions, this amendment to 10 CFR Part 51 requires the applicant to submit an environmental report that analyzes the environmental impacts associated with the proposed action, considers alternatives to the proposed action, and evaluates any alternatives for reducing adverse environmental effects. Additionally, the amendment requires the NRC staff to prepare a supplemental environmental impact statement for the proposed action, issue the statement in draft for public comment, and issue a final statement after considering public comments on the draft.

The amendment deviates from NRC's current NEPA review practice in some areas. First, the amendment codifies certain environmental impacts associated with license renewal that were analyzed in NUREG–1437, ‘‘Generic Environmental Impact Statement for License Renewal at Nuclear Plants’’ (xxxx 1996). Accordingly, absent new and significant information, the analyses for certain impacts codified by this rulemaking need only be incorporated by reference in an applicant's environmental report for license renewal and in the Commission's (including NRC staff, adjudicatory officers, and the Commission itself) draft and final SEIS and other environmental documents developed for the proceeding. Secondly, the amendment reflects the Commission's decision to limit its NEPA review for license renewal to a consideration of the environmental effects of the proposed action and alternatives to the proposed action. Finally, the amendment contains the decision standard that the Commission will use in determining the acceptability of the environmental impacts of individual license renewals.

The Commission and the applicant will consider severe accident mitigation alternatives to reduce or mitigate environmental impacts for any plant for which severe accident mitigation alternatives have not been previously considered in an environmental impact statement or related supplement or in an environmental assessment. The Commission has concluded that, for license renewal, the issues of need for power and utility economics should be reserved for State and utility officials to decide. Accordingly, the NRC will not conduct an analysis of these issues in the context of license renewal or perform traditional cost-benefit balancing in license renewal NEPA reviews. Finally, in a departure from the approach presented in the proposed rule, this final rule does not codify any conclusions regarding the subject of alternatives. Consideration of and decisions regarding alternatives will occur at the site-specific stage. The discussion below addresses the specific regulatory requirements of this amendment and any conforming changes to 10 CFR part 51 to implement the Commission's decision to eliminate cost-benefit balancing from license renewal NEPA reviews.

B. The Environmental Report

1. Environmental Impacts of License Renewal

Through this final rule, the NRC has amended 10 CFR 51.53 to require an applicant for license renewal to submit an environmental report with its application. This environmental report must contain an analysis of the environmental impacts of renewing a license, the environmental impacts of alternatives, and mitigation alternatives. In preparing the analysis of environmental impacts contained in the environmental report, the applicant should refer to the data provided in appendix B to 10 CFR part 51, which has been added to NRC's regulations as part of this rulemaking. The applicant is not required to provide an analysis in the environmental report of those issues identified as Category 1 issues in Table B–1 in Appendix B. For those issues identified as Category 2 in Table B–1, the applicant must provide a specified additional analysis beyond that contained in Table B–1. In this final rule, 10 CFR 51.53(c)(3)(ii) specifies the subject areas of the analysis that must be addressed for the Category 2 issues.

Pursuant to 10 CFR 51.45(c), 10 CFR 51.53(c)(2) requires the applicant to consider possible actions to mitigate the adverse impacts associated with the proposed action. This consideration is limited to designated Category 2 matters. Pursuant to 10 CFR 51.45(d), the environmental report must include a discussion of the status of compliance with applicable Federal, State, and local environmental standards. Also, 10 CFR 51.53(c)(2) specifically excludes from consideration in the environmental report the issues of need for power, the economic costs and benefits of the proposed action, economic costs and benefits of alternatives to the proposed action, or other issues not related to environmental effects of the proposed action and associated alternatives. In addition, the requirements in 10 CFR 51.45 are consistent with the exclusion of economic issues in 10 CFR 51.53(c)(2).

2. Consideration of Alternatives

Pursuant to 10 CFR 51.45(c), 10 CFR 51.53(c)(2) requires the applicant to consider the environmental impacts of alternatives to license renewal in the environmental report. The treatment of alternatives in the environmental report should be limited to the environmental impacts of such alternatives.

The amended regulations do not require a discussion of the economic costs and benefits of these alternatives in the environmental report for the operating license renewal stage except as necessary to determine whether an alternative should be included in the range of alternatives considered or whether certain mitigative actions are appropriate. The analysis should demonstrate consideration of a reasonable set of alternatives to license renewal. In preparing the alternatives analysis, the applicant may consider information regarding alternatives in NUREG–1437, ''Generic Environmental Impact Statement for License Renewal of Nuclear Plants'' (xxxx 1996).

The Commission has developed a new decision standard to be applied in environmental impact statements for license renewal as discussed in Section IV.C.2. The amended regulations for license renewal do not require applicants to apply this decision standard to the information generated in their environmental report (although the applicant is not prohibited from doing so if it desires). However, the NRC staff will use the information contained in the environmental report in preparing the environmental impact statement upon which the Commission will base its final decision.

3. Consideration of Mitigation Alternatives

Consistent with the NRC's current NEPA practice, an applicant must include a consideration of alternatives to mitigate adverse environmental impacts in its environmental report. However, for license renewal, the Commission has generically considered mitigation for environmental issues associated with renewal and has concluded that no additional site-specific consideration of mitigation is necessary for many issues. The Commission's consideration of mitigation for each issue included identification of current activities that adequately mitigate impacts and evaluation of other mitigation techniques that might or might not be warranted, depending on such factors as the size of the impact and the cost of the technique. The Commission has considered mitigation for all impacts designated as Category 1 in Table B–1. Therefore, a license renewal applicant need not address mitigation for issues so designated.

C. Supplemental Environmental Impact Statement

This amendment also requires that the Commission prepare a supplemental environmental impact statement (SEIS), consistent with 10 CFR 51.20(b)(2). This statement will serve as the Commission's independent analysis of the environmental impacts of license renewal as well as a comparison of these impacts to the environmental impacts of alternatives. This document will also present the preliminary recommendation by the NRC staff regarding the proposed action. Consistent with the revisions to 10 CFR 51.45 and 51.53 discussed above in regard to the applicant's environmental report, this rulemaking revises portions of 10 CFR 51.71 and 51.95 to reflect the Commission's approach to addressing the environmental impacts of license renewal.

The issues of need for power, the economic costs and benefits of the proposed action, and economic costs and benefits of alternatives to the proposed action are specifically excluded from consideration in the supplemental environmental impact statement for license renewal by 10 CFR 51.95(c), except as these costs and benefits are either essential for a determination regarding the inclusion of an alternative in the range of alternatives considered or relevant to mitigation. The supplemental environmental impact statement does not need to discuss issues other than environmental effects of the proposed action and associated alternatives. This rule amends the requirements in 10 CFR 51.71 (d) and (e) so that they are consistent with the exclusion of economic issues in 10 CFR 51.95(c). Additionally, 10 CFR 51.95 has been amended to allow information from previous NRC site-specific environmental reviews, as well as NRC final generic environmental impact statements, to be referenced in supplemental environmental impact statements.

1. Public Scoping and Public Comments on the SEIS

Consistent with NRC's current NEPA practice, the Commission will hold a public meeting in order to inform the local public of the proposed action and receive comments. In addition, the SEIS will be issued in draft for public comment in accordance with 10 CFR 51.91 and 51.93. In both the public scoping process and the public comment process, the Commission will accept comments on all previously analyzed issues and information codified in Table B–1 of appendix B to 10 CFR part 51 and will determine whether these comments provide any information that is new and significant compared with that previously considered in the GEIS. If the comments are determined to provide new and significant information bearing on the previous analysis in the GEIS, these comments will be considered and appropriately factored into the Commission's analysis in the SEIS. Public comments on the site-specific additional information provided by the applicant regarding Category 2 issues will be considered in the SEIS.

2. Commission's Analysis and Preliminary Recommendation

The Commission's draft SEIS will include its analysis of the environmental impacts of the proposed license renewal action and the environmental impacts of the alternatives to the proposed action. With the exception of offsite radiological impacts for collective effects and the disposal of spent fuel and high level waste, the Commission will integrate the codified environmental impacts of license renewal as provided in Table B–1 of appendix B to 10 CFR part 51 (supplemented by the underlying analyses in the GEIS), the appropriate site-specific analyses of Category 2 issues, and any new issues identified during the scoping and public comment process. The results of this integration process will be utilized to arrive at a conclusion regarding the sum of the environmental impacts associated with license renewal. These impacts will then be compared, quantitatively or qualitatively as appropriate, with the environmental impacts of the considered alternatives. The analysis of alternatives in the SEIS will be limited to the environmental impacts of these alternatives and will be prepared in accordance with 10 CFR 51.71 and subpart A of appendix A to 10 CFR part 51. The analysis of impacts of alternatives provided in the GEIS may be referenced in the SEIS as appropriate. The alternatives discussed in the GEIS include a reasonable range of different methods for power generation. The analysis in the draft SEIS will consider mitigation actions for designated Category 2 matters and will consider the status of compliance with Federal, State, and local environmental requirements as required by 10 CFR 51.71(d). Consistent with 10 CFR 51.71(e), the draft supplemental environmental impact statement must contain a preliminary recommendation regarding license renewal based on consideration of the information on the environmental impacts of license renewal and of alternatives contained in the SEIS. In order to reach its recommendation, the NRC staff must determine whether the adverse environmental impacts of license renewal are so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable. This decision standard is contained in 10 CFR 51.95(c)(4).

3. Final Supplemental Environmental Impact Statement

The Commission will issue a final supplemental environmental impact statement for a license renewal application in accordance with 10 CFR 51.91 and 51.93 after considering the public comments related to new issues identified from the scoping and public comment process, Category 2 issues, and any new and significant information regarding previously analyzed and codified Category 1 issues. Pursuant to 10 CFR 51.102 and 51.103, the Commission will provide a record of its decision regarding the environmental impacts of the proposed action. In making a final decision, the Commission must determine whether the adverse environmental impacts of license renewal (when compared with the environmental impacts of other energy generating alternatives) are so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable.

D. NEPA Review for Activities Outside NRC License Renewal Approval Scope

The Commission wishes to clarify that any activity that requires NRC approval and is not specifically required for NRC's action regarding management of the effects of aging on certain passive long-lived structures and components in the period of extended operation must be subject to a separate NEPA review. The actions subject to NRC approval for license renewal are limited to continued operation consistent with the plant design and operating conditions for the current operating license and to the performance of specific activities and programs necessary to manage the effects of aging on the passive, long-lived structures and components identified in accordance with 10 CFR part 54. Accordingly, the GEIS does not serve as the NEPA review for other activities or programs outside the scope of NRC's part 54 license renewal review. The separate NEPA review must be prepared regardless of whether the action is necessary as a consequence of receiving a renewed license, even if the activity were specifically addressed in the GEIS. For example, the environmental impacts of spent fuel pool expansion are addressed in the GEIS in the context of the environmental consequences of approving a renewed operating license, rather than in the context of a specific application to expand spent fuel pool capacity, which would require a separate NEPA review.

These separate NEPA reviews may reference and otherwise use applicable environmental information contained in the GEIS. For example, an EA prepared for a separate spent fuel pool expansion request may use the information in the GEIS to support a finding of no significant impact.

V. Availability of Documents

The principal documents supporting this supplementary information are as follows:

(1) NUREG–1437, ''Generic Environmental Impact Statement for License Renewal of Nuclear Plants'' (May 1996).

(2) NUREG–1529, ''Public Comments on the Proposed 10 CFR part 51 Rule for Renewal of Nuclear Power Plant Operating Licenses and Supporting Documents; Review of Concerns and NRC Staff Response'' (May 1996).

(3) NUREG–1440, ''Regulatory Analysis of Amendments to Regulations Concerning the Environmental Review

for Renewal of Nuclear Power Plant Operating Licenses'' (May 1996).

Copies of all documents cited in the supplementary information are available for inspection and for copying for a fee in the NRC Public Document Room, 2120 L Street NW. (Lower Level), Washington, DC. In addition, copies of NRC final documents cited here may be purchased from the Superintendent of Documents, U.S. Government Printing Office, PO Box 37082, Washington, DC 20013–7082. Copies are also available for purchase from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.

VI. Submittal of Comments in an Electronic Format

Commenters are encouraged to submit, in addition to the original paper copy, a copy of their letter in an electronic format on IBM PC DOS-compatible 3.5- or 5.25-inch, double-sided, double-density (DS/DD) diskettes. Data files should be provided in Wordperfect 5.1 or later version of Wordperfect. ASCII code is also acceptable or, if formatted text is required, data files should be provided in IBM Revisable-Form Text Document Content Architecture (RFT/DCA) format.

VII. Finding of No Significant Environmental Impact: Availability

The NRC has determined that this final rule is the type of action described as a categorical exclusion in 10 CFR 51.22(c)(3). Therefore, neither an environmental impact statement nor an environmental assessment has been prepared for this regulation. This action is procedural in nature and pertains only to the type of environmental information to be reviewed.

VIII. Paperwork Reduction Act Statement

This final rule amends information collection requirements that are subject to the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 *et seq.*). These requirements were approved by the Office of Management and Budget, approval number 3150–0021.

The public reporting burden for this collection of information is estimated to average 4,200 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden, to the Information and Records Management Branch (T–6F33), U.S. Nuclear Regulatory Commission, Washington, DC 20555–0001, or by Internet electronic mail at BJS1@nrc.gov; and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB–10202 (3150–0021), Office of Management and Budget, Washington, DC 20503.

Public Protection Notification

The NRC may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number.

IX. Regulatory Analysis

The Commission has prepared a regulatory analysis for this final rule. The analysis examines the costs and benefits of the alternatives considered by the Commission. The two alternatives considered were:

(A) Retaining the existing 10 CFR part 51 review process for license renewal, which requires that all reviews be on a plant-specific basis; and

(B) Amending 10 CFR part 51 to allow a portion of the environmental review to be conducted on a generic basis.

The conclusions of the regulatory analysis show substantial cost savings of alternative (B) over alternative (A). The analysis, NUREG–1440, is available for inspection in the NRC Public Document Room, 2120 L Street NW. (Lower Level), Washington, DC. Copies of the analysis are available as described in Section V.

X. Regulatory Flexibility Act Certification

As required by the Regulatory Flexibility Act of 1980, 5 U.S.C. 605(b), the Commission certifies that this final rule will not have a significant impact on a substantial number of small entities. The final rule states the application procedures and environmental information to be submitted by nuclear power plant licensees to facilitate NRC's obligations under NEPA. Nuclear power plant licensees do not fall within the definition of small businesses as defined in Section 3 of the Small Business Act, 15 U.S.C. 632, or the Commission's Size Standards, April 11, 1995 (60 FR 18344).

XI. Small Business Regulatory Enforcement Fairness Act

In accordance with the Small Business Regulatory Enforcement Fairness Act of 1996, the NRC has determined that this action is not a major rule and has verified this determination with the Office of Information and Regulatory Affairs of OMB.

XII. Backfit Analysis

The NRC has determined that these amendments do not involve any provisions which would impose backfits as defined in 10 CFR 50.109(a)(1); therefore, a backfit analysis need not be prepared.

List of Subjects in 10 CFR Part 51

Administrative practice and procedure, Environmental impact statement, Nuclear materials, Nuclear power plants and reactors, Reporting and recordkeeping requirements.

For the reasons set out in the preamble and under the authority of the Atomic Energy Act of 1954, as amended; the Energy Reorganization Act of 1974, as amended; the National Environmental Policy Act of 1969, as amended; and 5 U.S.C. 552 and 553, the NRC is adopting the following amendments to 10 CFR part 51.

PART 51—ENVIRONMENTAL PROTECTION REGULATIONS FOR DOMESTIC LICENSING AND RELATED REGULATORY FUNCTIONS

1. The authority citation for part 51 continues to read as follows:

Authority: Sec. 161, 68 Stat. 948, as amended, Sec. 1701, 106 Stat. 2951, 2952, 2953 (42 U.S.C. 2201, 2297f); secs. 201, as amended, 202, 88 Stat. 1242, as amended, 1244 (42 U.S.C. 5841, 5842).

Subpart A also issued under National Environmental Policy Act of 1969, secs. 102, 104, 105, 83 Stat. 853–854, as amended (42 U.S.C. 4332, 4334, 4335); and Pub. L. 95–604, Title II, 92 Stat. 3033–3041. Sections 51.20, 51.30, 51.60, 51.61, 51.80, and 51.97 also issued under secs. 135, 141, Pub. L. 97–425, 96 Stat. 2232, 2241, and sec. 148, Pub. L. 100–203, 101 Stat. 1330–223 (42 U.S.C. 10155, 10161, 10168). Section 51.22 also issued under sec. 274, 73 Stat. 688, as amended by 92 Stat. 3036–3038 (42 U.S.C. 2021) and under Nuclear Waste Policy Act of 1982, sec. 121, 96 Stat. 2228 (42 U.S.C. 10141). Sections 51.43, 51.67, and 51.109 also issued under Nuclear Waste Policy Act of 1982, sec. 114(f), 96 Stat. 2216, as amended (42 U.S.C. 10134(f)).

2. Section 51.45 is amended by revising paragraph (c) to read as follows:

§ 51.45 Environmental report.

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(c) *Analysis.* The environmental report shall include an analysis that considers and balances the environmental effects of the proposed action, the environmental impacts of alternatives to the proposed action, and alternatives available for reducing or avoiding adverse environmental effects. Except for environmental reports prepared at the license renewal stage pursuant to § 51.53(c), the analysis in the environmental report should also include consideration of the economic, technical, and other benefits and costs of the proposed action and of alternatives. Environmental reports prepared at the license renewal stage pursuant to § 51.53(c) need not discuss the economic or technical benefits and costs of either the proposed action or alternatives except insofar as such benefits and costs are either essential for a determination regarding the inclusion of an alternative in the range of alternatives considered or relevant to mitigation. In addition, environmental reports prepared pursuant to § 51.53(c) need not discuss other issues not related to the environmental effects of the proposed action and alternatives. The analyses for environmental reports shall, to the fullest extent practicable, quantify the various factors considered. To the extent that there are important qualitative considerations or factors that cannot be quantified, those considerations or factors shall be discussed in qualitative terms. The environmental report should contain sufficient data to aid the Commission in its development of an independent analysis.

* * * * *

3. Section 51.53 is revised to read as follows:

§ 51.53 Postconstruction environmental reports.

(a) *General.* Any environmental report prepared under the provisions of this section may incorporate by reference any information contained in a prior environmental report or supplement thereto that relates to the production or utilization facility or any information contained in a final environmental document previously prepared by the NRC staff that relates to the production or utilization facility. Documents that may be referenced include, but are not limited to, the final environmental impact statement; supplements to the final environmental impact statement, including supplements prepared at the license renewal stage; NRC staff-prepared final generic environmental impact statements; and environmental assessments and records of decisions prepared in connection with the construction permit, the operating license, and any license amendment for that facility.

(b) *Operating license stage.* Each applicant for a license to operate a production or utilization facility covered by § 51.20 shall submit with its application the number of copies specified in § 51.55 of a separate document entitled ''Supplement to Applicant's Environmental Report—Operating License Stage,'' which will update ''Applicant's Environmental Report—Construction Permit Stage.'' Unless otherwise required by the Commission, the applicant for an operating license for a nuclear power reactor shall submit this report only in connection with the first licensing action authorizing full-power operation. In this report, the applicant shall discuss the same matters described in §§ 51.45, 51.51, and 51.52, but only to the extent that they differ from those discussed or reflect new information in addition to that discussed in the final environmental impact statement prepared by the Commission in connection with the construction permit. No discussion of need for power, or of alternative energy sources, or of alternative sites for the facility, or of any aspect of the storage of spent fuel for the facility within the scope of the generic determination in § 51.23(a) and in accordance with § 51.23(b) is required in this report.

(c) *Operating license renewal stage.* (1) Each applicant for renewal of a license to operate a nuclear power plant under part 54 of this chapter shall submit with its application the number of copies specified in § 51.55 of a separate document entitled ''Applicant's Environmental Report—Operating License Renewal Stage.''

(2) The report must contain a description of the proposed action, including the applicant's plans to modify the facility or its administrative control procedures as described in accordance with § 54.21 of this chapter. This report must describe in detail the modifications directly affecting the environment or affecting plant effluents that affect the environment. In addition, the applicant shall discuss in this report the environmental impacts of alternatives and any other matters described in § 51.45. The report is not required to include discussion of need for power or the economic costs and economic benefits of the proposed action or of alternatives to the proposed action except insofar as such costs and benefits are either essential for a determination regarding the inclusion of an alternative in the range of alternatives considered or relevant to mitigation. The environmental report need not discuss other issues not related to the environmental effects of the proposed action and the alternatives. In addition, the environmental report need not discuss any aspect of the storage of spent fuel for the facility within the scope of the generic determination in § 51.23(a) and in accordance with § 51.23(b).

(3) For those applicants seeking an initial renewal license and holding either an operating license or construction permit as of June 30, 1995, the environmental report shall include the information required in paragraph (c)(2) of this section subject to the following conditions and considerations:

(i) The environmental report for the operating license renewal stage is not required to contain analyses of the environmental impacts of the license renewal issues identified as Category 1 issues in appendix B to subpart A of this part.

(ii) The environmental report must contain analyses of the environmental impacts of the proposed action, including the impacts of refurbishment activities, if any, associated with license renewal and the impacts of operation during the renewal term, for those issues identified as Category 2 issues in appendix B to subpart A of this part. The required analyses are as follows:

(A) If the applicant's plant utilizes cooling towers or cooling ponds and withdraws make-up water from a river whose annual flow rate is less than 3.15×10^{12} ft^3/year (9×10^{10} m^3/year), an assessment of the impact of the proposed action on the flow of the river and related impacts on instream and riparian ecological communities must be provided. The applicant shall also provide an assessment of the impacts of the withdrawal of water from the river on alluvial aquifers during low flow.

(B) If the applicant's plant utilizes once-through cooling or cooling pond heat dissipation systems, the applicant shall provide a copy of current Clean Water Act 316(b) determinations and, if necessary, a 316(a) variance in accordance with 40 CFR part 125, or equivalent State permits and supporting documentation. If the applicant can not provide these documents, it shall assess the impact of the proposed action on fish and shellfish resources resulting from heat shock and impingement and entrainment.

(C) If the applicant's plant uses Ranney wells or pumps more than 100 gallons of ground water per minute, an assessment of the impact of the proposed action on ground-water use must be provided.

(D) If the applicant's plant is located at an inland site and utilizes cooling ponds, an assessment of the impact of the proposed action on groundwater quality must be provided.

(E) All license renewal applicants shall assess the impact of refurbishment and other license-renewal-related construction activities on important plant and animal habitats. Additionally, the applicant shall assess the impact of the proposed action on threatened or endangered species in accordance with the Endangered Species Act.

(F) If the applicant's plant is located in or near a nonattainment or maintenance area, an assessment of vehicle exhaust emissions anticipated at the time of peak refurbishment workforce must be provided in accordance with the Clean Air Act as amended.

(G) If the applicant's plant uses a cooling pond, lake, or canal or discharges into a river having an annual average flow rate of less than 3.15×10^{12} ft^3/year (9×10^{10} m^3/year), an assessment of the impact of the proposed action on public health from thermophilic organisms in the affected water must be provided.

(H) If the applicant's transmission lines that were constructed for the specific purpose of connecting the plant to the transmission system do not meet the recommendations of the National Electric Safety Code for preventing electric shock from induced currents, an assessment of the impact of the proposed action on the potential shock hazard from the transmission lines must be provided.

(I) An assessment of the impact of the proposed action on housing availability, land-use, and public schools (impacts from refurbishment activities only) within the vicinity of the plant must be provided. Additionally, the applicant shall provide an assessment of the impact of population increases attributable to the proposed project on the public water supply.

(J) All applicants shall assess the impact of the proposed project on local transportation during periods of license renewal refurbishment activities.

(K) All applicants shall assess whether any historic or archaeological properties will be affected by the proposed project.

(L) If the staff has not previously considered severe accident mitigation alternatives for the applicant's plant in an environmental impact statement or related supplement or in an environmental assessment, a consideration of alternatives to mitigate severe accidents must be provided.

(M) The environmental effects of transportation of fuel and waste shall be reviewed in accordance with § 51.52.

(iii) The report must contain a consideration of alternatives for reducing adverse impacts, as required by § 51.45(c), for all Category 2 license renewal issues in Appendix B to Subpart A of this part. No such consideration is required for Category 1 issues in Appendix B to Subpart A of this part.

(iv) The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

(d) *Postoperating license stage.* Each applicant for a license amendment authorizing the decommissioning of a production or utilization facility covered by § 51.20 and each applicant for a license or license amendment to store spent fuel at a nuclear power plant after expiration of the operating license for the nuclear power plant shall submit with its application the number of copies specified in § 51.55 of a separate document entitled ''Supplement to Applicant's Environmental Report—Post Operating License Stage.'' This supplement will update ''Supplement to Applicant's Environmental Report—Operating License Stage'' and ''Applicant's Environmental Report—Operating License Renewal Stage,'' as appropriate, to reflect any new information or significant environmental change associated with the applicant's proposed decommissioning activities or with the applicant's proposed activities with respect to the planned storage of spent fuel. Unless otherwise required by the Commission, in accordance with the generic determination in § 51.23(a) and the provisions in § 51.23(b), the applicant shall address only the environmental impact of spent fuel storage for the term of the license.

4. In § 51.55, paragraph (a) is revised to read as follows:

§ 51.55 Environmental report—number of copies; distribution.

(a) Each applicant for a license to construct and operate a production or utilization facility covered by paragraphs (b)(1), (b)(2), (b)(3), or (b)(4) of § 51.20, each applicant for renewal of an operating license for a nuclear power plant, each applicant for a license amendment authorizing the decommissioning of a production or utilization facility covered by § 51.20, and each applicant for a license or license amendment to store spent fuel at a nuclear power plant after expiration of the operating license for the nuclear power plant shall submit to the Director of the Office of Nuclear Reactor Regulation or the Director of the Office of Nuclear Material Safety and Safeguards, as appropriate, 41 copies of an environmental report or any supplement to an environmental report. The applicant shall retain an additional 109 copies of the environmental report or any supplement to the environmental report for distribution to parties and Boards in the NRC proceedings; Federal, State, and local officials; and any affected Indian tribes, in accordance with written instructions issued by the Director of the Office of Nuclear Reactor Regulation or the Director of the Office Nuclear Material Safety and Safeguards, as appropriate.

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5. In § 51.71, paragraphs (d) and (e) are revised to read as follows:

§ 51.71 Draft environmental impact statement—contents.

* * * * *

(d) *Analysis.* The draft environmental impact statement will include a preliminary analysis that considers and weighs the environmental effects of the proposed action; the environmental impacts of alternatives to the proposed action; and alternatives available for reducing or avoiding adverse environmental effects. Except for supplemental environmental impact statements for the operating license renewal stage prepared pursuant to § 51.95(c), draft environmental impact statements should also include consideration of the economic, technical, and other benefits and costs of the proposed action and alternatives and indicate what other interests and considerations of Federal policy, including factors not related to environmental quality if applicable, are relevant to the consideration of environmental effects of the proposed action identified pursuant to paragraph (a) of this section. Supplemental environmental impact statements prepared at the license renewal stage pursuant to § 51.95(c) need not discuss the economic or technical benefits and costs of either the proposed action or alternatives except insofar as such benefits and costs are either essential for a determination regarding the inclusion of an alternative in the range of alternatives considered or relevant to mitigation. In addition, the supplemental environmental impact statement prepared at the license renewal stage need not discuss other issues not related to the environmental effects of the proposed action and associated alternatives. The draft supplemental environmental impact statement for license renewal prepared pursuant to § 51.95(c) will rely on conclusions as amplified by the supporting information in the GEIS for issues designated as Category 1 in appendix B to subpart A of this part. The draft supplemental environmental impact statement must contain an analysis of those issues identified as Category 2 in appendix B to subpart A of this part that are open for the proposed action. The analysis for all draft environmental impact statements will, to the fullest extent practicable, quantify the various factors considered. To the extent that there are important qualitative considerations or factors that cannot be quantified, these considerations or factors will be discussed in qualitative terms. Due consideration will be given to compliance with environmental quality standards and requirements that have been imposed by Federal, State, regional, and local agencies having responsibility for environmental protection, including applicable zoning and land-use regulations and water pollution limitations or requirements promulgated or imposed pursuant to the Federal Water Pollution Control Act. The environmental impact of the proposed action will be considered in the analysis with respect to matters covered by such standards and requirements irrespective of whether a certification or license from the appropriate authority has been obtained.[3] While satisfaction of Commission standards and criteria pertaining to radiological effects will be necessary to meet the licensing requirements of the Atomic Energy Act, the analysis will, for the purposes of NEPA, consider the radiological effects of the proposed action and alternatives.

(e) *Preliminary recommendation.* The draft environmental impact statement normally will include a preliminary recommendation by the NRC staff respecting the proposed action. This preliminary recommendation will be based on the information and analysis described in paragraphs (a) through (d) of this section and §§ 51.75, 51.76, 51.80, 51.85, and 51.95, as appropriate, and will be reached after considering the environmental effects of the proposed action and reasonable alternatives,[4] and, except for supplemental environmental impact statements for the operating license renewal stage prepared pursuant to § 51.95(c), after weighing the costs and benefits of the proposed action. In lieu of a recommendation, the NRC staff may indicate in the draft statement that two or more alternatives remain under consideration.

§ 51.75 [Amended]

6. In Section 51.75, redesignate footnote 4 as footnote 5.

7. Section 51.95 is revised to read as follows:

§ 51.95 Postconstruction environmental impact statements.

(a) *General.* Any supplement to a final environmental impact statement or any environmental assessment prepared under the provisions of this section may incorporate by reference any information contained in a final environmental document previously prepared by the NRC staff that relates to the same production or utilization facility. Documents that may be referenced include, but are not limited to, the final environmental impact statement; supplements to the final environmental impact statement, including supplements prepared at the operating license stage; NRC staff-prepared final generic environmental impact statements; environmental assessments and records of decisions prepared in connection with the construction permit, the operating license, and any license amendment for that facility. A supplement to a final environmental impact statement will include a request for comments as provided in § 51.73.

(b) *Initial operating license stage.* In connection with the issuance of an operating license for a production or utilization facility, the NRC staff will prepare a supplement to the final environmental impact statement on the construction permit for that facility, which will update the prior environmental review. The supplement will only cover matters that differ from the final environmental impact statement or that reflect significant new information concerning matters discussed in the final environmental impact statement. Unless otherwise determined by the Commission, a supplement on the operation of a nuclear power plant will not include a discussion of need for power, or of alternative energy sources, or of alternative sites, or of any aspect of the storage of spent fuel for the nuclear power plant within the scope of the generic determination in § 51.23(a) and in accordance with § 51.23(b), and will only be prepared in connection with the first licensing action authorizing full-power operation.

(c) *Operating license renewal stage.* In connection with the renewal of an operating license for a nuclear power plant under part 54 of this chapter, the Commission shall prepare a supplement to the Commission's NUREG–1437, ''Generic Environmental Impact Statement for License Renewal of Nuclear Plants'' (xxxx 1996).

(1) The supplemental environmental impact statement for the operating license renewal stage shall address those issues as required by § 51.71. In addition, the NRC staff must comply with 40 CFR 1506.6(b)(3) in conducting the additional scoping process as required by § 51.71(a).

(2) The supplemental environmental impact statement for license renewal is not required to include discussion of need for power or the economic costs and economic benefits of the proposed action or of alternatives to the proposed action except insofar as such benefits and costs are either essential for a determination regarding the inclusion of an alternative in the range of alternatives considered or relevant to mitigation. In addition, the supplemental environmental impact statement prepared at the license renewal stage need not discuss other issues not related to the environmental effects of the proposed action and the alternatives, or any aspect of the storage of spent fuel for the facility within the scope of the generic determination in § 51.23(a) and in accordance with § 51.23(b). The analysis of alternatives in the supplemental environmental impact statement should be limited to the environmental impacts of such alternatives and should otherwise be prepared in accordance with § 51.71 and appendix A to subpart A of this part.

(3) The supplemental environmental impact statement shall be issued as a final impact statement in accordance with §§ 51.91 and 51.93 after considering any significant new information relevant to the proposed

[3] Compliance with the environmental quality standards and requirements of the Federal Water Pollution Control Act (imposed by EPA or designated permitting states) is not a substitute for and does not negate the requirement for NRC to weigh all environmental effects of the proposed action, including the degradation, if any, of water quality, and to consider alternatives to the proposed action that are available for reducing adverse effects. Where an environmental assessment of aquatic impact from plant discharges is available from the permitting authority, the NRC will consider the assessment in its determination of the magnitude of environmental impacts for striking an overall cost-benefit balance at the construction permit and operating license stages, and in its determination of whether the adverse environmental impacts of license renewal are so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable at the license renewal stage. When no such assessment of aquatic impacts is available from the permitting authority, NRC will establish on its own or in conjunction with the permitting authority and other agencies having relevant expertise the magnitude of potential impacts for striking an overall cost-benefit balance for the facility at the construction permit and operating license stages, and in its determination of whether the adverse environmental impacts of license renewal are so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable at the license renewal stage.

[4] The consideration of reasonable alternatives to a proposed action involving nuclear power reactors (e.g., alternative energy sources) is intended to assist the NRC in meeting its NEPA obligations and does not preclude any State authority from making separate determinations with respect to these alternatives and in no way preempts, displaces, or affects the authority of States or other Federal agencies to address these issues.

action contained in the supplement or incorporated by reference.

(4) The supplemental environmental impact statement must contain the NRC staff's recommendation regarding the environmental acceptability of the license renewal action. In order to make its recommendation and final conclusion on the proposed action, the NRC staff, adjudicatory officers, and Commission shall integrate the conclusions, as amplified by the supporting information in the generic environmental impact statement for issues designated Category 1 (with the exception of offsite radiological impacts for collective effects and the disposal of spent fuel and high level waste) or resolved Category 2, information developed for those open Category 2 issues applicable to the plant in accordance with § 51.53(c)(3)(ii), and any significant new information. Given this information, the NRC staff, adjudicatory officers, and Commission shall determine whether or not the adverse environmental impacts of license renewal are so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable.

(d) *Postoperating license stage.* In connection with an amendment to an operating license authorizing the decommissioning of a production or utilization facility covered by § 51.20 or with the issuance, amendment, or renewal of a license to store spent fuel at a nuclear power plant after expiration of the operating license for the nuclear power plant, the NRC staff will prepare a supplemental environmental impact statement for the postoperating license stage or an environmental assessment, as appropriate, which will update the prior environmental review. Unless otherwise required by the Commission, in accordance with the generic determination in § 51.23(a) and the provisions of § 51.23(b), a supplemental environmental impact statement for the postoperating license stage or an environmental assessment, as appropriate, will address the environmental impacts of spent fuel storage only for the term of the license, license amendment, or license renewal applied for.

8. In § 51.103, paragraph (a)(3) is revised and paragraph (a)(5) is added to read as follows:

§ 51.103 Record of decision—General.

(a) * * *

(3) Discuss preferences among alternatives based on relevant factors, including economic and technical considerations where appropriate, the NRC's statutory mission, and any essential considerations of national policy, which were balanced by the Commission in making the decision and state how these considerations entered into the decision.

* * * * *

(5) In making a final decision on a license renewal action pursuant to part 54 of this chapter, the Commission shall determine whether or not the adverse environmental impacts of license renewal are so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable.

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9. Paragraph 4 of appendix A to subpart A of 10 CFR part 51 is revised as follows:

Appendix A to Subpart A—Format for Presentation of Material in Environmental Impact Statements

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4. *Purpose of and need for action.* The statement will briefly describe and specify the need for the proposed action. The alternative of no action will be discussed. In the case of nuclear power plant construction or siting, consideration will be given to the potential impact of conservation measures in determining the demand for power and consequent need for additional generating capacity.

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10. A new appendix B is added to subpart A of 10 CFR part 51 to read as follows:

Appendix B to Subpart A—Environmental Effect of Renewing the Operating License of a Nuclear Power Plant

The Commission has assessed the environmental impacts associated with granting a renewed operating license for a nuclear power plant to a licensee who holds either an operating license or construction permit as of June 30, 1995. Table B–1 summarizes the Commission's findings on the scope and magnitude of environmental impacts of renewing the operating license for a nuclear power plant as required by section 102(2) of the National Environmental Policy Act of 1969, as amended. Table B–1, subject to an evaluation of those issues identified in Category 2 as requiring further analysis and possible significant new information, represents the analysis of the environmental impacts associated with renewal of any operating license and is to be used in accordance with § 51.95(c). On a 10-year cycle, the Commission intends to review the material in this appendix and update it if necessary. A scoping notice must be published in the Federal Register indicating the results of the NRC's review and inviting public comments and proposals for other areas that should be updated.

TABLE B–1.—SUMMARY OF FINDINGS ON NEPA ISSUES FOR LICENSE RENEWAL OF NUCLEAR POWER PLANTS [1]

Issue	Category [2]	Findings [3]
Surface Water Quality, Hydrology, and Use (for all plants)		
Impacts of refurbishment on surface water quality.	1	SMALL. Impacts are expected to be negligible during refurbishment because best management practices are expected to be employed to control soil erosion and spills.
Impacts of refurbishment on surface water use.	1	SMALL. Water use during refurbishment will not increase appreciably or will be reduced during plant outage.
Altered current patterns at intake and discharge structures.	1	SMALL. Altered current patterns have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.
Altered salinity gradients	1	SMALL. Salinity gradients have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.
Altered thermal stratification of lakes.	1	SMALL. Generally, lake stratification has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.
Temperature effects on sediment transport capacity.	1	SMALL. These effects have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.
Scouring caused by discharged cooling water.	1	SMALL. Scouring has not been found to be a problem at most operating nuclear power plants and has caused only localized effects at a few plants. It is not expected to be a problem during the license renewal term.
Eutrophication	1	SMALL. Eutrophication has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.

TABLE B–1.—SUMMARY OF FINDINGS ON NEPA ISSUES FOR LICENSE RENEWAL OF NUCLEAR POWER PLANTS [1]—Continued

Issue	Category [2]	Findings [3]
Discharge of chlorine or other biocides.	1	SMALL. Effects are not a concern among regulatory and resource agencies, and are not expected to be a problem during the license renewal term.
Discharge of sanitary wastes and minor chemical spills.	1	SMALL. Effects are readily controlled through NPDES permit and periodic modifications, if needed, and are not expected to be a problem during the license renewal term.
Discharge of other metals in waste water.	1	SMALL. These discharges have not been found to be a problem at operating nuclear power plants with cooling-tower-based heat dissipation systems and have been satisfactorily mitigated at other plants. They are not expected to be a problem during the license renewal term.
Water use conflicts (plants with once-through cooling systems).	1	SMALL. These conflicts have not been found to be a problem at operating nuclear power plants with once-through heat dissipation systems.
Water use conflicts (plants with cooling ponds or cooling towers using make-up water from a small river with low flow).	2	SMALL OR MODERATE. The issue has been a concern at nuclear power plants with cooling ponds and at plants with cooling towers. Impacts on instream and riparian communities near these plants could be of moderate significance in some situations. See § 51.53(c)(3)(ii)(A).
Aquatic Ecology (for all plants)		
Refurbishment	1	SMALL. During plant shutdown and refurbishment there will be negligible effects on aquatic biota because of a reduction of entrainment and impingement of organisms or a reduced release of chemicals.
Accumulation of contaminants in sediments or biota.	1	SMALL. Accumulation of contaminants has been a concern at a few nuclear power plants but has been satisfactorily mitigated by replacing copper alloy condenser tubes with those of another metal. It is not expected to be a problem during the license renewal term.
Entrainment of phytoplankton and zooplankton.	1	SMALL. Entrainment of phytoplankton and zooplankton has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.
Cold shock	1	SMALL. Cold shock has been satisfactorily mitigated at operating nuclear plants with once-through cooling systems, has not endangered fish populations or been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds, and is not expected to be a problem during the license renewal term.
Thermal plume barrier to migrating fish.	1	SMALL. Thermal plumes have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.
Distribution of aquatic organisms	1	SMALL. Thermal discharge may have localized effects but is not expected to affect the larger geographical distribution of aquatic organisms.
Premature emergence of aquatic insects.	1	SMALL. Premature emergence has been found to be a localized effect at some operating nuclear power plants but has not been a problem and is not expected to be a problem during the license renewal term.
Gas supersaturation (gas bubble disease).	1	SMALL. Gas supersaturation was a concern at a small number of operating nuclear power plants with once-through cooling systems but has been satisfactorily mitigated. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term.
Low dissolved oxygen in the discharge.	1	SMALL. Low dissolved oxygen has been a concern at one nuclear power plant with a once-through cooling system but has been effectively mitigated. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term.
Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses.	1	SMALL. These types of losses have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.
Stimulation of nuisance organisms (e.g., shipworms).	1	SMALL. Stimulation of nuisance organisms has been satisfactorily mitigated at the single nuclear power plant with a once-through cooling system where previously it was a problem. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term.
Aquatic Ecology (for plants with once-through and cooling pond heat dissipation systems)		
Entrainment of fish and shellfish in early life stages.	2	SMALL, MODERATE, OR LARGE. The impacts of entrainment are small at many plants but may be moderate or even large at a few plants with once-through and cooling-pond cooling systems. Further, ongoing efforts in the vicinity of these plants to restore fish populations may increase the numbers of fish susceptible to intake effects during the license renewal period, such that entrainment studies conducted in support of the original license may no longer be valid. See § 51.53(c)(3)(ii)(B).
Impingement of fish and shellfish	2	SMALL, MODERATE, OR LARGE. The impacts of impingement are small at many plants but may be moderate or even large at a few plants with once-through and cooling-pond cooling systems. See § 51.53(c)(3)(ii)(B).
Heat shock	2	SMALL, MODERATE, OR LARGE. Because of continuing concerns about heat shock and the possible need to modify thermal discharges in response to changing environmental conditions, the impacts may be of moderate or large significance at some plants. See § 51.53(c)(3)(ii)(B).

TABLE B–1.—SUMMARY OF FINDINGS ON NEPA ISSUES FOR LICENSE RENEWAL OF NUCLEAR POWER PLANTS [1]—Continued

Issue	Category [2]	Findings [3]
Aquatic Ecology (for plants with cooling-tower-based heat dissipation systems)		
Entrainment of fish and shellfish in early life stages.	1	SMALL. Entrainment of fish has not been found to be a problem at operating nuclear power plants with this type of cooling system and is not expected to be a problem during the license renewal term.
Impingement of fish and shellfish	1	SMALL. The impingement has not been found to be a problem at operating nuclear power plants with this type of cooling system and is not expected to be a problem during the license renewal term.
Heat shock	1	SMALL. Heat shock has not been found to be a problem at operating nuclear power plants with this type of cooling system and is not expected to be a problem during the license renewal term.
Ground-water Use and Quality		
Impacts of refurbishment on ground-water use and quality.	1	SMALL. Extensive dewatering during the original construction on some sites will not be repeated during refurbishment on any sites. Any plant wastes produced during refurbishment will be handled in the same manner as in current operating practices and are not expected to be a problem during the license renewal term.
Ground-water use conflicts (potable and service water; plants that use <100 gpm).	1	SMALL. Plants using less than 100 gpm are not expected to cause any ground-water use conflicts.
Ground-water use conflicts (potable and service water, and dewatering; plants that use >100 gpm).	2	SMALL, MODERATE, OR LARGE. Plants that use more than 100 gpm may cause ground-water use conflicts with nearby ground-water users. See § 51.53(c)(3)(ii)(C).
Ground-water use conflicts (plants using cooling towers withdrawing make-up water from a small river).	2	SMALL, MODERATE, OR LARGE. Water use conflicts may result from surface water withdrawals from small water bodies during low flow conditions which may affect aquifer recharge, especially if other ground-water or upstream surface water users come on line before the time of license renewal. See § 51.53(c)(3)(ii)(A).
Terrestrial Resources		
Refurbishment impacts	2	SMALL, MODERATE, OR LARGE. Refurbishment impacts are insignificant if no loss of important plant and animal habitat occurs. However, it cannot be known whether important plant and animal communities may be affected until the specific proposal is presented with the license renewal application. See § 51.53(c)(3)(ii)(E).
Cooling tower impacts on crops and ornamental vegetation.	1	SMALL. Impacts from salt drift, icing, fogging, or increased humidity associated with cooling tower operation have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.
Cooling tower impacts on native plants.	1	SMALL. Impacts from salt drift, icing, fogging, or increased humidity associated with cooling tower operation have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.
Bird collisions with cooling towers.	1	SMALL. These collisions have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.
Cooling pond impacts on terrestrial resources.	1	SMALL. Impacts of cooling ponds on terrestrial ecological resources are considered to be of small significance at all sites.
Power line right-of-way management (cutting and herbicide application).	1	SMALL. The impacts of right-of-way maintenance on wildlife are expected to be of small significance at all sites.
Bird collision with power lines	1	SMALL. Impacts are expected to be of small significance at all sites.
Impacts of electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock).	1	SMALL. No significant impacts of electromagnetic fields on terrestrial flora and fauna have been identified. Such effects are not expected to be a problem during the license renewal term.
Floodplains and wetland on power line right of way.	1	SMALL. Periodic vegetation control is necessary in forested wetlands underneath power lines and can be achieved with minimal damage to the wetland. No significant impact is expected at any nuclear power plant during the license renewal term.
Threatened or Endangered Species (for all plants)		
Threatened or endangered species.	2	SMALL, MODERATE, OR LARGE. Generally, plant refurbishment and continued operation are not expected to adversely affect threatened or endangered species. However, consultation with appropriate agencies would be needed at the time of license renewal to determine whether threatened or endangered species are present and whether they would be adversely affected. See § 51.53(c)(3)(ii)(E).

TABLE B–1.—SUMMARY OF FINDINGS ON NEPA ISSUES FOR LICENSE RENEWAL OF NUCLEAR POWER PLANTS [1]—Continued

Issue	Category [2]	Findings [3]
Air Quality		
Air quality during refurbishment (nonattainment and maintenance areas).	2	SMALL, MODERATE, OR LARGE. Air quality impacts from plant refurbishment associated with license renewal are expected to be small. However, vehicle exhaust emissions could be cause for concern at locations in or near nonattainment or maintenance areas. The significance of the potential impact cannot be determined without considering the compliance status of each site and the numbers of workers expected to be employed during the outage. See § 51.53(c)(3)(ii)(F).
Air quality effects of transmission lines.	1	SMALL. Production of ozone and oxides of nitrogen is insignificant and does not contribute measurably to ambient levels of these gases.
Land Use		
Onsite land use	1	SMALL. Projected onsite land use changes required during refurbishment and the renewal period would be a small fraction of any nuclear power plant site and would involve land that is controlled by the applicant.
Power line right of way	1	SMALL. Ongoing use of power line right of ways would continue with no change in restrictions. The effects of these restrictions are of small significance.
Human Health		
Radiation exposures to the public during refurbishment.	1	SMALL. During refurbishment, the gaseous effluents would result in doses that are similar to those from current operation. Applicable regulatory dose limits to the public are not expected to be exceeded.
Occupational radiation exposures during refurbishment.	1	SMALL. Occupational doses from refurbishment are expected to be within the range of annual average collective doses experienced for pressurized-water reactors and boiling-water reactors. Occupational mortality risk from all causes including radiation is in the mid-range for industrial settings.
Microbiological organisms (occupational health).	1	SMALL. Occupational health impacts are expected to be controlled by continued application of accepted industrial hygiene practices to minimize worker exposures.
Microbiological organisms (public health) (plants using lakes or canals, or cooling towers or cooling ponds that discharge to a small river).	2	SMALL, MODERATE, OR LARGE. These organisms are not expected to be a problem at most operating plants except possibly at plants using cooling ponds, lakes, or canals that discharge to small rivers. Without site-specific data, it is not possible to predict the effects generically. See § 51.53(c)(3)(ii)(G).
Noise	1	SMALL. Noise has not been found to be a problem at operating plants and is not expected to be a problem at any plant during the license renewal term.
Electromagnetic fields, acute effects (electric shock).	2	SMALL, MODERATE, OR LARGE. Electrical shock resulting from direct access to energized conductors or from induced charges in metallic structures have not been found to be a problem at most operating plants and generally are not expected to be a problem during the license renewal term. However, site-specific review is required to determine the significance of the electric shock potential at the site. See § 51.53(c)(3)(ii)(H).
Electromagnetic fields, chronic effects [5].	NA [4]	UNCERTAIN. Biological and physical studies of 60–Hz electromagnetic fields have not found consistent evidence linking harmful effects with field exposures. However, because the state of the science is currently inadequate, no generic conclusion on human health impacts is possible.[5]
Radiation exposures to public (license renewal term).	1	SMALL. Radiation doses to the public will continue at current levels associated with normal operations.
Occupational radiation exposures (license renewal term).	1	SMALL. Projected maximum occupational doses during the license renewal term are within the range of doses experienced during normal operations and normal maintenance outages, and would be well below regulatory limits.
Socioeconomics		
Housing impacts	2	SMALL, MODERATE, OR LARGE. Housing impacts are expected to be of small significance at plants located in a medium or high population area and not in an area where growth control measures that limit housing development are in effect. Moderate or large housing impacts of the workforce associated with refurbishment may be associated with plants located in sparsely populated areas or in areas with growth control measures that limit housing development. See § 51.53(c)(3)(ii)(I).
Public services: public safety, social services, and tourism and recreation.	1	SMALL. Impacts to public safety, social services, and tourism and recreation are expected to be of small significance at all sites.
Public services: public utilities	2	SMALL OR MODERATE. An increased problem with water shortages at some sites may lead to impacts of moderate significance on public water supply availability. See § 51.53(c)(3)(ii)(I).
Public services, education (refurbishment).	2	SMALL, MODERATE, OR LARGE. Most sites would experience impacts of small significance but larger impacts are possible depending on site- and project-specific factors. See § 51.53(c)(3)(ii)(I).

TABLE B–1.—SUMMARY OF FINDINGS ON NEPA ISSUES FOR LICENSE RENEWAL OF NUCLEAR POWER PLANTS [1]—Continued

Issue	Category [2]	Findings [3]
Public services, education (license renewal term).	1	SMALL. Only impacts of small significance are expected.
Offsite land use (refurbishment)	2	SMALL OR MODERATE. Impacts may be of moderate significance at plants in low population areas. See § 51.53(c)(3)(ii)(I).
Offsite land use (license renewal term).	2	SMALL, MODERATE, OR LARGE. Significant changes in land use may be associated with population and tax revenue changes resulting from license renewal. See § 51.53(c)(3)(ii)(I).
Public services, Transportation	2	SMALL, MODERATE, OR LARGE. Transportation impacts are generally expected to be of small significance. However, the increase in traffic associated with the additional workers and the local road and traffic control conditions may lead to impacts of moderate or large significance at some sites. See § 51.53(c)(3)(ii)(J).
Historic and archaeological resources.	2	SMALL, MODERATE, OR LARGE. Generally, plant refurbishment and continued operation are expected to have no more than small adverse impacts on historic and archaeological resources. However, the National Historic Preservation Act requires the Federal agency to consult with the State Historic Preservation Officer to determine whether there are properties present that require protection. See § 51.53(c)(3)(ii)(K).
Aesthetic impacts (refurbishment).	1	SMALL. No significant impacts are expected during refurbishment.
Aesthetic impacts (license renewal term).	1	SMALL. No significant impacts are expected during the license renewal term.
Aesthetic impacts of transmission lines (license renewal term).	1	SMALL. No significant impacts are expected during the license renewal term.
Postulated Accidents		
Design basis accidents	1	SMALL. The NRC staff has concluded that the environmental impacts of design basis accidents are of small significance for all plants.
Severe accidents	2	SMALL. The probability weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to ground water, and societal and economic impacts from severe accidents are small for all plants. However, alternatives to mitigate severe accidents must be considered for all plants that have not considered such alternatives. See § 51.53(c)(3)(ii)(L).
Uranium Fuel Cycle and Waste Management		
Offsite radiological impacts (individual effects from other than the disposal of spent fuel and high level waste).	1	SMALL. Off-site impacts of the uranium fuel cycle have been considered by the Commission in Table S–3 of this part. Based on information in the GEIS, impacts on individuals from radioactive gaseous and liquid releases including radon-222 and technetium-99 are small.
Offsite radiological impacts (collective effects).	1	The 100 year environmental dose commitment to the U.S. population from the fuel cycle, high level waste and spent fuel disposal is calculated to be about 14,800 person rem, or 12 cancer fatalities, for each additional 20 year power reactor operating term. Much of this, especially the contribution of radon releases from mines and tailing piles, consists of tiny doses summed over large populations. This same dose calculation can theoretically be extended to include many tiny doses over additional thousands of years as well as doses outside the U.S. The result of such a calculation would be thousands of cancer fatalities from the fuel cycle, but this result assumes that even tiny doses have some statistical adverse health effect which will not ever be mitigated (for example, no cancer cure in the next thousand years), and that these does projection over thousands of years are meaningful. However these assumptions are questionable. In particular, science cannot rule out the possibility that there will be no cancer fatalities from these tiny doses. For perspective, the doses are very small fractions of regulatory limits, and even smaller fractions of natural background exposure to the same populations. Nevertheless, despite all the uncertainty, some judgement as to the regulatory NEPA implications of these matters should be made and it makes no sense to repeat the same judgement in every case. Even taking the uncertainties into account, the Commission concludes that these impacts are acceptable in that these impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR Part 54 should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the collective effects of the fuel cycle, this issue is considered Category 1.

TABLE B–1.—SUMMARY OF FINDINGS ON NEPA ISSUES FOR LICENSE RENEWAL OF NUCLEAR POWER PLANTS [1]—Continued

Issue	Category [2]	Findings [3]
Offsite radiological impacts (spent fuel and high level waste disposal).	1	For the high level waste and spent fuel disposal component of the fuel cycle, there are no current regulatory limits for offsite releases of radionuclides for the current candidate repository site. However, if we assume that limits are developed along the lines of the 1995 National Academy of Sciences (NAS) report, ''Technical Bases for Yucca Mountain Standards,'' and that in accordance with the Commission's Waste Confidence Decision, 10 CFR 51.23, a repository can and likely will be developed at some site which will comply with such limits, peak doses to virtually all individuals will be 100 millirem per year or less. However, while the Commission has reasonable confidence that these assumptions will prove correct, there is considerable uncertainty since the limits are yet to be developed, no repository application has been completed or reviewed, and uncertainty is inherent in the models used to evaluate possible pathways to the human environment. The NAS report indicated that 100 millirem per year should be considered as a starting point for limits for individual doses, but notes that some measure of consensus exists among national and international bodies that the limits should be a fraction of the 100 millirem per year. The lifetime individual risk from 100 millirem annual dose limit is about 310^{-3}. Estimating cumulative doses to populations over thousands of years is more problematic. The likelihood and consequences of events that could seriously compromise the integrity of a deep geologic repository were evaluated by the Department of Energy in the ''Final Environmental Impact Statement: Management of Commercially Generated Radioactive Waste,'' October 1980. The evaluation estimated the 70-year whole-body dose commitment to the maximum individual and to the regional population resulting from several modes of breaching a reference repository in the year of closure, after 1,000 years, after 100,000 years, and after 100,000,000 years. Subsequently, the NRC and other federal agencies have expended considerable effort to develop models for the design and for the licensing of a high level waste repository, especially for the candidate repository at Yucca Mountain. More meaningful estimates of doses to population may be possible in the future as more is understood about the performance of the proposed Yucca Mountain repository. Such estimates would involve very great uncertainty, especially with respect to cumulative population doses over thousands of years. The standard proposed by the NAS is a limit on maximum individual dose. The relationship of potential new regulatory requirements, based on the NAS report, and cumulative population impacts has not been determined, although the report articulates the view that protection of individuals will adequately protect the population for a repository at Yucca Mountain. However, EPA's generic repository standards in 40 CFR part 191 generally provide an indication of the order of magnitude of cumulative risk to population that could result from the licensing of a Yucca Mountain repository, assuming the ultimate standards will be within the range of standards now under consideration. The standards in 40 CFR part 191 protect the population by imposing ''containment requirements'' that limit the cumulative amount of radioactive material released over 10,000 years. The cumulative release limits are based on EPA's population impact goal of 1,000 premature cancer deaths world-wide for a 100,000 metric tonne (MTHM) repository. Nevertheless, despite all the uncertainty, some judgement as to the regulatory NEPA implications of these matters should be made and it makes no sense to repeat the same judgement in every case. Even taking the uncertainties into account, the Commission concludes that these impacts are acceptable in that these impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR part 54 should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the impacts of spent fuel and high level waste disposal, this issue is considered Category 1.
Nonradiological impacts of the uranium fuel cycle.	1	SMALL. The nonradiological impacts of the uranium fuel cycle resulting from the renewal of an operating license for any plant are found to be small.
Low-level waste storage and disposal.	1	SMALL. The comprehensive regulatory controls that are in place and the low public doses being achieved at reactors ensure that the radiological impacts to the environment will remain small during the term of a renewed license. The maximum additional on-site land that may be required for low-level waste storage during the term of a renewed license and associated impacts will be small. Nonradiological impacts on air and water will be negligible. The radiological and nonradiological environmental impacts of long-term disposal of low-level waste from any individual plant at licensed sites are small. In addition, the Commission concludes that there is reasonable assurance that sufficient low-level waste disposal capacity will be made available when needed for facilities to be decommissioned consistent with NRC decommissioning requirements.
Mixed waste storage and disposal.	1	SMALL. The comprehensive regulatory controls and the facilities and procedures that are in place ensure proper handling and storage, as well as negligible doses and exposure to toxic materials for the public and the environment at all plants. License renewal will not increase the small, continuing risk to human health and the environment posed by mixed waste at all plants. The radiological and nonradiological environmental impacts of long-term disposal of mixed waste from any individual plant at licensed sites are small. In addition, the Commission concludes that there is reasonable assurance that sufficient mixed waste disposal capacity will be made available when needed for facilities to be decommissioned consistent with NRC decommissioning requirements.

TABLE B–1.—SUMMARY OF FINDINGS ON NEPA ISSUES FOR LICENSE RENEWAL OF NUCLEAR POWER PLANTS [1]—Continued

Issue	Category [2]	Findings [3]
On-site spent fuel	1	SMALL. The expected increase in the volume of spent fuel from an additional 20 years of operation can be safely accommodated on site with small environmental effects through dry or pool storage at all plants if a permanent repository or monitored retrievable storage is not available.
Nonradiological waste	1	SMALL. No changes to generating systems are anticipated for license renewal. Facilities and procedures are in place to ensure continued proper handling and disposal at all plants.
Transportation	2	Table S–4 of this part contains an assessment of impact parameters to be used in evaluating transportation effects in each case. See § 51.53(c)(3)(ii)(M).
Decommissioning		
Radiation doses	1	SMALL. Doses to the public will be well below applicable regulatory standards regardless of which decommissioning method is used. Occupational doses would increase no more than 1 man-rem caused by buildup of long-lived radionuclides during the license renewal term.
Waste management	1	SMALL. Decommissioning at the end of a 20-year license renewal period would generate no more solid wastes than at the end of the current license term. No increase in the quantities of Class C or greater than Class C wastes would be expected.
Air quality	1	SMALL. Air quality impacts of decommissioning are expected to be negligible either at the end of the current operating term or at the end of the license renewal term.
Water quality	1	SMALL. The potential for significant water quality impacts from erosion or spills is no greater whether decommissioning occurs after a 20-year license renewal period or after the original 40-year operation period, and measures are readily available to avoid such impacts.
Ecological resources	1	SMALL. Decommissioning after either the initial operating period or after a 20-year license renewal period is not expected to have any direct ecological impacts.
Socioeconomic impacts	1	SMALL. Decommissioning would have some short-term socioeconomic impacts. The impacts would not be increased by delaying decommissioning until the end of a 20-year relicense period, but they might be decreased by population and economic growth.
Environmental Justice		
Environmental justice [6]	NA [4]	NONE. The need for and the content of an analysis of environmental justice will be addressed in plant-specific reviews.[6]

[1] Data supporting this table are contained in NUREG–1437, ''Generic Environmental Impact Statement for License Renewal of Nuclear Plants'' (xxxx 1996).

[2] The numerical entries in this column are based on the following category definitions:

Category 1: For the issue, the analysis reported in the Generic Environmental Impact Statement has shown:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristic;

(2) A single significance level (i.e., small, moderate, or large) has been assigned to the impacts (except for collective off site radiological impacts from the fuel cycle and from high level waste and spent fuel disposal); and

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

The generic analysis of the issue may be adopted in each plant-specific review.

Category 2: For the issue, the analysis reported in the Generic Environmental Impact Statement has shown that one or more of the criteria of Category 1 can not be met, and therefore additional plant-specific review is required.

[3] The impact findings in this column are based on the definitions of three significance levels. Unless the significance level is identified as beneficial, the impact is adverse, or in the case of ''small,'' may be negligible. The definitions of significance follow:

SMALL—For the issue, environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource. For the purposes of assessing radiological impacts, the Commission has concluded that those impacts that do not exceed permissible levels in the Commission's regulations are considered small as the term is used in this table.

MODERATE—For the issue, environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.

LARGE—For the issue, environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

For issues where probability is a key consideration (i.e. accident consequences), probability was a factor in determining significance.

[4] NA (not applicable). The categorization and impact finding definitions do not apply to these issues.

[5] Scientific evidence about a chronic biological effect on humans from exposure to transmission line electric and magnetic fields is inconclusive. If the Commission finds that a consensus has been reached by appropriate Federal health agencies that there are adverse health effects, the Commission will require applicants to submit plant-specific reviews of these health effects. Until such time, applicants for license renewal are not required to submit information on this issue.

[6] Environmental Justice was not addressed in NUREG–1437, ''Generic Environmental Impact Statement for License Renewal of Nuclear Plants,'' because guidance for implementing Executive Order 12898 issued on February 11, 1994, was not available prior to completion of NUREG–1437. This issue will be addressed in individual license renewal reviews.

Dated at Rockville, MD, this 29th day of May, 1996.

For the Nuclear Regulatory Commission.

John C. Hoyle,

Secretary of the Commission.

[FR Doc. 96–13874 Filed 6–4–96; 8:45 am]

BILLING CODE 7590–01–P

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 39

[Docket No. 95–NM–161–AD; Amendment 39–9644; AD 96–12–02]

RIN 2120–AA64

Airworthiness Directives; Airbus Model A300 B2 and B4 Series Airplanes, Excluding Model A300–600 Series Airplanes

AGENCY: Federal Aviation Administration, DOT.

ACTION: Final rule.

SUMMARY: This amendment adopts a new airworthiness directive (AD), applicable to certain Airbus Model A300 B2 and B4 series airplanes, that requires measurements of the thickness of the inner skin of the longitudinal lap joint from the inside of the fuselage at certain stringers. This amendment also requires inspections to detect stress corrosion cracking in the subject area, and repair, if necessary. This amendment is prompted by reports of stress corrosion cracking found in the skin at the longitudinal lap joint at certain stringers of the fuselage, which was caused by the increased stress level in the subject area when it was reworked beyond certain limits. The actions specified by this AD are intended to prevent such stress corrosion cracking which, if not detected and corrected in a timely manner, could result in rapid depressurization of the airplane.

DATES: Effective July 10, 1996.

The incorporation by reference of certain publications listed in the regulations is approved by the Director of the Federal Register as of July 10, 1996.

ADDRESSES: The service information referenced in this AD may be obtained from Airbus Industrie, 1 Rond Point Maurice Bellonte, 31707 Blagnac Cedex, France. This information may be examined at the Federal Aviation Administration (FAA), Transport Airplane Directorate, Rules Docket, 1601 Lind Avenue SW., Renton, Washington; or at the Office of the Federal Register, 800 North Capitol Street NW., suite 700, Washington, DC.

FOR FURTHER INFORMATION CONTACT: Tim Backman, Aerospace Engineer, Standardization Branch, ANM–113, FAA, Transport Airplane Directorate, 1601 Lind Avenue SW., Renton, Washington 98055–4056; telephone (206) 227–2797; fax (206) 227–1149.

SUPPLEMENTARY INFORMATION: A proposal to amend part 39 of the Federal Aviation Regulations (14 CFR part 39) to include an airworthiness directive (AD) that is applicable to certain Airbus Model A300 B2 and B4 series airplanes was published in the Federal Register on February 28, 1996 (61 FR 7444). That action proposed to require measurements of the thickness of the inner skin of the longitudinal lap joint from the inside of the fuselage at certain stringers using the ultrasonic thickness measurement method. That action also proposed to require high frequency eddy current (HFEC) inspections to detect cracking in the subject area, and repair, if necessary.

Interested persons have been afforded an opportunity to participate in the making of this amendment. Due consideration has been given to the two comments received.

Support for the Proposal

Both commenters support the proposed rule.

Conclusion

After careful review of the available data, including the comments noted above, the FAA has determined that air safety and the public interest require the adoption of the rule as proposed.

Cost Impact

The FAA estimates that 17 airplanes of U.S. registry will be affected by this AD, that it will take approximately 32 work hours per airplane to accomplish the required actions, and that the average labor rate is $60 per work hour. Based on these figures, the cost impact of the AD on U.S. operators is estimated to be $32,640, or $1,920 per airplane.

The cost impact figure discussed above is based on assumptions that no operator has yet accomplished any of the requirements of this AD action, and that no operator would accomplish those actions in the future if this AD were not adopted.

Regulatory Impact

The regulations adopted herein will not have substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government. Therefore, in accordance with Executive Order 12612, it is determined that this final rule does not have sufficient federalism implications to warrant the preparation of a Federalism Assessment.

For the reasons discussed above, I certify that this action (1) is not a ''significant regulatory action'' under Executive Order 12866; (2) is not a ''significant rule'' under DOT Regulatory Policies and Procedures (44 FR 11034, February 26, 1979); and (3) will not have a significant economic impact, positive or negative, on a substantial number of small entities under the criteria of the Regulatory Flexibility Act. A final evaluation has been prepared for this action and it is contained in the Rules Docket. A copy of it may be obtained from the Rules Docket at the location provided under the caption **ADDRESSES.**

List of Subjects in 14 CFR Part 39

Air transportation, Aircraft, Aviation safety, Incorporation by reference, Safety.

Adoption of the Amendment

Accordingly, pursuant to the authority delegated to me by the Administrator, the Federal Aviation Administration amends part 39 of the Federal Aviation Regulations (14 CFR part 39) as follows:

PART 39—AIRWORTHINESS DIRECTIVES

1. The authority citation for part 39 continues to read as follows:

Authority: 49 U.S.C. 106(g), 40113, 44701.

§ 39.13 [Amended]

2. Section 39.13 is amended by adding the following new airworthiness directive:

96–12–02 Airbus Industrie: Amendment 39–9644. Docket 95–NM–161–AD.

Applicability: Model A300 B2 and B4 series airplanes, manufacturer serial numbers 003 through 156 inclusive; on which Airbus Modification 2611 has not been installed; certificated in any category.

Note 1: This AD applies to each airplane identified in the preceding applicability provision, regardless of whether it has been modified, altered, or repaired in the area subject to the requirements of this AD. For airplanes that have been modified, altered, or repaired so that the performance of the requirements of this AD is affected, the owner/operator must request approval for an alternative method of compliance in accordance with paragraph (c) of this AD. The request should include an assessment of the effect of the modification, alteration, or repair on the unsafe condition addressed by this AD; and, if the unsafe condition has not

Applicant's Environmental Report - Operating License Renewal Stage

Limerick Generating Station, Units 1 and 2

Docket Numbers 50-352 and 50-353 License Numbers NPF-39 and NPF-85

Exelon Generation Company, LLC

TABLE OF CONTENTS

4.20 Severe Accident Mitigation Alternatives (SAMA)

NRC

The environmental report must contain a consideration of alternatives to mitigate severe accidents "…if the staff has not previously considered severe accident mitigation alternatives for the applicant's plant in an environmental impact statement or related supplement or in an environment assessment..." 10 CFR 51.53(c)(3)(ii)(L)

"…The probability weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to ground water, and societal and economic impacts from severe accidents are small for all plants. However, alternatives to mitigate severe accidents must be considered for all plants that have not considered such alternatives…." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 76

NRC characterizes consideration of alternatives to mitigate severe accidents as a Category 2 issue because the NRC's regulatory programs related to assessing severe accident mitigation (i.e., individual plant examination/individual plant examination of external events and Accident Management) have not established a record deemed adequate to support classifying the issue as Category 1 (NRC, 1996a; NRC, 2004). Notwithstanding, NRC has explained that Severe Accident Mitigation Alternatives (SAMAs) for LGS do not need to be analyzed at the license renewal stage because NRC previously completed such a site-specific analysis in a supplement to the Final Environmental Impact Statement Related to the Operation of LGS Units 1 and 2 (NRC, 1996a; NRC, 1989). The regulatory text codified in 10 CFR 51.53(c)(3)(ii)(L) also supports this conclusion. Accordingly, no analysis of SAMAs for LGS is provided in this License Renewal Environmental Report as none is required as a matter of law.

Nevertheless, in an abundance of caution, Section 5.3 discusses Exelon Generation's evaluation, which concludes that there is no new and significant information relevant to the conclusions codified in 10 CFR 51.53(c)(3)(ii)(L).

5.0 ASSESSMENT OF NEW AND SIGNIFICANT INFORMATION

5.1 Discussion

NRC

"…The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware." 10 CFR 51.53(c)(3)(iv)

The U.S. Nuclear Regulatory Commission (NRC) licenses the operation of domestic nuclear power plants and provides for license renewal, requiring a license renewal application that includes an environmental report (10 Code of Federal Regulations (CFR) 54.23). NRC regulations, 10 CFR Part 51, prescribe the environmental report content and identify the specific analyses the applicant must perform. In an effort to streamline the environmental review, NRC has resolved most of the environmental issues generically and only requires an applicant's analysis of the remaining issues.

While NRC regulations do not require an applicant's environmental report to contain analyses of the impacts of those Category 1 environmental issues that have been generically resolved [10 CFR 51.53(c)(3)(i)], the regulations do require that an applicant identify any new and significant information of which the applicant is aware [10 CFR 51.53(c)(3)(iv)]. The purpose of this requirement is to alert NRC staff to such information, so the staff can determine whether to seek the Commission's approval to waive or suspend application of the rule with respect to the affected generic analysis. NRC has explicitly indicated, however, that an applicant is not required to perform a site-specific validation of Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS) conclusions regarding Category 1 issues (NRC, 1996a).

Exelon Generation Company, LLC (Exelon Generation) expects that new and significant information for Limerick Generating Station, Units 1 and 2 (LGS) would include:

- Information that identifies a significant environmental issue not covered in the GEIS and codified in the regulation, or
- Information that was not covered in the GEIS analyses and that leads to an impact finding different from that codified in the regulation.

NRC does not specifically define the term significant. For the purpose of its review, Exelon Generation used guidance available in Council on Environmental Quality (CEQ) regulations. The National Environmental Policy Act (NEPA) authorizes CEQ to establish implementing regulations for federal agency use. NRC requires license renewal applicants to provide NRC with input, in the form of an environmental report, that NRC will use to meet NEPA requirements as they apply to license renewal (10 CFR 51.10).

CEQ guidance provides that federal agencies should prepare environmental impact statements for actions that would significantly affect the environment (40 CFR 1502.3), focus on significant environmental issues (40 CFR 1502.1), and eliminate from detailed study issues that are not significant [40 CFR 1501.7(a)(3)]. The CEQ guidance includes a lengthy definition of significantly that requires consideration of the context of the action and the intensity or severity of the impact(s) (40 CFR 1508.27). Exelon Generation considered that MODERATE or LARGE impacts, as defined by NRC, would be significant. Section 4.0 presents the NRC definitions of SMALL, MODERATE, and LARGE impacts.

The new and significant assessment that Exelon Generation conducted during preparation of this license renewal application included: (1) interviews with Exelon Generation subject matter experts on the validity of the conclusions in the GEIS as they relate to LGS, (2) an extensive review of documents related to environmental issues at LGS, (3) a review of correspondence with state and federal agencies to determine if the agencies had concerns relevant to their resource areas that had not been addressed in the GEIS, (4) a review of the results of LGS environmental monitoring and reporting, as required by regulations and oversight of plant facilities and operations by state and federal regulatory agencies (i.e., the results of ongoing routine activities that could bring significant issues to Exelon Generation's attention), (5) a review for issues relevant to the LGS application of certain license renewal applications that have previously been submitted to the NRC by the operators of other nuclear plants, and (6) a review of information related to severe accident mitigation.

5.2 Radiological Groundwater Protection

As part of the assessment for new and significant information described in Section 5.1, Exelon Generation evaluated information about tritium and plant-related gamma-emitting isotopes in groundwater at LGS (Section 2.3). Based on that evaluation, Exelon Generation has concluded for the following reasons that LGS is not contributing to changes in groundwater quality that would preclude current or future uses of the groundwater:

- As discussed in Section 2.3.1, there are no glacial deposits capable of maintaining alluvial aquifers along the Schuylkill River or upland of the Schuylkill River in the vicinity of LGS.
- Tritium concentrations in groundwater are monitored within the Radiological Groundwater Protection Program (RGPP) and have not exceeded 2,000 pCi/L (see Section 2.3.3).
- Neither Sr-90 nor plant-related gamma emitters have been detected in samples of groundwater and surface water from LGS.
- The RGPP at LGS has been shown to provide an effective detection monitoring system for inadvertent releases of tritium to groundwater from Station operations.
- The Exelon Generation response to issues documented under the RGPP illustrates that timely corrective action is effective to remediate and control inadvertent tritium releases to groundwater.

The identification of tritium in groundwater is new information, but based on the monitoring results discussed in Section 2.3.3, it is not significant. There has been no identification of plant-related gamma-emitting radioisotopes in groundwater at LGS. A Buried and Underground Piping and Tanks aging management program consistent with NEI Guideline for the Management of Buried Piping Integrity (NEI 09-14, January 2010) will be implemented at LGS. Therefore, the contribution of LGS operations during the license renewal period to the cumulative impacts of major activities on groundwater quality would be SMALL.

5.3 Severe Accident Mitigation

In the 1996 GEIS, NRC evaluated whether Severe Accident Mitigation Design Alternatives (SAMDAs) could be adequately addressed generically for all plants (NRC, 1996a, Sec. 5.4). This evaluation found that ongoing regulatory programs related to severe accident mitigation (i.e., individual plant examination/individual plant examination of external events and Accident Management) had not been completed for all plants. Therefore, NRC decided that consideration of severe accident mitigation alternatives should be included in site-specific environmental impact statements (EISs) for license renewal of nuclear plants (NRC, 1996a, Sec. 5.4.1.5). Notwithstanding, the NRC explicitly exempted plants for which an evaluation of alternatives to mitigate severe accidents was completed and included in a prior EIS or EIS supplement from this requirement (NRC, 1996a, Sec. 5.4.1.5). LGS is a plant that qualifies for this exemption because, as discussed in Section 4.20, an evaluation of severe accident mitigation design alternatives was completed in the "Final Environmental Statement Related to the Operation of Limerick Generating Station, Units 1 and 2" (NRC, 1989).

The assessment described in Section 5.1 found no new and significant information that would change the small impact determination for severe accidents set forth in the GEIS (NRC, 1996a, Sec. 5.5.2). Also, no new and significant information has been found that would change the generic conclusion codified by the NRC that LGS need not reassess severe accident mitigation alternatives for license renewal [10 CFR 51.53(c)(3)(ii)(L)]. The following subsections report the results of the assessment components for this latter issue.

5.3.1 Process to Identify New Information

The process developed by Exelon Generation to identify new information related to environmental impacts of postulated severe accidents focused on the following steps:

- Review of the NRC's Supplement to NUREG-0974 (NRC, 1989)
- Review of the June 1989 PRA Update (PECO, 1989), and
- Review of the LGS probabilistic risk assessment (PRA) model and updates to that model since publication of the Supplement to NUREG-0974 in 1989.

For purposes of this review, new information is defined as information indicating a potential change in the consequences of severe accidents from those considered by the NRC in the GEIS. The process for identifying new information, which is further explained below, considers information related to plant functions (e.g., plant changes or new severe accident challenges) that contribute to the consequences of a severe accident. The significance and materiality of the new information identified through this process is discussed further in Section 5.3.2, "Significance of New Information."

To facilitate the review for new information, the key severe accident issues addressed in the NRC's Supplement to NUREG-0974 were identified. Each of the Severe Accident Mitigation Design Alternatives (SAMDAs) previously considered by the NRC staff for Limerick addresses at least one specific severe accident function the interruption of which can jeopardize core cooling and/or threaten containment integrity. For several of the SAMDAs, the function is associated with prevention of core damage and, for others, mitigation of a core damage event. Exelon Generation conducted the review to assess whether new information that would suggest the need to evaluate additional severe accident mitigation alternatives has become known concerning any of these functions since the assessment was performed in the Supplement to

NUREG-0974. Exelon Generation concludes that, overall, the strategies identified in the Supplement to NUREG-0974 for preventing and mitigating core damage remain appropriate and adequate to address each of the accident functions, and no new information exists that would significantly and materially change the accident sequence progression from postulated severe accidents.

The change in population in the area surrounding LGS could impact the consequences of any severe accident. Therefore, the population change is identified as new information.

In June 1989, Philadelphia Electric Company updated the LGS PRA. The June 1989 Update, which provided the foundation for NRC's Supplement to NUREG-0974, based the SAMDA cost benefit analysis solely on off-site exposure cost by estimating the person-rem averted for each of the candidate SAMDAs. In comparison, current license renewal analyses of severe accident mitigation alternatives consider additional costs which include; on-site exposure and economic costs, off-site economic costs, on-site cleanup costs, and replacement power costs. The off-site exposure cost and the off-site economic cost tend to dominate the overall cost assessment. Accordingly, the evaluation of the off-site economic cost is considered here to be new information that could change the outcome of the SAMDA cost/benefit analysis presented in the Supplement to NUREG-0974.

The screening cost/benefit analysis in the Supplement to NUREG-0974 assigned $1,000 to each person-rem averted by a SAMDA. However, subsequent guidance provided in *Regulatory Analysis Technical Evaluation Handbook*, NUREG/BR-0184 (1997) assigns $2,000 to each person-rem averted. This has the potential to increase the benefit assigned to a proposed SAMDA and is considered to be new information.

Since its inception, the LGS PRA model has been regularly updated to reflect as-built and as-operated conditions. The current LGS PRA model was reviewed to identify new information relative to the quantification of risk (measured in core damage events per year) in comparison to information provided in the Supplement to NUREG-0974. A comparison of the internal-events core damage frequency (CDF) is a useful indication of significant changes to the PRA. Table 5.3-1 lists the estimated internal-events CDF beginning with the results provided in NUREG-1068, *Review Insights on the Probabilistic Risk Assessment for the Limerick Generating Station* (August 1984), and continuing through LG108A/LG208A, *Limerick Generating Station Probabilistic Risk Assessment, Summary Notebook, LG108A and LG208A Models, LG-PRA-013, Revision 2,* (September 18, 2009).

Table 5.3-1 – History of Internal-Events CDF

PRA Model	Date	CDF (per yr)
NUREG-1068	1984	1.5E-5
June 1989 Update	1989	5.9E-6
Individual Plant Examination (IPE)	1992	4.3E-6
LGS93	1993	5.3E-6
LGS95	1995	4.4E-6 (Unit 1) 4.4E-6 (Unit 2)
LGS197/LGS297	1998	3.2E-6 (Unit 1) 3.2E-6 (Unit 2)
LGS101/LGS201	2002	4.5E-6 (Unit 1) 4.5E-6 (Unit 2)
LGS104B/LGS204B	2005	3.7E-6 (Unit 1) 3.7E-6 (Unit 2)
LGS104C/LGS204C	2007	3.9E-6 (Unit 1) 3.9E-6 (Unit 2)
LG108A/LG208A	2009	3.2E-6 (Unit 1) 3.2E-6 (Unit 2)

The reduction in CDF reflects improvements in reliability data, improvements in procedural guidance and plant capabilities, and a reduction in the number of reactor trips. The reduction in CDF can also be linked to Exelon Generation's implementation over the years of the following industry programs, which NRC identified in the Supplement to NUREG-0974 as components of a systematic program described in SECY-88-147 ("Integration Plan for Closure of Severe Accident Issues," May 25, 1988) that provides the proper vehicle for further review of severe accidents at nuclear power plants, including LGS:

- Containment Performance Improvement (CPI)
- Accident Management (AM)
- Individual Plant Examination (IPE)

None of the contributors to the reduction in CDF qualifies as new information relative to the quantification of risk at LGS.

New information has become available as described in Generic Issue 199 (GI-199), *Implications of Updated Probabilistic Seismic Hazard Estimates in Central and Eastern United States on Existing Plants* (August 2010). Through GI-199, NRC is investigating proposed changes to seismic hazards at many nuclear power plant sites, both with respect to Ground Motion Response Spectra (GMRS) used in design analyses and probabilistic seismic hazard curves used in seismic probabilistic risk assessments.

Relative to estimates of core damage from fire induced contributors, the industry is currently working on the development of fire PRAs following the guidance provided in NUREG/CR-6850, *EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities* (September 2005). However, because NUREG/CR-6850 describes primarily the process for fire PRA development, it does not itself provide new information relative to fire risk at LGS.

In summary, Exelon Generation has identified the following four items of new information that could affect the analysis of severe accident mitigation alternatives for LGS:

1. Population increase
2. Consideration of offsite economic cost risk
3. Changed criterion for assigning cost per person-rem averted
4. Changed seismic hazard proposed in GI-199

5.3.2 Significance of New Information

In the context of the NRC's License Renewal environmental review, new information would be considered significant if it would cause a materially different result in the assessment of impacts than were determined in prior environmental assessments conducted consistent with the National Environmental Policy Act (NEPA). The pertinent NEPA environmental assessments for the LGS License Renewal are the 1996 GEIS and the associated site-specific supplemental EIS, for which the LGS License Renewal Environmental Report serves as a basis.

5.3.2.1 Population Increase

The SAMDA evaluation as documented in the Supplement to NUREG-0974 calculated the consequences of postulated severe accidents out to a radius of 50 miles from the LGS site boundary. Population information was provided in the *Environmental Report Operating License Stage, Limerick Generating Station, Units 1 & 2.* Rev. 1, September 1981 (updated through Rev. 20, September 1984), Vol. 1, Section 2.1, "Geography and Demography". The 50-mile population values for 1980 were 6,819,505.

Population estimates for 2030 obtained from Delaware, Pennsylvania, New Jersey, and Maryland state population data centers for counties within a 50-mile radius of LGS yield a 50-mile population of 9,499,925. This represents an increase in population of approximately 39% between the time the Supplement to NUREG-0974 was prepared and a time several years into the proposed period of extended operation for LGS. The year 2030 was chosen for population projections because this was the farthest future year to which population data for most counties within the 50-mile radius were projected.

The relationship between the population surrounding a nuclear plant and the estimated dose following a severe accident is approximately linear. Applying this relationship to the estimated 39% increase in population within 50 miles of the LGS site would yield an approximate 39% increase in dose values over those calculated in the LGS June 1989 Update. An increase in the person-rem averted values by 39% would reduce the cost per person-rem averted by 28%. Hence, even assuming 2030 population numbers, the SAMDA in the LGS June 1989 Update with the highest benefit/cost ratio (ATWS Vent), based on cost per person-rem averted, would still have a ratio of approximately $10,000 per person-rem averted, which is well above the $1,000 per person-rem averted criterion used in 1989.

Since none of the SAMDAs in the LGS June 1989 Update would become cost beneficial if 2030 population numbers were assumed, the new information concerning population increase is not judged to be significant. Furthermore, this conclusion would remain true even if the cost/benefit criterion was increased to $2,000 per person-rem averted, as is discussed in a separate evaluation below.

5.3.2.2 Consideration of Off-site Economic Cost Risk

The SAMDA evaluation for LGS as documented in the Supplement to NUREG-0974 calculated the benefit of each proposed SAMDA based on a reduction of the estimated person-rem. The resulting benefit value did not account for possible reduction in land contamination from a severe accident or the associated economic cost reduction. The economic cost of a severe accident at LGS can be estimated using information from other license renewal applications. In particular, a review of the Three Mile Island Nuclear Station Unit 1 Environmental Report for License Renewal (Docket No. 50-289), Section E.4.2 indicates that the off-site economic cost risk is approximately 70% larger than the off-site exposure cost risk. Therefore, as applied to the cost/benefit result in Table 2-3 of the June 1989 Update, a factor of 3 increase in the person-rem averted value for each SAMDA would provide an approximation for the impact due to economic cost. This increase in the averted person-rem would result in a factor of 3 reduction in the estimated cost per person-rem averted values. Applying a factor of 3 reduction to the most beneficial SAMDA (ATWS Vent) would result in an adjusted cost per person-rem averted of $5,000, which remains well above both the $1,000 per person-rem averted threshold used in 1989 and the currently used $2,000 per person-rem averted threshold.

5.3.2.3 Changed Criterion For Assigning Cost Per Person-Rem Averted

The SAMDA evaluation as documented in the Supplement to NUREG-0974 calculated the benefit of each proposed SAMDA based on a criterion of $1,000 per person-rem averted. Using a value of $2,000 per person-rem averted would increase the threshold and potentially result in new cost beneficial SAMDAs. As described in the Supplement to NUREG-0974, where several of the proposed SAMDAs fell below the $1,000 per person-rem averted benefit threshold, the June 1989 Update presents significantly lower risk estimates. To be specific, the cost/benefit results reported in the June 1989 Update show a cost per person-rem averted value of $15,100 for the ATWS Vent plant modification. This is the lowest cost/benefit ratio for the set, and it represents the SAMDA with the largest benefit potential. Even for this limiting SAMDA, changing the cost/benefit threshold to $2,000 per person-rem averted would still not result in this or any other of the SAMDAs becoming cost beneficial. Therefore, Exelon Generation concludes that changing the criterion for assigning benefit (i.e., cost per person-rem averted) from $1,000 per person-rem averted to $2,000 per person-rem averted would not change the conclusions in the Supplement to NUREG-0974. Hence, the new information represented by the changed criterion for assigning cost per person-rem averted is judged not to be significant.

5.3.2.4 Changed Seismic Hazard Proposed in GI-199

GI-199 issues will not result in postulated accident scenarios not already considered for LGS. Seismologists are refining methodologies, which may increase the estimated frequency of seismic events with very low probability. However, any change in risk that may be postulated from such low probability events would be very small from a societal (human health) risk perspective. Results from the June 1989 Update indicate that the contribution from seismic risk to the total CDF is approximately 25%, with fire risk contributing 31% to the total. Therefore, based on the June 1989 Update, the major risk contributors for external hazards are approximately equal to the CDF computed for internal events only. Based on this, total CDF for internal and external events can generally be approximated by multiplying the CDF for internal events by a factor of 2.

With a multiplication factor of 2 applied to the CDF estimated by the current model of record (CDF=3.2E-6), the revised CDF that accounts for both internal and external hazards (CDF=6.4E-6) would still be a factor of 6.5 below the value used in 1989 to assess the SAMDAs in Supplement to NUREG-0974 (CDF=4.2E-5). This demonstrates the excess margin in the SAMDA evaluation documented in the Supplement to NUREG-0974. A possible increase in risk beyond this assumption due to an even larger seismic CDF would be more than offset by the factor of 6.5 reduction in the current CDF. Therefore, Exelon Generation concludes that the new information represented by the changed seismic hazard proposed in GI-199 is not significant because it would not materially alter the SAMDA conclusions in the Supplement to NUREG-0974.

5.3.3 Summary of Findings

Exelon Generation has performed an evaluation to identify new information and to judge the significance of any such new information. For the purpose of this evaluation, Exelon Generation defined new information as information indicating a potential change in the consequences of severe accidents from those considered by NRC in the GEIS. For LGS, the consequences of severe accidents considered by NRC in the GEIS are reported in the NRC's Supplement to NUREG-0974, which was published in 1989. The following four (4) items of new information were identified by comparing assumptions for the SAMDA assessment reported in that document with assumptions used for current-day assessments of severe accident mitigation alternatives:

1. Population increase
2. Consideration of offsite economic cost risk
3. Changed criteria for assigning cost per person-rem averted
4. Changed seismic hazard proposed by GI-199

Each item of new information was reviewed to determine whether it would materially alter the NRC's conclusions, as documented in the Supplement to NUREG-0974. None of the items of new information was found to be significant. Hence, no new and significant information has been found that would change the generic conclusion codified by the NRC that LGS need not reassess severe accident mitigation alternatives for license renewal [10 CFR 51.53(c)(3)(ii)(L)].

5.4 Conclusion

In its entirety, Exelon Generation's assessment did not identify any new and significant information regarding the plant's environment or operations that would make any generic conclusion codified by the NRC for Category 1 issues not applicable to LGS, that would alter regulatory or GEIS statements regarding Category 2 issues, or that would suggest any other measure of license renewal environmental impact.

5.0 ENVIRONMENTAL IMPACTS OF POSTULATED ACCIDENTS

This chapter describes the environmental impacts from postulated accidents that Limerick Generating Station, Units 1 and 2 (LGS or Limerick) might experience during the period of extended operation. The term "accident" refers to any unintentional event outside the normal plant operational envelope that results in a release or the potential for release of radioactive materials into the environment. The two classes of postulated accidents listed in Table 5–1 are evaluated in detail in the generic environmental impact statement (GEIS). These two classes of accidents are:

- design-basis accidents (DBAs), and
- severe accidents.

Table 5–1. Issues Related to Postulated Accidents

Issues	GEIS Section	Category
DBAs	5.3.2; 5.5.1	1
Severe accidents	5.3.3; 5.3.3.2; 5.3.3.3; 5.3.3.4; 5.3.3.5; 5.4; 5.5.2	2

5.1 Design-Basis Accidents

To receive U.S. Nuclear Regulatory Commission (NRC) approval to operate a nuclear power plant, an applicant for an initial operating license must submit a safety analysis report (SAR) as part of its application. The SAR presents the design criteria and design information for the proposed reactor and comprehensive data on the proposed site. The SAR also discusses various hypothetical accident situations and the safety features that prevent and mitigate accidents. The NRC staff (the staff) reviews the application to determine if the plant design meets the NRC's regulations and requirements and includes, in part, the nuclear plant design and its anticipated response to an accident.

Design-basis accidents (DBAs) are those accidents that both the licensee and the staff evaluate to ensure that the plant can withstand normal and abnormal transients and a broad spectrum of postulated accidents, without undue hazard to the health and safety of the public. Many of these postulated accidents are not expected to occur during the life of the plant but are evaluated to establish the design basis for the preventive and mitigative safety systems of the nuclear power plant. Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50 and 10 CFR Part 100 describe the acceptance criteria for DBAs.

The environmental impacts of DBAs are evaluated during the initial licensing process, and the ability of the nuclear power plant to withstand these accidents is demonstrated to be acceptable before issuance of the operating license. The results of these evaluations are found in license documentation such as the applicant's final safety analysis report (FSAR), the staff's safety evaluation report (SER), the final environmental statement (FES), and Section 5.1 of this supplemental environmental impact statement (SEIS). A licensee is required to maintain the acceptable design and performance criteria throughout the life of the nuclear power plant, including any period of extended operation. The consequences for these events are evaluated for the hypothetical maximum exposed individual. Because of the requirements that continuous acceptability of the consequences and aging management programs be in effect for license renewal, the environmental impacts, as calculated for DBAs, should not differ significantly from initial licensing assessments over the life of the nuclear power plant, including the license renewal period. Accordingly, the design of the nuclear power plant, relative to DBAs during the extended period, is considered to remain acceptable; therefore, the environmental impacts of those accidents were not examined further in the GEIS.

The NRC has determined in the GEIS that the environmental impacts of DBAs are of SMALL significance for all nuclear power plants because the plants were designed to successfully withstand these accidents. Therefore, for the purposes of license renewal, DBAs are designated as a Category 1 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. The early resolution of the DBAs makes them a part of the current licensing basis (CLB) of the plant; the CLB of the plant is to be maintained by the licensee under its current license and, therefore, under the provisions of 10 CFR 54.30, is not subject to review under license renewal. This issue is applicable to LGS.

Exelon Generation Company, LLC (Exelon) stated in its environmental report (ER) (Exelon 2011c) that it is not aware of any new and significant information related to DBAs associated with the renewal of the LGS. The staff did not find any new and significant information during its independent review of Exelon's ER, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts related to DBAs beyond those discussed in the GEIS (NRC 2013a).

5.2 Severe Accidents

Severe nuclear accidents are those that are more severe than DBAs because they could result in substantial damage to the reactor core, whether or not there are serious offsite consequences. In the GEIS, the staff assessed the effects of severe accidents during the period of extended operation, using the results of existing analyses and site-specific information to conservatively predict the environmental impacts of severe accidents for each plant during the period of extended operation.

The impacts from severe accidents initiated by external phenomena such as tornadoes, floods, earthquakes, fires, and sabotage were specifically considered in the GEIS. The GEIS evaluated existing impact assessments—performed by the staff and by the industry at 44 nuclear power plants (including LGS) in the United States—and concluded that the risk from beyond design-basis earthquakes at existing nuclear power plants is SMALL. The GEIS also performed a discretionary analysis of sabotage, in connection with license renewal, and concluded that the core damage and radiological release from such acts would be no worse than the damage and release expected from internally initiated events. In the GEIS, the NRC concludes that the risk from sabotage at existing nuclear power plants is SMALL and, additionally, that the risks from other external events are adequately addressed by a generic consideration of internally initiated severe accidents (NRC 1996, 2013a).

Based on information in the GEIS, the NRC determined in its regulations that:

> The probability-weighted consequences of severe accidents are SMALL for all plants. However, alternatives to mitigate severe accidents must be considered for all plants that have not considered such alternatives.

The staff found no new and significant information related to severe accidents during the review of Exelon's ER (Exelon 2011c), the scoping process, the review of public comments, NRDC's waiver petition, or evaluation of other available information. Therefore, there are no impacts related to these issues, beyond those already discussed in the GEIS.

5.3 Severe Accident Mitigation Alternatives

The purpose of the evaluation of severe accident mitigation alternatives (SAMAs) is to identify design alternatives, procedural modifications, or training activities that are cost-beneficial and further reduce the risks of severe accidents (NRC 1999a). The analysis of SAMAs includes the identification and evaluation of alternatives that reduce the radiological risk from a severe accident by preventing substantial core damage (i.e., preventing a severe accident) or by limiting releases from containment in the event that substantial core damage occurs (i.e., mitigating the impacts of a severe accident) (NRC 1999b). In accordance with 10 CFR 51.53(c)(3)(ii)(L) and Table B-1 of Part 51, license renewal ERs must provide a consideration of alternatives to mitigate severe accidents if the staff has not previously evaluated SAMAs for the applicant's plant in an environmental impact statement (EIS) or related supplement or in an environmental assessment.

The staff has previously performed a site-specific analysis of severe accident mitigation in a National Environmental Policy Act of 1969 (NEPA) document for LGS in the Final Environmental Statement Related to Operation of LGS, Units 1 and 2 in NUREG-0974, Supplement 1 (NRC 1989) ("1989 SAMDA Analysis"). Therefore, no analysis of SAMAs for LGS is required in Exelon's ER or the staff's SEIS. The NRC staff uses the term SAMA to refer to SAMAs at the license renewal phase. In contrast, the term severe accident mitigation design alternative (SAMDA) refers to SAMAs at the initial licensing phase. The site-specific SAMDAs reviewed for applicability to LGS were evaluated in the 1989 SAMDA Analysis and also documented in GEIS Table 5.35. The staff examined each SAMDA (individually and, in some cases, in combination) to determine the potential SAMDA individual risk reduction potential. This risk reduction was then compared with the cost of implementing the SAMDA to provide cost-benefit evidence of its value. The staff concluded that:

> The risks of early fatality from potential accidents at the site are small in comparison with risks of early fatality from other human activities in a comparably sized population, and the accident risk will not add significantly to population exposure and cancer risks. Accident risks from Limerick are expected to be a small fraction of the risks the general public incurs from other sources. Further, the best estimates show that the risks of potential reactor accidents at Limerick are within the range of such risks from other nuclear power plants.

However, in the LGS specific 1989 SAMDA Analysis, the staff acknowledged:

> In the longer term, these same severe accident issues are currently being pursued by the NRC in a systematic way for all utilities through the Severe Accident Program described in SECY-88-147, "Integration Plan for Closure of Severe Accident Issues." The plan includes provisions for an Individual Plant Examination (IPE) for each operating reactor, a Containment Performance Improvement (CPI) program, and an Accident Management (AM) program. These programs will produce a more complete picture of the risks of operating plants and the benefits of potential design improvements, including SAMDAs. The staff believes that the severe accident program is the proper vehicle for further review of severe accidents at nuclear power plants, including Limerick.

Therefore, the Commission considers ways to mitigate severe accidents at a given site more than once. The Commission has considered alternatives for mitigating severe accidents at many sites, including LGS, multiple times through a variety of NRC programs. When it promulgated Table B-1 of 10 CFR Part 51, the Commission explained:

> The Commission has considered containment improvements for all plants pursuant to its Containment Performance Improvement (CPI) program…and the Commission has additional ongoing regulatory programs whereby licensees

> search for individual plant vulnerabilities to severe accidents and consider cost-beneficial improvements [(the individual plant examination "IPE" and individual plant examination of external events "IPEEE" programs)]. [61 FR 28467]

In light of these studies, the Commission believed that if the staff has already considered severe accident mitigation under NEPA once for a facility, it was "unlikely that any site-specific consideration of SAMAs for license renewal will identify major plant design changes or modifications that will prove to be cost-beneficial for reducing severe accident frequency or consequences" (61 FR 28467). In CLI-13-7, the Commission reaffirmed the conclusions in Table B-1 and 10 CFR 51.53(c)(3)(ii)(L) and stated that it promulgated those regulations "because we determined that one SAMA analysis would uncover most cost-beneficial measures to mitigate both the risk and the effects of severe accidents, thus satisfying our obligations under NEPA" (NRC 2013d).. Given the significant costs of a major plant design change, such an improvement must result in a substantial reduction in risk to be cost-beneficial. As discussed below, the NRC has thoroughly considered severe accidents and ways to mitigate their impacts, in the original SAMDA analysis for Limerick and other studies, and did not identify cost-beneficial major plant design changes or modifications for mitigating the impacts of severe accidents.

5.3.1 Containment Performance Improvement Program

One of the programs the Commission relied on in determining that SAMAs need not be performed at license renewal if the staff had already performed a SAMA review in an earlier NEPA document is the CPI program. With this program, the NRC examined each of five U.S. reactor containment types (BWR Mark I, II, and III; PWR Ice Condenser; and PWR Dry) with the purpose of examining the potential failure modes, potential fixes, and the cost benefit of such fixes. Tables 5.32 through 5.34 in the GEIS summarize the results of this program. As can be seen from these tables, many potential changes were evaluated but only a few containment improvements were identified for site-specific review. The items evaluated in the CPI program were also included in the list of plant-specific SAMDAs examined in the LGS FES supplement (NRC 1996). Furthermore, the CPI program issues applicable to Limerick were effectively subsumed into the IPE process in Supplements 1 and 3 to Generic Letter 88-20. Additionally, the Emergency Procedure Guidelines (EPG) and Severe Accident Management Guidelines (SAMGs) developed by the BWR Owners' Group (BWROG) and implemented at Limerick incorporate the accident management strategies identified in the CPI program (Exelon 2014a).

5.3.2 Individual Plant Examination

Another program the Commission relied on in determining that SAMAs need not be performed at license renewal if the staff had already performed a SAMA review in an earlier NEPA document is the Individual Plant Examination (IPE). The IPE's specific objective was to develop an appreciation of severe accident behavior, and to identify ways in which the overall probabilities of core damage and fission product releases could be reduced if deemed necessary. In general, the IPEs have resulted in plant procedural and programmatic improvements (i.e., accident management) and, in only a few cases, minor plant modifications, to further reduce the risk and consequences of severe accidents (NRC 1996).

In accordance with NRC's policy statement on severe accidents, the licensee performed an IPE to look for vulnerabilities to both internal and external initiating events (NRC 1988a). This examination considered potential improvements on a plant-specific basis. The core damage frequency (CDF) was found to be considerably less in the LGS IPE (4.3×10^{-6}) than in the original CDF value provided in NUREG-1068 (1.0×10^{-5}) for LGS and the 1989 PRA Update (1.0×10^{-5}) used in the 1989 SAMDA Analysis review. The staff further notes that the 2009 PRA Update (3.2×10^{-6}) is approximately an order of magnitude less than the 1989 PRA Update (Exelon ER) used in the 1989 SAMDA Analysis review. Plant improvements identified and implemented for LGS as a result of the IPE included: (1) relaxing restrictions on the drywell spray initiation curve in the Emergency Operating Procedures; (2) creating a procedure to cross-tie the 4-kilovolt (kV) safeguards electrical buses; (3) creating a procedure to power Unit 2 emergency service water (ESW) pumps from Unit 1; and (4) creating a cross-connection between the fire water and residual heat removal (RHR) systems (PECO 1992). Exelon request for additional information (RAI) response dated March 12, 2014, confirms these and other improvements were implemented to reduce risk at LGS as a result of the IPE (Exelon 2014a). These results at Limerick are also consistent with other IPEs in that they have resulted in only plant procedural and programmatic improvements (i.e., accident management) and, in only a few cases, minor plant modifications to further reduce the risk and consequences of severe accidents.

5.3.3 Individual Plant Examination of External Events

Another program the Commission relied on in determining that SAMAs need not be performed at license renewal if the staff had already performed a SAMA review in an earlier NEPA document is the Individual Plant Examination of External Events (IPEEE) program. While the IPE takes into account events that could challenge the design from things that could go awry internally (in the sense that equipment might fail because components do not work as expected), the IPEEE considers challenges such as earthquakes, internal fires, and high winds. The IPEEE program was initiated in the early 1990s. All operating plants in the United States (including LGS) performed an assessment to identify vulnerabilities to severe accidents initiated by external events and reported the results to the NRC, along with any identified improvements and/or corrective actions. *Perspectives Gained from the Individual Plant Examination of External Events (IPEEE) Program*, NUREG–1742 documents the perspectives derived from the technical reviews of the IPEEE results (NRC 2002). As a result of conducting the LGS IPEEE, PECO Energy identified seismic event and fire event findings. Actions were taken to address minor housekeeping and maintenance issues related to the seismic analysis such as unrestrained tools, lockers, hoist controllers and lifting devices for low voltage switchgear. In addition, fire brigade drill activities and fire brigade awareness were increased for three areas in the common control structure. Furthermore, actions credited in the fire analysis such as improved transient combustible controls, creation of transient combustible free zones and formal designation of certain fire rated doors as “fire” doors were implemented at LGS (PECO 1995). Exelon RAI response dated March 12, 2014, confirms these and other improvements were implemented to reduce risk at LGS as a result of the IPEEE (Exelon 2014a). These results at Limerick are also consistent with other IPEEEs in that they have resulted in only plant procedural and programmatic improvements (i.e., accident management) and, in only a few cases, minor plant modifications to further reduce the risk and consequences of severe accidents.

5.3.4 Accident Management Program

The staff specifically relied on the Accident Management Program as the proper avenue for addressing the improvements considered in the 1989 SAMDA Analysis. Accident management involves the development of procedures that promote the most effective use of available plant equipment and staff in the event of an accident. The staff indicated its intent (NRC 1988a) that licensees develop an accident management framework that will include implementation of accident management procedures, training, and technical guidance. Exelon developed an accident management program at LGS which factored insights gained as a result of the IPE. As discussed earlier, the improvements identified from the completed IPEs to date have been in the area of accident management or other procedural and programmatic improvements (NRC 1996 and NRC 1997). Additionally the EPG and SAMGs developed by the BWROG and implemented at Limerick incorporate the accident management strategies identified in the CPI program. Exelon RAI response dated March 12, 2014, confirms these and other improvements were implemented to reduce risk at LGS as a result of the IPE (Exelon 2014a).

5.3.5 NRC Efforts to Address Severe Accident-Related Issues Since the Publication of the 1996 GEIS

The evaluation of Limerick's 1989 SAMDA analysis is summarized in the 1996 GEIS. The NRC has continued to address severe accident-related issues since the GEIS was published and 10 CFR Part 51 changes related to license renewal were promulgated. The NRC and licensee efforts have reduced risks from accidents beyond that considered in the 1996 GEIS (summarized below) and the 2013 GEIS (NRC 2013a). In some cases, such as the agency response to Fukushima, these activities are ongoing. Each of the activities applied or continues to apply to all reactors, including LGS. The specific requirement for any given reactor was based either on a site-specific evaluation or a design-specific requirement.

5.3.6 10 CFR 50.54(hh) Conditions of License Regarding Loss of Large Areas of the Plant Caused by Fire or Explosions

Following September 11, 2001, the Commission issued Order EA-02-026 and ultimately a new regulation (10 CFR 50.54(hh)), which required commercial power reactor licensees to, among other things, adopt mitigation strategies using readily available resources to maintain or restore core cooling, containment, and spent fuel pool cooling capabilities to cope with the loss of large areas of the facility because of large fires and explosions from any cause, including beyond-design-basis aircraft impacts (See 74 FR 13926). The final rule also added several new requirements developed as a result of insights gained from implementation of the security orders, reviews of site security plans, and implementation of the enhanced baseline inspection program, and updated the NRC's security regulatory framework for the licensing of new nuclear power plants. Compliance with the final rule was required by March 31, 2010, for licensees, including Exelon, currently licensed to operate under 10 CFR Part 50. Exelon has updated its plant and procedures accordingly, and the NRC has inspected the guidelines and strategies that Exelon has implemented to meet the requirements of 10 CFR 50.54(hh)(2). The specifics of the enhancements are security related and not publicly available but are described, in general, in the 2013 GEIS. These enhancements include: (1) significant reinforcement of the defense capabilities for nuclear facilities, (2) better control of sensitive information, (3) enhancements in emergency preparedness (EP) to further strengthen the NRC's nuclear facility security program, and (4) implementation of mitigating strategies to deal with postulated events potentially causing loss of large areas of the plant caused by explosions or fires, including those that an aircraft impact might create. These measures are outlined in greater detail in NUREG/BR-0314 (NRC 2004), NUREG-1850 (NRC 2005), and Sandia National Laboratory's "Mitigation of Spent Fuel Loss-of-Coolant Inventory Accidents and Extension of Reference Plant Analyses to Other Spent Fuel Pools" (Wagner and Gaunt 2006).

As discussed in Section 5.3.3.1 of the 1996 GEIS, security-related events are addressed via deterministic criteria in 10 CFR Part 73, rather than by risk assessments or SAMAs. However, as provided above in the severe accident introduction (Section 5.3), the purpose of the evaluation of SAMAs is to identify design alternatives, procedural modifications, or training activities that are cost-beneficial and further reduce the risks of severe accidents (NRC 1999a). The analysis of SAMAs includes the identification and evaluation of alternatives that reduce the radiological risk from a severe accident by preventing substantial core damage (i.e., preventing a severe accident) or by limiting releases from containment in the event that substantial core damage occurs (i.e., mitigating the impacts of a severe accident) (NRC 1999b). Exelon's efforts to implement the deterministic requirements of 10 CFR 50.54(hh) and 10 CFR Part 73 were similar to the purpose of evaluating SAMAs because they mitigate the consequences of a beyond design basis accident. However, the implementation of deterministic 10 CFR 50.54(hh) and 10 CFR Part 73 requirements are required regardless of whether they are cost-beneficial or not. Nevertheless, these activities have further contributed to the reduction of risk at Limerick.

5.3.7 Severe Accident Management Guidelines

Exelon has also developed and implemented severe accident mitigation guidelines (SAMGs) at LGS, which further reduce risk at the facility. SAMGs were developed by the industry during the 1980s and 1990s in response to the Three Mile Island (TMI) Nuclear Station accident and follow-up activities. SAMGs are meant to "enhance the ability of the operators to manage accident sequences that progress beyond the point where emergency operating procedures (EOPs) and other plant procedures are applicable and useful" (NRC 2011a). The CPI program issues applicable to Limerick were effectively subsumed into the IPE process in Supplements 1 and 3 to Generic Letter 88-20. Additionally, the EPG and SAMGs developed by the BWROG and implemented at Limerick incorporate the accident management strategies identified in the CPI program and elsewhere (Exelon 2014a). The development and implementation of these guidelines are similar to SAMAs in that they are procedural modifications that further reduce the risks of severe accidents.

5.3.8 Fukushima-Related Activities

On March 11, 2011, a massive earthquake off the east coast of Honshu, Japan, produced a tsunami that struck the coastal town of Fukushima. The six-unit Fukushima Dai-ichi nuclear power plant was directly impacted by these events. The resulting damage caused the failure of several of the units' safety systems needed to maintain cooling water flow to the reactors. As a result of the loss of cooling, the fuel overheated, and there was a partial meltdown of the fuel contained in three of the reactors. Damage to the systems and structures containing reactor fuel resulted in the release of radioactive material to the surrounding environment (NRC 2013a).

In response to the earthquake, tsunami, and resulting reactor accidents at Fukushima Dai-ichi (hereafter referred to as the "Fukushima events"), the Commission directed the staff to convene an agency task force of senior leaders and experts to conduct a methodical and systematic review of the relevant NRC regulatory requirements, programs, and processes, including their implementation, and to recommend whether the agency should make near-term improvements to its regulatory system. As part of the short-term review, the task force concluded that, while improvements are expected to be made as a result of the lessons learned from the Fukushima events, the continued operation of nuclear power plants and licensing activities for new plants do not pose an imminent risk to public health and safety. During the time that the task force was conducting its review, groups of individuals and nongovernmental organizations petitioned the Commission to suspend all licensing decisions in order to conduct a separate, generic NEPA analysis to determine whether the Fukushima events constituted "new and significant information" under NEPA that must be analyzed as part of environmental reviews. The Commission found the request premature and noted, "In short, we do not know today the full implications of the [Fukushima] events for U.S. facilities." However, the Commission found that if "new and significant information comes to light that requires consideration as part of the ongoing preparation of application-specific NEPA documents, the agency will assess the significance of that information, as appropriate." The Federal courts of appeal and the Commission have interpreted NEPA such that an EIS must be updated to include new information only when that new information provides "a seriously different picture of the environmental impact of the proposed project from what was previously envisioned" (NRC 2013a).

The NRC also ensured U.S. nuclear power plants took action to prepare for a Fukushima-like event. The NRC told its inspectors to independently assess each plant's level of preparedness. The inspections covered procedures that compensate for extensive onsite damage, loss of all alternating current (AC) power, and seismic and flooding issues, as well as procedures for dealing with a damaged reactor.

The agency also created the Japan Lessons Learned-Project Directorate, or JLD, to lead the NRC efforts relating to Fukushima. The JLD's approximately 20 full-time employees work with experts from across the agency. The JLD is directed by a steering committee made up of NRC senior managers.

The agency issued three Orders in March 2012 requiring U.S. reactors to:

- Obtain and protect additional emergency equipment, such as pumps and generators, to support all reactors at a given site simultaneously following a natural disaster
- Install enhanced equipment for monitoring water levels in each plant's spent fuel pool.
- Improve/install emergency venting systems that can relieve pressure in the event of a serious accident (only for reactors with designs similar to the Fukushima plant).

The NRC strengthened the venting Order in 2013, requiring the vents to handle the pressures, temperatures, and radiation levels from a damaged reactor. The revised Order also calls for plants to ensure their personnel could operate the vents under those conditions (NRC 2013b).

The NRC has also asked all U.S. reactors to reconfirm their flooding and earthquake preparedness, as well as reanalyze their earthquake and flooding hazards. Other NRC activities include creating or revising rules related to maintaining key safety functions, if a plant loses all AC power, and several aspects of EP. The NRC's Web site includes more information on Fukushima-related actions.

Significantly, while the Commission did impose additional safety requirements on operating reactors following Fukushima as provided in the preceding paragraphs, the Commission did so on the basis of a safety analysis conducted under the Backfit Rule, not the results of a SAMA analysis conducted for NEPA purposes. Those SAMA analyses had long assumed that prolonged station blackouts, such as the one experienced by the Fukushima reactors, could yield devastating consequences. Therefore, subsequent events, including the Fukushima events, have confirmed the Commission's twin expectations that (1) future SAMA analyses would not likely find major plant improvements cost-beneficial and that (2) the NRC would continue to reduce risk at regulated facilities through its ongoing safety oversight (61 FR 28467; NRC 1996).

Given the many ways the NRC has and continues to address severe accident-related issues since the publication of the 1996 GEIS (Sections 5.3.5 to 5.3.8) and the 1989 SAMDA, the NRC concludes that the NRC does not need to reconsider SAMAs for LGS at the license renewal phase. See 10 CFR 51.53(c)(3)(ii)(L) and 10 CFR Part 51 Table B–1. As provided above, 10 CFR 51.53(c)(3)(ii)(L) and 10 CFR Part 51 Table B–1 rely on more than just the prior 1989 SAMDA Analysis; they also rest on the IPE, IPEEE, and CPI programs, to consider SAMAs in cases like LGS in which the NRC has already analyzed SAMAs. These plant-specific analyses did not identify major cost-beneficial mitigation measures that could substantially reduce offsite risk. Rather, they mostly uncovered minor improvements and programmatic fixes. The volume of plant-specific analyses cited by the Commission, and their ongoing nature, provide the type of "hard look" the Commission understood it must apply to the issue of SAMAs in its NEPA review for every license renewal proceeding (61 FR 28481). This approach is all the more reasonable in light of the Commission's finding that the probability-weighted environmental impacts of severe accidents are small.

Furthermore, the 2013 GEIS mentions the vast operating experience to support the safety of U.S. nuclear power plants. As with any technology, experience generally leads to improved plant performance and public safety. This additional experience has contributed to improved plant performance (e.g., as measured by trends in plant-specific performance indicators), a reduction in operating events, and lessons learned that improve the safety of all of the operating nuclear power plants. The items above contribute to improved safety as do those safety improvements not related to license renewal such as generic safety issues (e.g., Generic Safety Issue 191 on sump performance). Thus, the performance and safety record of nuclear power plants operating in the United States, including Limerick, continues to improve. This is also confirmed by analysis which indicates that, in many cases, improved plant performance and design features have resulted in reductions in initiating event frequency, CDF, and containment failure frequency (NRC 2013a).

5.3.9 Evaluation of Other New Information

Additionally, both the applicant and the NRC must consider whether new and significant information affects environmental determinations in the NRC's regulations, including the determination in 10 CFR 51.53(c)(3)(ii)(L) and Table B-1 that the agency need not reconsider SAMAs at license renewal if it has already done so in a NEPA document for the plant. See 61 FR 28467 to 28468; see *Marsh* v. *Oregon Natural Resources Council*, 490 U.S. 360, 373–374 (1989). As the Commission observed in CLI-13-7, the staff must consider whether there is new and significant information pertaining to the 1989 SAMDA analysis for Limerick's original operating licenses in the SEIS. If new and significant information is available, "then the original SAMA analysis may be inadequate to satisfy NEPA at the license renewal stage, and may require supplementation."

The 1989 SAMDA concluded, "The risks and environmental impacts of severe accidents at Limerick are acceptably low." We have found no new information that would call into question the FES conclusion that:

> [T]he risks of early fatality from potential accidents at the site are small in comparison with risks of early fatality from other human activities in a comparably sized population, and the accident risk will not add significantly to population exposure and cancer risks. Accident risks from Limerick are expected to be a small fraction of the risks the general public incurs from other sources. Further, the best estimate calculations show that the risks of potential reactor accidents at Limerick are within the range of such risks.

Furthermore, the 1989 SAMDA stated, "In light of these considerations, the staff has no clear basis at this time for concluding that modifications to the plant are justified for the purpose of further mitigating severe accident risks" and "The staff believes that the severe accident program is the proper vehicle for further review of severe accidents at nuclear power plants, including Limerick."

New information is significant if it provides a seriously different picture of the impacts of the Federal action under consideration. Thus, for mitigation alternatives such as SAMAs, new information is significant if it indicates that a mitigation alternative would substantially reduce an impact of the Federal action on the environment. Consequently, with respect to SAMAs, new information may be significant if it indicated a given cost-beneficial SAMA would substantially reduce the impacts of a severe accident or the probability or consequences (risk) of a severe accident occurring. As discussed below, none of the information identified by the applicant, commenters on the EIS, waiver petitions, or the staff indicates that any SAMAs would be cost-beneficial and likely to result in such a reduction of risk. Rather, new information indicates that further SAMA analyses are unlikely to identify a SAMA that substantially reduces the risk of a severe accident, such as major, cost-beneficial plant improvements, and that the overall probability of a severe accident has decreased at LGS. The following evaluation for new and significant information is to determine whether any new and significant information exists that provides a “seriously different picture of the environmental impacts than what was previously envisioned” regarding the determination in 10 CFR 51.53(c)(3)(ii)(L) Table B-1 and the clarifications in the statement of considerations.

The applicant relied on these requirements and did not submit a new SAMA analysis for license renewal. Specifically, the applicant cited 10 CFR 51.53(c)(3)(ii)(L) and stated that no SAMA was submitted as none was required as a matter of law (Exelon 2011c). Because the Commission stated in the statements of consideration for 10 CFR 51.53(c)(3)(ii)(L) that the 1989 SAMDA was a SAMA for purposes of the rule (61 FR 28481), the staff concluded that Exelon’s treatment of SAMA in its ER was in accordance with the Commission’s regulations. Exelon evaluated whether there was new and significant information with respect to the Commission’s regulation (Exelon 2011c). Specifically, Exelon analyzed whether potentially new and significant information would change the results of its 1989 SAMDA Analysis review. The Commission stated in CLI-12-19 that if the staff identifies new information that could invalidate the 1989 SAMDA Analysis, it should evaluate whether that information is significant under NEPA. The staff reviewed the applicant’s submitted information to assess if any of that information invalidated the 1989 SAMDA and also assessed if any new and significant information has been found that would change the generic conclusion codified by the NRC that Exelon need not reassess SAMAs at LGS for license renewal (10 CFR 51.53(c)(3)(ii)(L)) and the staff need not reconsider SAMAS at this stage (10 CFR 51, Table B-1). The following summarizes Exelon’s evaluation and the staff’s review of this information. In addition, the staff’s independent assessment did not identify any other new and significant information with respect to those regulations or the 1989 SAMDA. Hence, no new and significant information has been found with respect to the generic conclusion codified by the NRC that LGS need not reassess SAMAs for license renewal (10 CFR 51.53(c)(3)(ii)(L)) because neither the staff nor applicant uncovered any new and significant information that suggested another cost-beneficial SAMA that could substantially reduce the risk of a severe accident at Limerick.

5.3.10 The Applicant’s Evaluation of New and Significant Information

The applicant explained the process it used to identify any potentially new and significant information related to its existing 1989 SAMDA review in Section 5.3.1 of the ER (Exelon 2011c). As provided in Section 5.1 of Appendix E of the ER (Exelon 2011c), the new and significant assessment that Exelon conducted during preparation of this license renewal application included: (1) interviews with Exelon Generation subject-matter experts on the validity of the conclusions in the GEIS as they relate to LGS, (2) an extensive review of documents related to environmental issues at LGS, (3) a review of correspondence with State and Federal agencies to determine if the agencies had concerns relevant to their resource areas that had not been addressed in the GEIS, (4) a review of the results of LGS environmental monitoring and reporting, as required by regulations and oversight of plant facilities and operations by State and Federal regulatory agencies (i.e., the results of ongoing routine activities that could bring significant issues to Exelon Generation's attention), (5) a review for issues relevant to the LGS application of certain license renewal applications that have previously been submitted to the NRC by the operators of other nuclear plants, and (6) a review of information related to severe accident mitigation. The significance and materiality of the new information identified through this process was discussed further in ER Section 5.3.2, "Significance of New Information." Exelon used a methodical approach to identify new and significant information and the staff finds Exelon's process adequate to ensure a reasonable likelihood that the applicant would be aware of any new and significant information.

The following four items of new information were identified and evaluated by the applicant by comparing assumptions for the 1989 SAMDA Analysis with assumptions used for current-day assessments of SAMAs:

(1) population increase;

(2) consideration of offsite economic cost risk;

(3) changed criteria for assigning cost per person-rem averted; and

(4) changed seismic hazard proposed by GI-199, "Implications of Updated Probabilistic Seismic Hazard Estimates in Central and Eastern United States on Existing Plants."

Each item of new information was evaluated by the applicant and reviewed by the staff to determine whether it would materially alter the NRC's conclusions, as documented in the 1989 SAMDA Analysis. None of the items of new information led to the identification of a SAMA that was cost-beneficial. Consequently, the applicant's and staff's review of new and significant information with respect to the 1989 SAMDA review did not uncover any cost-beneficial plant improvements or SAMAs that would substantially decrease the risk of a severe accident. Instead, it indicated that no plant improvements that led to a substantial reduction in risk would be cost-beneficial. Therefore, the staff finds that none of the new information identified by the applicant affects the generic conclusion codified by the NRC that applicants need not reassess SAMAs for license renewal at facilities like LGS (10 CFR 51.53(c)(3)(ii)(L)) or the 1989 SAMDA analysis.

5.3.11 Risk

As provided in the discussion earlier regarding LGS's IPE, the CDF in the 2009 PRA Update (3.2×10^{-6}) is more than an order of magnitude less than the 1989 PRA Update (Exelon ER). Any change in the likelihood of accidents that release substantial amounts of radioactive material to the environment not only affects the human impact but also any environmental impact. For LGS, this decrease in CDF would demonstrate less impact to dose, economic, and environmental impact. The overall reduction in risk indicates that further SAMA analyses for LGS would be unlikely to uncover cost-beneficial major plant improvements or plant improvements that could substantially reduce risk. Furthermore, as improvements are implemented and risk decreases, not only is it more difficult to find a SAMA that yields significant reduction in CDF, but SAMAs which lead to a small reduction in risk are more likely not to be cost-beneficial. In light of the significant reductions in CDF at Limerick, no new information is likely to significantly affect the Commission's generic determination that the NRC need not reanalyze SAMAs at LGS for license renewal or invalidate the 1989 SAMDA.

5.3.12 Population Increase

A summary of Exelon's evaluation of population increase provided in the ER is as follows. Exelon provided population values within 50 miles growing from 6,819,505 in 1980 to 9,499,925 in 2030. They further assumed that this 39 percent increase in population would yield an approximate 39 percent increase in total off-site dose values. Assuming 2030 population numbers, the applicant determined that the highest benefit/cost ratio SAMDA (ATWS Vent) based on cost per person-rem averted would still not be cost-beneficial in the 1989 SAMDA Analysis.

There were also public comments that provided site specific information regarding population increases and economics around Limerick Generating Station. Comment 30-39-PA indicates that the impact of a severe accident at Limerick erroneously relies on data from an analysis done at TMI, a site that involves a markedly different and less economically developed area than the area within 50 miles of Limerick, which includes the densely populated urban environments of Philadelphia, PA; Camden and Trenton, NJ; and Wilmington, DE.

The staff reviewed the calculation provided by the applicant and considered the public comments regarding population growth.

GEIS section E.3.9.2 provides an evaluation of the population increase for multiple plants to determine the effect of population increases on the plants evaluated in the GEIS. The 2013 GEIS states,

> To adjust the impacts estimated in the NUREGs and NUREG/CRs to the mid-year of the assessed plant's license renewal period, the information (i.e., exposure indexes [EIs]) in the 1996 GEIS can be used. The EIs adjust a plant's airborne and economic impacts from the year 2000 to its mid-year license renewal period based on population increases. These adjustments result in anywhere from a 5- to a 30-percent increase in impacts, depending upon the plant being assessed. Given the range of uncertainty in these types of analyses, a 5- to 30-percent change is not considered significant. Therefore, the effect of increased population around the plant does not generally result in significant increases in impacts.

Exelon's population calculation was reviewed by the staff and found to be reasonable. Furthermore, the 39-percent increase in impacts determined at Limerick was more conservative than any of the other plants evaluated in the GEIS (a maximum of a 30-percent increase). Thus the Exelon calculation was determined to be reasonable and found acceptable by the staff. The staff also confirmed that the population increase would not make any of the 1989 SAMDAs cost-effective.

The staff acknowledges that a more precise estimate of this relationship could be obtained by using the MACCS2 code, performing a level 3 PRA, and completing a new SAMA analysis. However, the staff notes that improvements or mitigating strategies as a result of population increases at Limerick would be implemented as part of the current licensing basis in the plant's emergency plan. A key component of the mission of the NRC is to ensure adequate protective actions are in place to protect the health and safety of the public. Protective actions are taken to avoid or reduce radiation dose and are sometimes referred to as protective measures. The overall objective of emergency preparedness (EP) is to ensure that the nuclear power plant operator is capable of implementing adequate measures to protect public health and safety in the event of a radiological emergency. As a condition of their license, operators of these nuclear power plants must develop and maintain EP plans that meet comprehensive NRC EP requirements. Increased confidence in public protection is obtained through the combined inspection of the requirements of EP and the evaluation of their implementation. The NRC assesses the capabilities of the nuclear power plant operator to protect the public by requiring the performance of a full-scale exercise at least once every 2 years that includes the participation of government agencies. These exercises are performed in order to maintain the skills of the emergency responders and to identify and correct weaknesses. They are evaluated by NRC inspectors and FEMA evaluators. Between these 2-year exercises, additional drills are conducted by the nuclear power plant operators that are evaluated by NRC inspectors (NRC Website). An example where population is evaluated in the current term is found in the Limerick Generating Station Evacuation Time and Plume Exposure Pathway Estimates using 2010 Census population data (Exelon 2013b). Thus, Limerick's population-related mitigating alternatives are considered in the current term regardless of whether they are pursuing license renewal or not. The 2013 GEIS evaluation of population and economic consequences is described in Section 5.3.13.

Since Limerick's calculation was reasonable, more conservative than any of the population increase evaluations in the GEIS, and mitigation alternatives as a result of population increases are implemented in the current term, the staff finds Limerick's evaluation acceptable and population increases at Limerick are not new and significant information. Moreover, even if population increase led to another SAMA becoming cost-beneficial, that SAMA would still not likely result in a substantial reduction in offsite risk, given the substantial reduction in CDF at Limerick since the 1989 SAMDA analysis. In addition, the implementation of Limerick's improvements to reduce the CDF makes it more difficult to identify additional cost beneficial SAMAs, thus, it is unlikely that further consideration of economic risk would yield many cost-beneficial SAMAs. Consequently, the population increase within 50 miles of LGS does not suggest that additional cost-beneficial SAMAs could substantially reduce the risk of severe accidents and therefore does not constitute new and significant information with respect to the 1989 SAMDA or the generic conclusion codified by the NRC that SAMAs need not be reassessed at facilities like LGS for license renewal (10 CFR 51.53(c)(3)(ii)(L)).

5.3.13 Consideration of Offsite Economic Cost Risk

The applicant indicated that the 1989 SAMDA Analysis did not consider offsite economic cost risk. To account for the offsite economic cost risk, the applicant estimated these impacts by using data from the TMI license renewal application (Amergen 2008; Exelon 2011b). Using TMI data, the applicant determined offsite economic cost risk was approximately 70 percent larger than the offsite exposure cost risk at TMI. In order to apply the TMI data to LGS, the applicant applied a factor of 3 (300 percent) to analyze the impact on the 1989 SAMDA Analysis for LGS. Applying a factor of 3 reduction to the closest potential cost-beneficial SAMDA (ATWS Vent) would not result in a cost-beneficial SAMDA (Exelon 2011c).

The staff assessed the calculation provided by the applicant. The staff confirmed the applicant's value by using similar ratios to evaluate the cost impact of onsite exposure and economic costs for LGS ($2,000 and $400,000, respectively) to obtain the total offsite and onsite economic and exposure cost. The net value was determined by the staff to be −$284,000, indicating that the ATWS Vent SAMDA was still not cost-effective. Since this was applied to the SAMDA (ATWS Vent) that was closest to being cost-effective, none of the SAMDAs identified in the 1989 SAMDA Analysis would be cost-effective.

Additional conservatisms not mentioned by the applicant include converting the $3,000,000 cost of the ATWS Vent SAMA to 2012 dollars that would increase the cost of the SAMDA to over $5,000,000 (assuming similar engineering and construction practices). Considering the large conservatisms in the Exelon analysis, it is reasonable. Moreover, even if consideration of offsite economic risk increase led to another SAMA becoming cost-beneficial, that SAMA would still not likely result in a substantial reduction in offsite risk, given the substantial reduction in CDF at

Limerick since the 1989 SAMDA analysis. In addition, the implementation of Limerick's improvements to reduce the CDF makes it more difficult to identify additional cost beneficial SAMAs, therefore, it is unlikely that further consideration of economic risk would yield many cost-beneficial SAMAs. Therefore, consideration of offsite costs would not likely lead to discovery of a cost-beneficial SAMA that would substantially reduce risk of severe accidents and, therefore, does not constitute new and significant information with respect to the 1989 SAMDA or the generic conclusion codified by the NRC that applicants need not reassess SAMAs for facilities such as LGS for license renewal.

There were also public comments that provided site-specific information regarding offsite economic cost risk around Limerick Generating Station. Comment 30-39-PA indicates that the impact of a severe accident at Limerick erroneously relies on data from an analysis done at TMI. The commenter states that it was erroneous to rely on TMI data because TMI involves a markedly different and less economically developed area than the area within 50 miles of Limerick, which includes the densely populated urban environments of Philadelphia, PA; Camden and Trenton, NJ; and Wilmington, DE. The commenter also stated that the ER ignores new and significant information regarding the likely cost of cleanup from a severe accident in a metropolitan area like Philadelphia and thus understates the impact of a properly conducted economic analysis on the environmental consequences of a severe accident at Limerick.

The GEIS evaluated the economic impacts of accidents using plant-specific information. Chapter 5 of the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), Volumes 1 and 2 (NRC 1996), assessed the impacts of postulated accidents at nuclear power plants on the environment. The postulated accidents included design-basis accidents and severe accidents (e.g., those with core damage). The impacts considered included dose and health effects of accidents (Sections 5.3.3.2 through 5.3.3.4), economic impacts of accidents (Section 5.3.3.5), and the effect of uncertainties on the results (Section 5.3.4). Similar to Limerick:

> …the performance and safety record of nuclear power plants operating in the United States continues to improve. This is also confirmed by analysis which indicates that, in many cases, improved plant performance and design features have resulted in reductions in initiating event frequency, core damage frequency, and containment failure frequency (NRC 2013a).

To assess the impacts from the airborne pathway, the 1996 GEIS relied on severe accident analyses provided in 28 nuclear power plants (including Limerick) that included severe accident analyses in their plant-specific EISs. These 28 nuclear power plants are provided in Table 5-1 in the 1996 GEIS. These plant-specific EISs used site-specific meteorology, land topography, population distributions, and offsite emergency response parameters, along with generic or plant-specific source terms, to calculate offsite health and economic impacts. The offsite health effects included those from airborne releases of radioactive material and contamination of surface water and groundwater. The 1996 GEIS used the environmental impact information from the 28 plant-specific EISs and a metric called the exposure index (EI) to (1) scale up the radiological impact of severe accidents on the population due to demographic changes from the time the original EIS was done until the year representing the mid-license renewal period and (2) estimate the severe accident environmental impacts for the earlier plants (whose EISs did not include a quantitative assessment of severe accidents). The EI method uses the projected population distribution around each nuclear power plant site at the middle of its license renewal period and meteorology data for each site to provide a measure of the degree to which the population would be exposed to the release of radioactive material resulting from a severe accident (i.e., the EI method weights the population in each of 16 sectors around a nuclear power plant by the fraction of time the wind blows in that direction on an annual basis). The EI metric was also used to project economic impacts at the mid-year of the license renewal period. A more detailed description of the EI method is contained in Appendix G of the 1996 GEIS. The use of the EI method remains valid. Regarding economic impacts, the GEIS specifically provides that the "probability-weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to ground water, and societal and economic impacts from severe accidents are small for all plants."

The 2013 GEIS compares the CDFs that formed the basis for the 1996 GEIS, and offsite doses directly from the 1996 GEIS, to the newer information. The comparison is done for pressurized water reactors (PWRs) and boiling water reactors (BWRs) and covers each of the plants listed in Table 5.1 of the 1996 GEIS, which included Limerick Units 1 and 2. Changes in source terms (i.e., the quantity, form, and timing of radioactive material released to the environment) are assessed in Section E.3.3 of the 2013 GEIS. The 2013 GEIS concluded, "Given the discussion in this appendix, the staff concludes that the reduction in environmental impacts from the use of new information (since the 1996 GEIS analysis) outweighs any increases resulting from this same information."

Therefore, the 2013 GEIS analysis using plant-specific information was consistent with the evaluation for Limerick. The staff acknowledges that a more precise estimate of this relationship could be obtained by using the MACCS2 code, performing a Level 3 PRA, and completing a new SAMA analysis using site-specific data. However, most mitigation alternatives are identified at the Level 1 and Level 2 stages because relevant Level 1 and Level 2 improvements are physical or process changes to the plant to protect the reactor core in the case of Level 1 PRA, or containment in the case of Level 2 PRA. The Level 3 portion deals with the magnitude of the consequences. The change in magnitude of the consequences could possibly make some mitigation alternatives cost-beneficial. However, most of the benefit is ascertained by focusing on protecting the reactor core and the containment in the Level 1 and Level 2 stages. As provided in Section 5.3.17, specific improvements at Limerick have been implemented to drive the risk downward. Furthermore, if there is higher economic cost and dose consequence, more SAMAs could become cost-effective, however no SAMA is expected to be a major design change that will reduce the risk significantly because of the continuous implementation of improvements since the 1989 SAMDA.

The result of the applicant's and staff's analysis in this case is consistent with the GEIS. As provided in GEIS Table 3.8-8, the populations at both Limerick and TMI are considered high. Furthermore, the GEIS states, "The expected costs resulting from a severe accident at nuclear power plants during their renewal periods have been predicted from evaluations presented in 27 FESs. Estimates of the extent of land contamination have also been presented. In both cases, the conditional impacts are judged to be of small significance for all plants" (NRC 2013a).

5.3.14 Changed Criterion for Assigning Cost Per Person-Rem Averted

The 1989 SAMDA Analysis calculated the benefit of each proposed SAMDA based on a criterion of $1,000 per person-rem averted. Using a value of $2,000 per person-rem averted would increase the threshold and potentially result in new cost-beneficial SAMDAs. As described in the 1989 SAMDA Analysis, changing the cost/benefit threshold using the $2,000 per person-rem averted conversion would still not result in this or any other of the 1989 SAMDAs becoming cost-beneficial. Therefore, Exelon concludes that changing the criterion for assigning benefit (i.e., cost per person-rem averted) from $1,000 per person-rem averted to $2,000 per person-rem averted would not change the conclusions in the 1989 SAMDA Analysis. Hence, the new information represented by the changed criterion for assigning cost per person-rem averted was judged not to be significant by Exelon.

The staff reviewed the LGS analysis provided in the License Renewal ER and agrees that changing the criterion for assigning cost per person-rem averted would not result in a cost-beneficial SAMDA or change the conclusions in the 1989 SAMDA. As provided above, the ATWS Vent has the lowest cost/benefit ratio for the set, and it represents the SAMDA with the largest benefit potential. Even for this limiting SAMDA, changing the cost/benefit threshold to $2,000 per person-rem averted would still not result in this or any other of the SAMDAs becoming cost-beneficial. Since this was applied to the SAMDA (ATWS Vent) closest to being cost-effective, none of the 1989 SAMDAs are cost-effective. This conclusion is even more reasonable given that the 2013 GEIS concluded that the population dose estimates presented in Table E-3 demonstrate the conservatism in the older studies, both from the standpoint of reduced population dose from more recent estimates and the conservatism built into the earlier methodology (NRC 2013a). Additional conservatisms not mentioned by the applicant include that converting the $3,000,000 cost of the ATWS Vent SAMA to 2012 dollars would increase the cost of the SAMDA to over $5,000,000 (assuming similar engineering and construction practices). Considering all of the large conservatisms in the analysis, the applicant's analysis is reasonable. Moreover, even if the increase in cost per person-rem averted led to another SAMA becoming cost-beneficial, that SAMA would still not likely result in a substantial reduction in offsite risk, given the substantial reduction in CDF at Limerick since the 1989 SAMDA analysis. Therefore, consideration of the increased costs per person-rem averted would not likely lead to discovery of a cost-beneficial SAMA, let alone one that would substantially reduce offsite risk and therefore does not constitute new and significant information with respect to the generic conclusion codified by the NRC that Exelon need not reassess LGS SAMAs for license renewal.

5.3.15 Changed Seismic Hazard Proposed in GI-199

On June 9, 2005, the NRC opened GI-199 to assess the implications of updated seismic data and methods for Central and Eastern U.S. (CEUS) operating plants. The staff's confirmatory analysis of the seismic hazard concluded that the calculated seismic hazard for some operating plants in the CEUS had increased. The NRC issued IN 2010-18 to nuclear power plants and independent spent fuel storage installations. This information notice stated that the NRC would follow the appropriate regulatory process to request that operating plants provide specific information about their facilities to enable the staff to complete the regulatory assessment and to identify and evaluate candidate backfits. NRR developed a draft Generic Letter to request needed data from power reactor licensees. The NRC originally intended the request to apply only to power reactor licensees in the CEUS, but, in light of the March 2011 Japanese earthquake, NRR expanded the scope of the request to include all U.S. power reactor licensees. On March 12, 2012, the NRC issued a request for information pursuant to 10 CFR 50.54(f) (hereafter referred to as the 50.54(f) letter) (Agencywide Documents Access and Management System (ADAMS) Accession No. ML 12053A340). The purpose of that request was, in part, to gather updated information concerning the seismic hazards at operating reactor sites and to enable the NRC staff to determine whether licenses should be modified, suspended, or revoked. The "Required Response" section of Enclosure 1 of the 50.54(f) letter indicated that licensees and construction permit holders should provide a Seismic Hazard Evaluation and Screening report within 1.5 years from the date of the 50.54(f) letter for CEUS nuclear power plants and within 3 years of the 50.54(f) for western United States plants (NRC 2012f).

Limerick provided its submittal regarding the new seismic hazard. Limerick's response concluded:

> For LGS, the Safe Shutdown Earthquake envelopes the ground motion response spectra (GMRS) in the frequency range from 1 to 10 Hz. Therefore per the SPID Sections 3.2 and 7 (Reference 3), LGS screens out of further seismic risk assessments in response to NTTF 2.1: Seismic, including seismic probabilistic risk assessment (SPRA) or seismic margin assessment (SMA), as well as spent fuel pool integrity evaluations. Additionally, LGS screens out of the Expedited Seismic Evaluation Process (ESEP) interim action per the 'Augmented Approach' guidance document, Section 2.2 (Reference 4). Due to the GMRS exceeding the SSE in the frequency range above 10 Hz, high-frequency confirmations are needed for LGS in accordance with the SPID Sections 3.2 and 3.4 (Reference 3). Actions to address NTTF 2.1: Seismic for central and eastern United States nuclear plants will be performed in accordance with the schedule provided in the April 9, 2013, letter from the industry to the NRC (Reference 5), as agreed to by the NRC in the May 7, 2013, letter to the industry (Reference 23). [Exelon 2014b]

In a May 9, 2014, letter titled, "Screening And Prioritization Results Regarding Information Pursuant To Title 10 Of The *Code Of Federal Regulations* 50.54(F) Regarding Seismic Hazard Re-Evaluations For Recommendation 2.1 Of The Near-Term Task Force Review Of Insights From The Fukushima Dai-Ichi Accident," Limerick is conditionally screened in as a group 3 plant which means:

> Group 3 plants have GMRS to SSE ratios that are greater than 1, but the amount of exceedance in the 1–10 Hz range is relatively small, and the maximum ground motion in the 1–10 Hz range is also not high. Given the limited level of exceedance of the Group 3 plants, staff is evaluating the need for licensees to conduct a seismic risk evaluation in order for the staff to complete its regulatory decision making. However, the staff has had insufficient review time with the recently submitted seismic hazard submittals to reach a conclusion. After further review of the seismic hazard re-evaluations and the Expedited Approach submittals, the staff will decide which Group 3 plants need to complete a risk evaluation. Risk evaluations for Group 3 plants are due by December 31, 2020. [NRC 2014b]

As provided above, these evaluations and actions are ongoing and the regulatory response is independent of whether or not the plant is seeking license renewal or not. The applicant indicated that GI-199 issues related to the seismic hazard will not result in postulated accident scenarios not already considered for LGS. Seismologists are frequently refining seismic methodologies and results, which may increase the estimated frequency of seismic events with very low probability. Results from the LGS June 1989 PRA Update indicate that the contribution from seismic risk to the total CDF is approximately 25 percent, with fire risk contributing 31 percent to the total risk (Exelon 2011c). Therefore, based on the June 1989 Update, the major risk contributors for external hazards are approximately equal to the CDF computed for internal events only. Based on the ER, total CDF for internal and external events can generally be approximated by multiplying the CDF for internal events by a factor of 2. With a multiplication factor of 2 applied to the CDF estimated by the current model of record ($CDF=3.2\times10^{-6}$), the revised CDF that accounts for both internal and external hazards ($CDF=6.4\times10^{-6}$) would still be a factor of 6.5 below the value used in the 1989 SAMDA Analysis ($CDF=4.2\times10^{-5}$). This demonstrates the excess margin in the 1989 SAMDA Analysis. A possible increase in risk beyond this assumption caused by an even larger seismic CDF would be more than offset by the factor of 6.5 reduction in the current CDF. Therefore, Exelon concludes that the new information represented by the changed seismic hazard proposed in GI-199 is not significant because it would not materially alter the SAMDA conclusions in the 1989 SAMDA (Exelon 2011c).

The staff reviewed the method the applicant used in determining the external events multiplier and its use and determined that it was consistent with the guidance provided in Nuclear Energy Institute (NEI) 05-01. Limerick's analysis is also consistent with similar analyses provided in section E.3.2.3 of the 2013 GEIS. The staff also confirmed that the risk has decreased since the 1989 SAMDA and agrees with Exelon's analysis that the new information represented by the changed seismic hazard proposed in GI-199 is not significant because it would not materially alter the SAMDA conclusions in the 1989 SAMDA Analysis. Considering the large conservatism in the 1989 SAMDA Analysis, the applicant's approach is reasonable. Moreover, even if the change in seismic hazard led to another SAMA becoming cost-beneficial, that SAMA would still not likely result in a substantial reduction in offsite risk, given the substantial reduction in CDF at Limerick since the 1989 SAMDA analysis. Therefore, consideration of GI-199 is not likely to lead to the discovery of a cost-beneficial SAMA that would substantially reduce offsite risk and, therefore, does not constitute new and significant information with respect to the generic conclusion codified by the NRC that SAMAs need not be reassessed at LGS for license renewal.

However, the NRC continues to review earthquakes as part of the reactor oversight process. As provided in the conclusions in Exelon's response to the 50.54(f) letter regarding Near-Term Task Force (NTTF) recommendation 2.3 (NRC 2011c):

> In response to NTTF 2.3, the 50.54(f) letter (Reference 1) also requested licensees to perform seismic walkdowns in order to, in the context of seismic response: (1) verify that the current plant configuration is consistent with the licensing basis; (2) verify the adequacy of current strategies, monitoring, and maintenance programs; and (3) identify degraded, nonconforming, or unanalyzed conditions. Exelon committed to and performed seismic walkdowns in accordance with the seismic walkdown guidance (Reference 27) as initially documented and supplemented in Exelon Correspondence Numbers RS-12-171 and RS-13-138 (References 11 and 29), respectively. The remaining walkdowns for initially inaccessible equipment are scheduled to be completed during the next Unit 1 Refueling Outage, 1 R 15, or during the next scheduled system outage window, whichever is applicable. The results will be reported to the NRC after completion of the follow-on walkdowns. [Exelon 2014b]

Exelon further confirmed that seismic vulnerabilities (similar to SAMAs) identified in the Limerick IPEEE have been implemented:

> Based on the successful completion of seismic walkdowns for all components to date in response to NTTF 2.3, and the lack of adverse seismic conditions identified, Exelon has directly concluded that the LGS current plant configuration is consistent with the plant licensing basis and can safely shut down the reactor and maintain containment integrity following the design-basis SSE event. Additionally, the findings of the seismic walkdown program indirectly verify that the current LGS strategies, monitoring, and maintenance programs are adequate for ensuring seismic safety consistent with the licensing basis. Plant vulnerabilities and commitments identified in the LGS IPEEE (Reference 10) were reviewed as part of the NTTF 2.3 seismic walkdowns (References 11 and 29). The seismic walkdown reports confirmed that there are no outstanding IPEEE vulnerabilities or commitments, and all previously identified IPEEE vulnerabilities and commitments have been resolved (References 11 and 29). [Exelon 2014b]

Exelon also confirmed that Limerick has significant seismic margin beyond design basis.

> An evaluation of beyond-design-basis ground motions was performed for LGS as part of the IPEEE program. The LGS IPEEE program demonstrated plant-level seismic capacity, which can be expressed in terms of a HCLPF. This plant-level

> seismic capacity is defined in Section 3.3.2 of the SPID (Reference 3) as the IHS. The LGS IPEEE seismic evaluation was initially submitted as a reduced scope SMA (Reference 10). Subsequent to the IPEEE submittal, LGS responded to a series of Requests for Additional Information (RAI) and provided additional information that justified the LGS IPEEE SMA as achieving the intent of a focused-scope EPRI SMA anchored at 0.3g PGA (References 19, 20, and 21). The IHS for LGS is defined by the median-shaped NUREG/CR-0098 spectra for rock sites per LGS IPEEE seismic demand analysis (Reference 22). As a result of the LGS IPEEE seismic evaluations, plant processes for seismic housekeeping were made to enhance the reliability and safety of the plant. There are no outstanding IPEEE vulnerabilities or commitments, and all previously identified IPEEE vulnerabilities and commitments have been resolved (Reference 11). The results of the LGS IPEEE showed there were no vulnerabilities to severe accident risk from external events, including seismic events (Reference 10). Based on the results of the IPEEE program for LGS, it may be qualitatively concluded that the plant has significant seismic margin beyond the design basis (Reference 28, Section 2.3.4) as evidenced by a comparison between the site SSE and the IHS in Figure 5.4-1. [Exelon 2014b]

Exelon's confirmation regarding Limerick having significant seismic margin beyond the design basis reinforces the NRC staff conclusion that further evaluation of GI-199 related issues is not likely to lead to the discovery of a cost-beneficial SAMA that would substantially reduce offsite risk and, therefore, does not constitute new and significant information with respect to the 1989 SAMDA or the generic conclusion codified by the NRC that SAMAs need not be reassessed at LGS for license renewal.

The staff has also estimated the seismic CDFs (ADAMS No. ML100270756) using various seismic hazard curves. The values cited for Limerick indicate that the seismic CDF is higher than used in the 1989 SAMDA. Note that these values were calculated using a simplified conservative methodology and have very large uncertainties, and more realistic values may be calculated by Limerick as a result of the NRC letter dated May 9, 2014, "Seismic Screening and Prioritization Results Regarding Information Pursuant to Title 10 of the *Code of Federal Regulations* 50.54(f) Regarding Seismic Hazard Reevaluations for Recommendation 2.1 of the Near-Term Task Force Review of Insights" (NRC 2014c). Even though the new seismic CDF is larger than the seismic value used in 1989, Fukushima orders have essentially bounded anything seismically the NRC could do as a result of SAMA analysis since Limerick has implemented the IPEEE seismic recommendations and performed a recent thorough formal seismic walkdown as provided above. Thus, it is unlikely that Exelon will identify any cost-beneficial SAMAs that would substantially reduce the off-site seismic risk and, therefore, does not constitute new and significant information with respect to the generic conclusion codified by the NRC that SAMAs need not be reassessed at LGS for license renewal.

5.3.16 Additional Staff Evaluation for New and Significant Information

The staff reviewed records of public meetings and correspondence related to the application and compared information presented by the public with information considered in NUREG-1437 to determine if there was any new and significant information with respect to the generic conclusion codified by the NRC, which indicates that SAMAs need not be reassessed at LGS for license renewal (10 CFR 51.53(c)(3)(ii)(L)). This consideration included an evaluation of whether any new information invalidated the 1989 SAMDA analysis.

5.3.17 Cost-Effective SAMAs Identified at Other Plants

SAMA evaluations have been completed for operating plant license renewal applications that were approved for over 75 nuclear power plants. Numerous potentially cost-beneficial SAMAs have been identified in U.S. operating nuclear power plant license renewal applications that have been approved. Most of these SAMAs are low-cost improvements such as modifications to plant procedures or training, minimal hardware changes to enable cross-tying existing pipes or electrical buses, and using portable equipment (e.g., generators and pumps) as backups.

Many of the SAMA recommendations identified from other plants are compiled in an NRC published paper entitled "Perspectives on Severe Accident Mitigation Alternatives for U.S. Plant License Renewal" (NRC 2009). The paper concludes, "SAMAs that are found to be potentially cost-beneficial tend to be low-cost improvements such as modifications to plant procedures or training, minimal hardware changes, and use of portable equipment." These potential cost-beneficial SAMAs are further evaluated and many times not found cost-beneficial because sufficient risk is not eliminated by the modification (which was assumed) or other factors. Furthermore, the staff found that SAMA analyses that have been performed to date have found SAMAs that were cost-beneficial, or at least possibly cost-beneficial subject to further analysis, in approximately half of the plants. In general, the cost-beneficial SAMAs were identified and considered by the licensee under the current operating license. In several cases, SAMA-related modifications were implemented at LGS, further reducing that probability of an additional SAMA substantially reducing severe accident risk (PECO 1992)(Exelon 2014). Examples are provided below.

As provided in the statement of considerations for 10 CFR 51.53(c)(3)(ii)(L), in forming its basis for determining which plants needed to submit a SAMA, the Commission noted that all licensees had undergone, or were in the process of undergoing, more detailed site-specific severe accident mitigation analyses through processes separate from license renewal, specifically the CPI, IPE, and IPEEE programs (61 FR 28467). These programs for LGS were discussed earlier. In light of these studies, the Commission stated that it did not expect future SAMA analyses in the license renewal stage to uncover "major plant design changes or modifications that will prove to be cost-beneficial" (61 FR 28467). As discussed above, the NRC's experience in completed license renewal proceedings has confirmed this assumption (NRC 2009). As a result, potentially cost-beneficial SAMAs at other facilities do not constitute new and significant information with respect to the 1989 SAMDA or the NRC's determination not to perform a second SAMA analysis at license renewal in the event the agency has previously considered such analysis, because even if cost-beneficial the NRC staff's experience shows that a new SAMA analysis will not likely yield a major reduction of risk, particularly in light of the many improvements already implemented at Limerick.

From the public comments (NRDC 2011) there was a recommendation that potential cost-effective SAMAs identified at other similar plants be addressed at LGS. Specifically, comment 30-38 from NRDC stated that Exelon omitted a required analysis of new and significant information regarding the potential new SAMAs previous considered for other BWR Mark II Containment reactors from its ER. In response, the staff sent a letter dated February 12, 2014 (NRC 2014a), to Exelon requesting additional information regarding potentially new SAMAs previously considered for other BWR Mark II Containment reactors. Exelon responded in a letter dated March 12, 2014 (Exelon 2014). In their response, Exelon provided a summary of the evaluation of each potentially cost-beneficial SAMA identified in the February 12, 2014, RAI. The evaluation identifies and eliminates from further consideration SAMAs that have already been implemented at Limerick. Then, the percent change in the maximum averted cost-risk (MACR) from implementing each remaining SAMA at the plant for which it was potentially cost-beneficial is estimated using cost benefit information from the respective plant's ER from which the SAMA was taken, and/or the GEIS. To determine whether the SAMA should be considered "new and significant information" with respect to the 1989 Limerick SAMDA analysis, the percent change in the MACR was verified to be less than 50 percent. Exelon selected a 50-percent reduction in the MACR as the threshold for what may be "significant" based on criteria provided in the American Society of Mechanical Engineers (ASME)/American Nuclear Society PRA Standard, NUMARC 93-01 and NEI 00-04 (Exelon 2014).

Changes at Limerick that are functionally equivalent but not identical to those named in a SAMA are also identified in the RAI response. Exelon determined that either the SAMA had already been implemented at Limerick or that there were no SAMAs that exceeded the 50-percent reduction in the MACR. Thus, there were no SAMAs identified at other plants with Mark II containments that were determined to be "new and significant" at Limerick. Hence, further assessment of such information was not needed (Exelon 2014).

The staff reviewed the information provided by Exelon. The staff determined that either the SAMA had already been implemented at Limerick or that there were no SAMAs that exceeded the 50-percent reduction in the MACR. The staff also found exceeding a 50-percent reduction in the MACR was a reasonable significance value based on the guidance provided in the ASME standard, NUMARC 93-01, and NEI 00-04. This determination is particularly reasonable in light of the already significant reductions achieved in severe accident risk at Limerick since 1989. Even 50-percent reduction in current MACR would represent a small reduction in estimated risk at the facility in 1989 because the CDF today is an order of magnitude smaller than used in the 1989 SAMDA. . Thus, there were no SAMAs identified at other plants with Mark II containments that were determined to be "new and significant" at Limerick.

The staff noted that many of the potential cost-beneficial SAMAs identified at the other Mark II containment plants were for SAMAs relating to loss of power. According to the LGS IPE, loss of power provided 31 percent of the CDF at Limerick (PECO 1992).

Table 6.2-2 of the Limerick IPE (PECO 1992) listed four improvement items that were planned as part of the IPE and which were implemented prior to or shortly after the 1992 IPE submittal. Three of the improvements related to loss of power. These improvements are listed below along with their current status.

(1) Create procedure to crosstie 4-kV electrical buses. (Capability maintained in current site response procedures which allow for alignment of alternate power supply for any 4-kV safeguard bus using any diesel generator.)

(2) Create procedure to power C & D ESW pumps from Unit 1, Division 3 & 4 respectively. (Capability maintained in a current station procedure.)

(3) Create cross connection between diesel driven fire pump and fire water system and RHR. (Capability maintained in a current station procedure.)

Thus Limerick has continued to improve the risk associated with loss of power by implementing related items.

The staff further notes that Limerick is implementing the Fukushima orders and provided the Limerick Generating Station, Units 1 and 2, "Overall Integrated Plan in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)," dated February 28, 2013 (RS-13-022). This order specified that these strategies must be capable of mitigating a simultaneous loss of all AC power and loss of normal access to the ultimate heat sink and have adequate capacity to address challenges to core cooling, containment, and SFP cooling capabilities at all units on a site subject to the Order.

By letter dated January 10, 2014, the NRC staff determined that, based on a review of Exelon's plan, including the 6-month update dated August 28, 2013, and information obtained through the mitigation strategies audit process, the NRC concludes that the licensee has provided sufficient information to determine that there is reasonable assurance that the plan, when properly implemented, will meet the requirements of Order EA-12-049 at Limerick Generating Station, Units 1 and 2 (NRC 2014b). Thus, as a result of this order, Limerick will be implementing several improvements or mitigation alternatives whether they are cost-beneficial or not.

Therefore, the staff does not expect further SAMA analyses at the license renewal stage to uncover major plant design changes or modifications that will prove to be cost-beneficial. As discussed above, the NRC's experience in completed license renewal proceedings has confirmed this assumption (Ghosh 2009). As a result, potentially cost-beneficial SAMAs at other facilities do not constitute new and significant information with respect to Limerick's 1989 SAMDA or the NRC's determination not to perform a second SAMA analysis at license renewal in the event the agency has previously considered the issue, because, even if cost-beneficial, the NRC staff's experience shows that they will not likely yield a major reduction of risk, particularly in light of the many improvements already implemented at Limerick. Moreover, in light of Limerick's reduction in CDF and the propensity of cost-beneficial SAMAs to further eliminate risk and thereby make it less likely for other SAMA candidates to be cost-beneficial, it is unlikely that further consideration of these other SAMA candidates would yield many cost-beneficial SAMAs.

5.3.18 Current State of the Art Knowledge for Performing SAMA Analysis

Modern SAMA analysis has evolved over the years. Currently, SAMA analyses typically follow the guidance provide in NEI guidance (NEI O5-01), which is endorsed by the NRC in Regulatory Guide 4.2, supplement 1 (NRC 2013c). Offsite consequence codes used in SAMA analyses use plant-specific inputs related to core inventory, meteorology, population, evacuation, and economic impacts.

A current detailed SAMA analysis has the ability to analyze numerous plant-specific variables and the sensitivity of a SAMA analysis to these variables. In the scoping comments, numerous variables were identified that could potentially cast doubt on the results of the initial 1989 SAMDA Analysis. To thoroughly evaluate all of these variables would require a *de novo* SAMA analysis, which is not required by 51.53(c)(3)(ii)(L) and Table B-1. However, the applicant evaluated some of the changes at LGS that could have a significant impact on the SAMDA analysis such as population increase, consideration of offsite economic cost risk, changed criteria for assigning cost per person-rem averted, and changed seismic hazard proposed by GI-199 and found that none of the items of new information was found to be significant. As provided earlier, the staff independently reviewed the applicant's information, independently evaluated other potentially new and significant information, and determined that they would not lead to identification of a SAMA that would significantly reduce offsite risks, but acknowledges that a more precise answer could be found with a detailed modern SAMA analysis. However, the staff believes that this more precise answer would still not identify significant cost-beneficial SAMAs. As explained above, new and significant information must provide a seriously different picture of the consequences of the Federal action under consideration. With respect to SAMAs, new information may be significant if it indicated a given SAMA would substantially reduce the probability or consequences of a severe accident. None of the information identified by the applicant or the staff indicates that any SAMAs would be likely to lead to such results. Instead, as discussed above, new information indicates that further SAMA analyses are unlikely to identify many cost-beneficial SAMAs or major, cost-beneficial plant improvements, particularly in light of the substantial reduction in the CDF for Limerick since the 1989 SAMDA analysis.

The GEIS evaluated some of the differences in older methods and newer methods for performing risk analysis, which is the basis for SAMAs. The data selected for use in the 1996 GEIS analysis were taken from the FESs published since 1981, which is near the time of Limerick's 1989 SAMDA analysis. As discussed previously, these FES analyses are based upon source terms resulting from the Reactor Safety Study (NUREG-75/014, formerly WASH-1400), rebaselined in NUREG-0773. As such, these source terms (and the resulting risk and environmental impacts calculated using them) reflect the plant designs used in WASH-1400. However, this approach is considered conservative because the source terms developed in WASH-1400 generally reflect a 1970s-era plant and, as such, do not reflect the improvements that have been made in nuclear industry plant design and operations since the early 1980s. Accordingly, the use of WASH-1400 source terms in the FESs may, in many cases, tend to overestimate the actual environmental consequences and risks.

Furthermore, as provided in Section 5.3.3.1 of the 1996 GEIS, the source terms (i.e., the magnitude, timing, and characteristics of the radioactive material released to the environment) used in the EIS analyses for the 28 sites, including Limerick, were generally based on the 95 percent upper confidence bound (UCB) and analysis documented in NUREG-0773 . The NUREG-0773 source terms represented an update (re-baseline) of the source terms used in WASH-1400 (NRC 1996).

NUREG-0773 indicates that the provided source terms are based on models that tend to give overestimates of the magnitude of the releases." Based on the comparisons with newer information such as NUREG/CR 6295, the expected impacts (i.e., the frequency-weighted consequences) from the airborne pathway using the updated source term information would be much lower than previously predicted (NRC 2013). Therefore, the source terms used in the 1989 SAMDA were more conservative than the source terms used today. This provides additional support for the conclusion that SAMA analyses for LGS would be unlikely to uncover cost-beneficial major plant improvements or plant improvements that could substantially result in lower doses to offsite populations in the event of a severe accident.

5.3.19 Enrichment of Fuel (Power Uprates)

Another potentially new and significant item that could impact the 1989 SAMDA analysis is increases in the enrichment of the fuel in the core. The following is the staff's review for any substantial changes to the fuel enrichment design basis at LGS by reviewing LGS docketed information regarding power uprates. Extended power uprates require using fuel with a higher percentage of uranium-235 or additional fresh fuel to derive more energy from the operation of the reactor. This results in a larger radionuclide inventory (particularly short-lived isotopes, assuming no change in burnup limits) in the core, than the same core at a lower power level. The larger radionuclide inventory represents a larger source term for accidents and can result in higher doses to offsite populations in the event of a severe accident. Typically, short-lived isotopes are the main contributor to early fatalities. As stated in NUREG-1449 (NRC 1993), short-lived isotopes make up 80 percent of the dose following early release. The staff found that LGS had received two power uprate approvals since 1989. One uprate occurred in 1995, and was based on a1993 license amendment request that requested an increase in the licensed thermal power level of the reactor from 3,293 megawatts thermal (MWt) to 3,458 MWt, primarily by increasing the licensed core flow. In the staff's Environmental Assessment and Finding of No Significant Impact related to the LGS application for the amendment, the staff found, "the radiological and nonradiological environmental impacts associated with the proposed small increase in power are very small and do not change the conclusion in the FES that the operation of LGS, Units 1 and 2, would cause no significant adverse impact upon the quality of the human environment." Furthermore, in the January 23, 1995 submittal relating to increasing core flow, the licensee indicated that while fuel burnup and enrichment levels may increase as a result of operation at uprated power, the burnup and enrichment will remain within the 5 percent enrichment and 60,000 MWd/MT value previously evaluated by the staff. Thus, the fuel enrichment did not exceed the previously licensed value (NRC 1995).

By application dated March 25, 2010 (Exelon 2010), Exelon submitted a license amendment request for the LGS Units 1 and 2 Facility Operating Licenses and Technical Specifications. The proposed amendment consisted of a 1.65 percent measurement uncertainty recapture (MUR) power uprate that will increase each unit's rated thermal power from 3,458 megawatts (MWt) to 3,515 MWt. The proposed amendment was characterized as a MUR power uprate, which uses a Cameron International (formerly Caldon) CheckPlus™ Leading Edge Flow Meter (LEFM) system to improve plant calorimetric heat balance measurement accuracy. This flowmeter provides a more accurate measurement of feedwater (FW) flow and thus reduces the uncertainty in the FW flow measurement. This submittal did not change the fuel enrichment design basis (NRC 2011b).

Neither of these power uprates increased the fuel enrichment any higher than was previously evaluated by the staff before the 1989 SAMDA Analysis was completed. Since the fuel enrichment was not increased, further SAMA analyses for LGS would be unlikely to uncover cost-beneficial major plant improvements or plant improvements that could substantially result in lower doses to offsite populations in the event of a severe accident.

Furthermore, as provided in Section 5.3.3.1 of the 1996 GEIS, the source terms (i.e., the magnitude, timing, and characteristics of the radioactive material released to the environment) used in the GEIS analyses for the 28 sites, including Limerick, were generally based on the 95-percent UCB and analysis documented in NUREG-0773 (NRC 1996).

NUREG-0773 states that the provided source terms are based on models that tend to give overestimates of the magnitude of the releases. Based on the comparisons with newer information such as NUREG/CR 6295, the expected impacts (i.e., the frequency-weighted consequences) from the airborne pathway using the updated source term information would be much lower than previously predicted (NRC 2013a). Therefore, the source terms used in the 1989 SAMDA were more conservative than the source terms used today, providing additional confidence that SAMA analyses for LGS would be unlikely to uncover cost-beneficial major plant improvements or plant improvements that could substantially result in lower doses to offsite populations in the event of a severe accident. Also, it reinforces the Commission's generic determinations that the NRC need not reanalyze SAMAs at LGS for license renewal and that a subsequent SAMA analysis would not likely uncover many cost-beneficial SAMAs.

5.3.20 Conclusion

In conclusion, 10 CFR 51.53(c)(3)(ii)(L) states that, "[i]f the staff has not previously considered SAMAs for the applicant's plant, in an environmental impact statement or related supplement or in an environmental assessment, a consideration of alternatives to mitigate severe accidents must be provided." Table B-1 in 10 CFR Part 51, which governs the scope of the staff's environmental review for license renewal, echoes this regulation. Applicants for plants that have already had a SAMA analysis considered by the NRC as part of an EIS, supplement to an EIS, or EA, do not need to have a SAMA analysis reconsidered for license renewal. In forming its basis for determining which plants needed to submit a SAMA at license renewal, the

Commission noted that all licensees had undergone, or were in the process of undergoing, more detailed site-specific severe accident mitigation analyses through processes separate from license renewal, specifically the CPI, IPE, and IPEEE programs (61 FR 28467). In light of these studies, the Commission stated that it did not expect future SAMA analyses to uncover "major plant design changes or modifications that will prove to be cost-beneficial" (61 FR 28467). The NRC's experience in completed license renewal proceedings has confirmed this assumption.

LGS is a plant that had a previous SAMA documented in a NEPA document. Therefore, Exelon was not required to, and did not, submit a SAMA in its license renewal ER. Exelon and staff did evaluate whether there was new and significant information with respect to the Commission's prior determination not to require a SAMA analysis at license renewal for those plants that were already the subject of a SAMA analysis by the staff. This evaluation included an evaluation of whether any new information invalidated the 1989 SAMDA. The staff analyzed information in the applicant's ER with respect to the 1989 SAMDA Analysis for LGS, public comments, and its own review of information relevant to LGS to search for new and significant information with respect to the NRC's determination not to conduct a second SAMA analysis at LGS for license renewal and the studies and assumptions underlying that determination. In conducting that search, the staff considered whether new information provided a seriously different picture of the environmental impact of the proposed project from what was previously envisioned. For a mitigation analysis, such as a SAMA analysis, such information would need to demonstrate a substantial change in the environmental impact sought to be mitigated, in this case severe accidents. In doing its review of new information, the staff found that since the 1989 SAMDA Limerick's CDF has decreased, past current licensing bases initiatives have addressed known weaknesses, and implementation costs are high for design retrofits.

Given the discussion above, it is unlikely that further SAMA analyses for LGS could uncover many cost-beneficial SAMAs or cost-beneficial SAMAs that would substantially reduce the risk of severe accidents because of implementation of programs to reduce the severe accident risk outweighs any increases resulting from the new considerations described above. Therefore, the staff did not identify any new and significant information that would invalidate the 1989 SAMDA.

The staff also did not identify any new and significant information that rises to a level that requires staff to seek Commission approval to conduct a new SAMA analysis (similar to the waiver requirement that applies for Category 1 issues when staff identifies new and significant information). The impacts of all other new information do not contribute sufficiently to the environmental impacts to warrant their inclusion in a SAMA analysis, since the likelihood of finding cost-effective plant improvements that substantially reduce risk is small. Additionally, the staff did not identify a significant environmental issue not covered in the GEIS, or that was not considered in the analysis in the GEIS and leads to an impact finding that is different from the finding presented in the GEIS.

The staff identified no new and significant information related to postulated accidents during the review of LGS's ER (Exelon 2011c) or evaluation of other available information. Therefore, there are no impacts related to these issues beyond those discussed in the GEIS. In accordance with 10 CFR 51.53(c)(3)(ii)(L), the staff did not repeat the review of SAMAs for LGS.

Therefore, as provided in the 1989 SAMDA, "The risks and environmental impacts of severe accidents at Limerick are acceptably low."

The staff has found no new information that would call into question the FES conclusion that:

> [T]he risks of early fatality from potential accidents at the site are small in comparison with risks of early fatality from other human activities in a comparably sized population, and the accident risk will not add significantly to population

exposure and cancer risks. Accident risks from Limerick are expected to be a small fraction of the risks the general public incurs from other sources. Further, the best estimate calculations show that the risks of potential reactor accidents at Limerick are within the range of such risks.

5.4 References

10 CFR Part 50. *Code of Federal Regulations*, Title 10, *Energy*, Part 50, "Domestic licensing of production and utilization facilities."

10 CFR Part 51. *Code of Federal Regulations*, Title 10, *Energy*, Part 51, "Environmental protection regulations for domestic licensing and related regulatory functions."

10 CFR Part 54. *Code of Federal Regulations*, Title 10, *Energy*, Part 54, "Requirements for renewal of operating licenses for nuclear power plants."

10 CFR Part 100. *Code of Federal Regulations*, Title 10, *Energy*, Part 100, "Reactor site criteria."

61 FR 28467. U.S. Nuclear Regulatory Commission. Environmental review for renewal of nuclear power plant operating licenses. *Federal Register* 61(109):28467-28481. June 5, 1996.

74 FR 13926. U.S. Nuclear Regulatory Commission. Power reactor security requirements. *Federal Register* 74(58): 13926-13993. March 27, 2009.

[Amergen] Amergen Energy Company, LLC. 2008. "Three Mile Island Nuclear Station, Applicant's Environmental Report, License Renewal Operating Stage." Kennett Square, PA: Amergen. ADAMS Nos. ML080220255, ML080220257, ML080220261, and ML080220282.

[Exelon] Exelon Generation Company, LLC. 2010. Letter from M. Jesse, Manager, Licensing-Power Uprate, to NRC Document Control Desk. Limerick Generating Station, Units 1 and 2: Request for license amendment regarding measurement uncertainty recapture power uprate. March 25, 2010. ADAMS No. ML100850380.

[Exelon] Exelon Generation Company, LLC. 2011a. Letter from M.P. Gallagher, Vice President, License Renewal Projects, to NRC Document Control Desk. Limerick Generating Station, Units 1 and 2: Application for renewed operating licenses. June 22, 2011. ADAMS No. ML11179A096.

[Exelon] Exelon Generation Company, LLC. 2011b. License Renewal Application [LRA], Limerick Generating Station, Units 1 and 2. June 22, 2011. ADAMS No. ML11179A101.

[Exelon] Exelon Generation Company, LLC. 2011c. *Environmental Report–Operating License Renewal Stage* [ER], Limerick Generating Station, Units 1 and 2. June 22, 2011. ADAMS No. ML11179A104.

[Exelon] Exelon Generation Company, LLC. 2013a. "Overall Integrated Plan in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)," February 28, 2013. ADAMS No. ML14071A738.

[Exelon] Exelon Generation Company, LLC. 2013b. "Updated Evacuation Time Estimates for Limerick Generating Station Plume Exposure Pathway and ETE Review Criteria Checklist." September 5 2013. 246 p. ADAMS No. ML13254A120.

[Exelon] Exelon Generation Company, LLC. 2014a. *Response to Request for Additional Information*. Kennett Square, PA: Exelon. March 12, 2014. 17 p. ADAMS No. ML14071A378.

(Pub. L. 104–13), NARA invites the general public and other Federal agencies to comment on proposed information collections. The comments and suggestions should address one or more of the following points: (a) Whether the proposed collection information is necessary for the proper performance of the functions of NARA; (b) the accuracy of NARA's estimate of the burden of the proposed information collections; (c) ways to enhance the quality, utility, and clarity of the information to be collected; and (d) ways to minimize the burden of the collection of information on respondents, including the use of information technology; and (e) whether small businesses are affected by this collection. The comments that are submitted will be summarized and included in the NARA request for Office of Management and Budget (OMB) approval. All comments will become a matter of public record. In this notice, NARA is soliciting comments concerning the following information collection:

Title: Request Pertaining to Military Records.

OMB number: 3095–0029.

Agency form number: SF 180.

Type of review: Regular.

Affected public: Veterans, their authorized representatives, state and local governments, and businesses.

Estimated number of respondents: 1,028,769.

Estimated time per response: 5 minutes.

Frequency of response: On occasion (when respondent wishes to request information from a military personnel record).

Estimated total annual burden hours: 85,731 hours.

Abstract: The authority for this information collection is contained in 36 CFR 1233.18. In accordance with rules issued by the Department of Defense (DOD) and Department of Homeland Security (DHS, U.S. Coast Guard), the National Personnel Records Center (NPRC) of the National Archives and Records Administration (NARA) administers military service records of veterans after discharge, retirement, and death. When veterans and other authorized individuals request information from or copies of documents in military service records, they must provide in forms or in letters certain information about the veteran and the nature of the request. Federal agencies, military departments, veterans, veterans' organizations, and the general public use Standard Forms (SF) 180, Request Pertaining to Military Records, in order to obtain information from military service records stored at NPRC. Veterans and next-of-kin of deceased veterans can also use eVetRecs (*http://www.archives.gov/research_room/vetrecs/*) to order copies.

Dated: August 18, 2011.

Michael L. Wash,

Executive for Information Services/CIO.

[FR Doc. 2011–21718 Filed 8–23–11; 8:45 am]

BILLING CODE 7515–01–P

NATIONAL CREDIT UNION ADMINISTRATION

Sunshine Act; Notice of Agency Meeting

TIME AND DATE: 1 p.m., Monday, August 29, 2011.

PLACE: Board Room, 7th Floor, Room 7047, 1775 Duke Street (All visitors must use Diagonal Road Entrance), Alexandria, VA 22314–3428.

STATUS: Open.

MATTERS TO BE CONSIDERED: 1. Proposed Rule—Part 704 of NCUA's Rules and Regulations, Corporate Credit Unions.

2. NCUA Guaranteed Notes Maintenance.

3. Temporary Corporate Credit Union Stabilization Fund Assessment.

RECESS: 1:45 p.m.

TIME AND DATE: 2 p.m., Monday, August 29, 2011.

PLACE: Board Room, 7th Floor, Room 7047, 1775 Duke Street, Alexandria, VA 22314–3428.

STATUS: Closed.

MATTERS TO BE CONSIDERED:

1. Merger Request Pursuant to Part 708b of NCUA's Rules and Regulations. Closed pursuant to exemption (8).

FOR FURTHER INFORMATION CONTACT: Mary Rupp, Secretary of the Board, Telephone: 703–518–6304.

Mary Rupp,

Board Secretary.

[FR Doc. 2011–21760 Filed 8–22–11; 4:15 pm]

BILLING CODE 7535–01–P

NUCLEAR REGULATORY COMMISSION

[NRC–2011–0166; Docket Numbers 50–352 and 50–353]

Notice of Acceptance for Docketing of the Application and Notice of Opportunity for Hearing Regarding Renewal of Facility Operating License Nos. NPF–39 and NPF–85 for an Additional 20-Year Period, Exelon Generation Company, LLC, Limerick Generating Station

The U.S. Nuclear Regulatory Commission (NRC or the Commission) is considering an application for the renewal of operating licenses NPF–39 and NPF–85, which authorizes Exelon Generation Company, LLC (EXELON), to operate the Limerick Generating Station (LGS) Unit 1 at 3515 megawatts thermal and LGS Unit 2 at 3515 megawatts thermal, respectively. The renewed licenses would authorize the applicant to operate LGS, Units 1 and 2, for an additional 20 years beyond the period specified in the current license. LGS Units 1 and 2 are located in Limerick, PA; the current operating license for LGS Unit 1 expires on October 26, 2024, and LGS Unit 2 expires on June 22, 2029.

EXELON submitted the application dated June 22, 2011, pursuant to Title 10, Part 54, of the Code of Federal Regulations (10 CFR part 54), to renew operating licenses NPF–39 and NPF–85. A notice of receipt and availability of the license renewal application (LRA) was published in the **Federal Register** on July 26, 2011 (76 FRN 44624).

The Commission's staff has determined that EXELON has submitted sufficient information in accordance with 10 CFR 54.19, 54.21, 54.22, 54.23, 51.45, and 51.53(c), to enable the staff to undertake a review of the application, and that the application is therefore acceptable for docketing. The current Docket Numbers, 50–352 and 50–353, for operating license numbers NPF–39 and NPF–85, respectively, will be retained. The determination to accept the LRA for docketing does not constitute a determination that a renewed license should be issued, and does not preclude the NRC staff from requesting additional information as the review proceeds.

Before issuance of the requested renewed licenses, the NRC will have made the findings required by the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations. In accordance with 10 CFR 54.29, the NRC may issue a renewed license on the basis of its review if it finds that actions have been identified and have been or will be taken with respect to: (1) Managing the effects of aging during the period of extended operation on the functionality of structures and components that have been identified as requiring aging management review, and (2) time-limited aging analyses that have been identified as requiring review, such that there is reasonable assurance that the activities authorized by the renewed license will continue to be conducted in accordance with the current licensing basis (CLB) and that any changes made to the plant's CLB will comply with the Act and the Commission's regulations.

Additionally, in accordance with 10 CFR 51.95(c), the NRC will prepare an environmental impact statement that is a supplement to the Commission's NUREG–1437, ''Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants,'' dated May 1996. In considering the LRA, the Commission must find that the applicable requirements of Subpart A of 10 CFR Part 51 have been satisfied, and that matters raised under 10 CFR 2.335 have been addressed. Pursuant to 10 CFR 51.26, and as part of the environmental scoping process, the staff intends to hold a public scoping meeting. Detailed information regarding the environmental scoping meeting will be the subject of a separate **Federal Register** notice. Within 60 days after the date of publication of this **Federal Register** notice, any person whose interest may be affected by this proceeding and who wishes to participate as a party in the proceeding must file a written request for a hearing and a petition for leave to intervene with respect to the renewal of the license. Requests for a hearing or petitions for leave to intervene must be filed in accordance with the Commission's ''Rules of Practice for Domestic Licensing Proceedings and Issuance of Orders'' in 10 CFR Part 2. Interested persons should consult a current copy of 10 CFR 2.309, which is available at the Commission's Public Document Room (PDR), located at One White Flint North, 11555 Rockville Pike (first floor), Rockville, Maryland 20852 and is accessible from the NRC's Agencywide Documents Access and Management System (ADAMS) Public Electronic Reading Room online in the NRC library at *http://www.nrc.gov/reading-rm/adams.html. http://www.nrc.gov/readingrm/adams.html* Persons who do not have access to the Internet or who encounter problems in accessing the documents located in ADAMS should contact the NRC's PDR reference staff by telephone at 1–800–397–4209, or 301–415–4737, or by e-mail at *PDR.Resource@nrc.gov.* If a request for a hearing/petition for leave to intervene is filed within the 60-day period, the Commission or a presiding officer designated by the Commission or by the Chief Administrative Judge of the Atomic Safety and Licensing Board Panel will rule on the request and/or petition; and the Secretary or the Chief Administrative Judge of the Atomic Safety and Licensing Board Panel will issue a notice of a hearing or an appropriate order. In the event that no request for a hearing or petition for leave to intervene is filed within the 60-day period, the NRC may, upon completion of its evaluations and upon making the findings required under 10 CFR parts 51 and 54, renew the license without further notice.

As required by 10 CFR 2.309, a petition for leave to intervene shall set forth with particularity the interest of the petitioner in the proceeding, and how that interest may be affected by the results of the proceeding, taking into consideration the limited scope of matters that may be considered pursuant to 10 CFR parts 51 and 54. The petition must specifically explain the reasons why intervention should be permitted with particular reference to the following factors: (1) The nature of the requestor's/petitioner's right under the Act to be made a party to the proceeding; (2) the nature and extent of the requestor's/petitioner's property, financial, or other interest in the proceeding; and (3) the possible effect of any decision or order which may be entered in the proceeding on the requestor's/petitioner's interest. The petition must also set forth the specific contentions which the petitioner/requestor seeks to have litigated at the proceeding.

Each contention must consist of a specific statement of the issue of law or fact to be raised or controverted. In addition, the requestor/petitioner shall provide a brief explanation of the basis for each contention and a concise statement of the alleged facts or the expert opinion that supports the contention on which the requestor/petitioner intends to rely in proving the contention at the hearing. The requestor/petitioner must also provide references to those specific sources and documents of which the requestor/petitioner is aware and on which the requestor/petitioner intends to rely to establish those facts or expert opinion. The requestor/petitioner must provide sufficient information to show that a genuine dispute exists with the applicant on a material issue of law or fact.[1] Contentions shall be limited to matters within the scope of the action under consideration. The contention must be one that, if proven, would entitle the requestor/petitioner to relief. A requestor/petitioner who fails to satisfy these requirements with respect to at least one contention will not be permitted to participate as a party.

The Commission requests that each contention be given a separate numeric or alpha designation within one of the following groups: (1) Technical (primarily related to safety concerns); (2) environmental; or (3) miscellaneous.

As specified in 10 CFR 2.309, if two or more requestors/petitioners seek to co-sponsor a contention or propose substantially the same contention, the requestors/petitioners will be required to jointly designate a representative who shall have the authority to act for the requestors/petitioners with respect to that contention.

All documents filed in NRC adjudicatory proceedings, including a request for hearing, a petition for leave to intervene, any motion or other document filed in the proceeding prior to the submission of a request for hearing or petition to intervene, and documents filed by interested governmental entities participating under 10 CFR 2.315(c), must be filed in accordance with the NRC E-Filing rule (72 FR 49139, August 28, 2007). The E-Filing process requires participants to submit and serve all adjudicatory documents over the internet, or in some cases to mail copies on electronic storage media. Participants may not submit paper copies of their filings unless they seek an exemption in accordance with the procedures described below.

To comply with the procedural requirements of E-Filing, at least ten (10) days prior to the filing deadline, the participant should contact the Office of the Secretary by e-mail at *hearing.docket@nrc.gov,* or by telephone at 301–415–1677, to request (1) a digital ID certificate, which allows the participant (or its counsel or representative) to digitally sign documents and access the E-Submittal server for any proceeding in which it is participating; and (2) advise the Secretary that the participant will be submitting a request or petition for hearing (even in instances in which the participant, or its counsel or

[1] To the extent that the application contains attachments and supporting documents that are not publicly available because they are asserted to contain safeguards or proprietary information, petitioners desiring access to this information should contact the applicant or applicant's counsel to discuss the need for a protective order.

representative, already holds an NRC-issued digital ID certificate). Based upon this information, the Secretary will establish an electronic docket for the hearing in this proceeding if the Secretary has not already established an electronic docket. Information about applying for a digital ID certificate is available on NRC's public Web site at *http://www.nrc.gov/site-help/e-submittals/apply-certificates.html.* System requirements for accessing the E-Submittal server are detailed in NRC's ''Guidance for Electronic Submission,'' which is available on the agency's public Web site at *http://www.nrc.gov/site-help/e-submittals.html.* Participants may attempt to use other software not listed on the Web site, but should note that the NRC's E-Filing system does not support unlisted software, and the NRC Meta System Help Desk will not be able to offer assistance in using unlisted software.

If a participant is electronically submitting a document to the NRC in accordance with the E-Filing rule, the participant must file the document using the NRC's online, Web-based submission form. In order to serve documents through EIE, users will be required to install a Web browser plug-in from the NRC Web site. Further information on the Web-based submission form, including the installation of the Web browser plug-in, is available on the NRC's public Web site at *http://www.nrc.gov/site-help/e-submittals.html.*

Once a participant has obtained a digital ID certificate and a docket has been created, the participant can then submit a request for hearing or petition for leave to intervene. Submissions should be in Portable Document Format (PDF) in accordance with NRC guidance available on the NRC public Web site at *http://www.nrc.gov/site-help/e-submittals.html.* A filing is considered complete at the time the documents are submitted through the NRC's E-Filing system. To be timely, an electronic filing must be submitted to the E-Filing system no later than 11:59 p.m. Eastern Time on the due date. Upon receipt of a transmission, the E-Filing system time-stamps the document and sends the submitter an e-mail notice confirming receipt of the document. The E-Filing system also distributes an e-mail notice that provides access to the document to the NRC Office of the General Counsel and any others who have advised the Office of the Secretary that they wish to participate in the proceeding, so that the filer need not serve the documents on those participants separately. Therefore, applicants and other participants (or their counsel or representative) must apply for and receive a digital ID certificate before a hearing request/petition to intervene is filed so that they can obtain access to the document via the E-Filing system.

A person filing electronically using the agency's adjudicatory E-Filing system may seek assistance by contacting the NRC Meta System Help Desk through the ''Contact Us'' link located on the NRC Web site at *http://www.nrc.gov/site-help/e-submittals.html,* by e-mail at *MSHD.Resource@nrc.gov,* or by a toll-free call at (866) 672–7640. The NRC Meta System Help Desk is available between 8 a.m. and 8 p.m., Eastern Time, Monday through Friday, excluding government holidays.

Participants who believe that they have a good cause for not submitting documents electronically must file an exemption request, in accordance with 10 CFR 2.302(g), with their initial paper filing requesting authorization to continue to submit documents in paper format. Such filings must be submitted by: (1) First class mail addressed to the Office of the Secretary of the Commission, U.S. Nuclear Regulatory Commission, Washington, DC 20555–0001, Attention: Rulemaking and Adjudications Staff; or (2) courier, express mail, or expedited delivery service to the Office of the Secretary, Sixteenth Floor, One White Flint North, 11555 Rockville Pike, Rockville, Maryland 20852, *Attention:* Rulemaking and Adjudications Staff. Participants filing a document in this manner are responsible for serving the document on all other participants. Filing is considered complete by first-class mail as of the time of deposit in the mail, or by courier, express mail, or expedited delivery service upon depositing the document with the provider of the service. A presiding officer, having granted an exemption request from using E-Filing, may require a participant or party to use E-Filing if the presiding officer subsequently determines that the reason for granting the exemption from use of E-Filing no longer exists.

Documents submitted in adjudicatory proceedings will appear in NRC's electronic hearing docket which is available to the public at *http://ehd1.nrc.gov/EHD/,* unless excluded pursuant to an order of the Commission, or the presiding officer. Participants are requested not to include personal privacy information, such as Social Security numbers, home addresses, or home phone numbers in their filings, unless an NRC regulation or other law requires submission of such information. With respect to copyrighted works, except for limited excerpts that serve the purpose of the adjudicatory filings and would constitute a Fair Use application, participants are requested not to include copyrighted materials in their submission.

Detailed information about the license renewal process can be found under the Nuclear Reactors icon at *http://www.nrc.gov/reactors/operating/licensing/renewal.html* on the NRC's Web site. Copies of the application to renew the operating license for LGS are available for public inspection at the Commission's PDR, located at One White Flint North, 11555 Rockville Pike (first floor), Rockville, Maryland 20852–2738, and at *http://www.nrc.gov/reactors/operating/licensing/renewal/applications.html,* the NRC's Web site while the application is under review. The application may be accessed in ADAMS through the NRC's Public Electronic Reading Room on the Internet at *http://www.nrc.gov/reading-rm/adams.html* under ADAMS Accession Number ML111790800. As stated above, persons who do not have access to ADAMS or who encounter problems in accessing the documents located in ADAMS may contact the NRC's Public Document Room (PDR) reference staff by telephone at 1–800–397–4209 or 301–415–4737, or by e-mail to *PDR.Resource@nrc.gov.*

The NRC staff has verified that a copy of the license renewal application is also available to local residents near LGS, at the Pottstown Regional Public Library, 500 East High Street, Pottstown, PA 19464–5656.

Dated at Rockville, Maryland, this 12th day of August 2011.

For the Nuclear Regulatory Commission.

Melanie A. Galloway,

Deputy Director, Division of License Renewal, Office of Nuclear Reactor Regulation.

[FR Doc. 2011–21631 Filed 8–23–11; 8:45 am]

BILLING CODE 7590–01–P

NUCLEAR REGULATORY COMMISSION

Application for a License To Export Heavy Water

Pursuant to 10 CFR 110.70 (b) ''Public Notice of Receipt of an Application,'' please take notice that the Nuclear Regulatory Commission (NRC) has received the following request for an export license. Copies of the request are available electronically through ADAMS and can be accessed through the Public Electronic Reading Room (PERR) link *http://www.nrc.gov/reading-rm.html* at the NRC Homepage.

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

NUREG-1437
Supplement 49
Volume 1

Generic Environmental Impact Statement for License Renewal of Nuclear Plants

Supplement 49

Regarding
Limerick Generating Station, Units 1 and 2

Chapters 1 to 12

Final Report

Manuscript Completed: August 2014
Date Published: August 2014

Office of Nuclear Reactor Regulation

TABLE OF CONTENTS

5.0 ENVIRONMENTAL IMPACTS OF POSTULATED ACCIDENTS

This chapter describes the environmental impacts from postulated accidents that Limerick Generating Station, Units 1 and 2 (LGS or Limerick) might experience during the period of extended operation. The term "accident" refers to any unintentional event outside the normal plant operational envelope that results in a release or the potential for release of radioactive materials into the environment. The two classes of postulated accidents listed in Table 5–1 are evaluated in detail in the generic environmental impact statement (GEIS). These two classes of accidents are:

- design-basis accidents (DBAs), and
- severe accidents.

Table 5–1. Issues Related to Postulated Accidents

Issues	GEIS Section	Category
DBAs	5.3.2; 5.5.1	1
Severe accidents	5.3.3; 5.3.3.2; 5.3.3.3; 5.3.3.4; 5.3.3.5; 5.4; 5.5.2	2

5.1 Design-Basis Accidents

To receive U.S. Nuclear Regulatory Commission (NRC) approval to operate a nuclear power plant, an applicant for an initial operating license must submit a safety analysis report (SAR) as part of its application. The SAR presents the design criteria and design information for the proposed reactor and comprehensive data on the proposed site. The SAR also discusses various hypothetical accident situations and the safety features that prevent and mitigate accidents. The NRC staff (the staff) reviews the application to determine if the plant design meets the NRC's regulations and requirements and includes, in part, the nuclear plant design and its anticipated response to an accident.

Design-basis accidents (DBAs) are those accidents that both the licensee and the staff evaluate to ensure that the plant can withstand normal and abnormal transients and a broad spectrum of postulated accidents, without undue hazard to the health and safety of the public. Many of these postulated accidents are not expected to occur during the life of the plant but are evaluated to establish the design basis for the preventive and mitigative safety systems of the nuclear power plant. Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50 and 10 CFR Part 100 describe the acceptance criteria for DBAs.

The environmental impacts of DBAs are evaluated during the initial licensing process, and the ability of the nuclear power plant to withstand these accidents is demonstrated to be acceptable before issuance of the operating license. The results of these evaluations are found in license documentation such as the applicant's final safety analysis report (FSAR), the staff's safety evaluation report (SER), the final environmental statement (FES), and Section 5.1 of this supplemental environmental impact statement (SEIS). A licensee is required to maintain the acceptable design and performance criteria throughout the life of the nuclear power plant, including any period of extended operation. The consequences for these events are evaluated for the hypothetical maximum exposed individual. Because of the requirements that continuous acceptability of the consequences and aging management programs be in effect for license renewal, the environmental impacts, as calculated for DBAs, should not differ significantly from initial licensing assessments over the life of the nuclear power plant, including the license renewal period. Accordingly, the design of the nuclear power plant, relative to DBAs during the extended period, is considered to remain acceptable; therefore, the environmental impacts of those accidents were not examined further in the GEIS.

The NRC has determined in the GEIS that the environmental impacts of DBAs are of SMALL significance for all nuclear power plants because the plants were designed to successfully withstand these accidents. Therefore, for the purposes of license renewal, DBAs are designated as a Category 1 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. The early resolution of the DBAs makes them a part of the current licensing basis (CLB) of the plant; the CLB of the plant is to be maintained by the licensee under its current license and, therefore, under the provisions of 10 CFR 54.30, is not subject to review under license renewal. This issue is applicable to LGS.

Exelon Generation Company, LLC (Exelon) stated in its environmental report (ER) (Exelon 2011c) that it is not aware of any new and significant information related to DBAs associated with the renewal of the LGS. The staff did not find any new and significant information during its independent review of Exelon's ER, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts related to DBAs beyond those discussed in the GEIS (NRC 2013a).

5.2 Severe Accidents

Severe nuclear accidents are those that are more severe than DBAs because they could result in substantial damage to the reactor core, whether or not there are serious offsite consequences. In the GEIS, the staff assessed the effects of severe accidents during the period of extended operation, using the results of existing analyses and site-specific information to conservatively predict the environmental impacts of severe accidents for each plant during the period of extended operation.

The impacts from severe accidents initiated by external phenomena such as tornadoes, floods, earthquakes, fires, and sabotage were specifically considered in the GEIS. The GEIS evaluated existing impact assessments—performed by the staff and by the industry at 44 nuclear power plants (including LGS) in the United States—and concluded that the risk from beyond design-basis earthquakes at existing nuclear power plants is SMALL. The GEIS also performed a discretionary analysis of sabotage, in connection with license renewal, and concluded that the core damage and radiological release from such acts would be no worse than the damage and release expected from internally initiated events. In the GEIS, the NRC concludes that the risk from sabotage at existing nuclear power plants is SMALL and, additionally, that the risks from other external events are adequately addressed by a generic consideration of internally initiated severe accidents (NRC 1996, 2013a).

Based on information in the GEIS, the NRC determined in its regulations that:

> The probability-weighted consequences of severe accidents are SMALL for all plants. However, alternatives to mitigate severe accidents must be considered for all plants that have not considered such alternatives.

The staff found no new and significant information related to severe accidents during the review of Exelon's ER (Exelon 2011c), the scoping process, the review of public comments, NRDC's waiver petition, or evaluation of other available information. Therefore, there are no impacts related to these issues, beyond those already discussed in the GEIS.

5.3 Severe Accident Mitigation Alternatives

The purpose of the evaluation of severe accident mitigation alternatives (SAMAs) is to identify design alternatives, procedural modifications, or training activities that are cost-beneficial and further reduce the risks of severe accidents (NRC 1999a). The analysis of SAMAs includes the identification and evaluation of alternatives that reduce the radiological risk from a severe accident by preventing substantial core damage (i.e., preventing a severe accident) or by limiting releases from containment in the event that substantial core damage occurs (i.e., mitigating the impacts of a severe accident) (NRC 1999b). In accordance with 10 CFR 51.53(c)(3)(ii)(L) and Table B-1 of Part 51, license renewal ERs must provide a consideration of alternatives to mitigate severe accidents if the staff has not previously evaluated SAMAs for the applicant's plant in an environmental impact statement (EIS) or related supplement or in an environmental assessment.

The staff has previously performed a site-specific analysis of severe accident mitigation in a National Environmental Policy Act of 1969 (NEPA) document for LGS in the Final Environmental Statement Related to Operation of LGS, Units 1 and 2 in NUREG-0974, Supplement 1 (NRC 1989) ("1989 SAMDA Analysis"). Therefore, no analysis of SAMAs for LGS is required in Exelon's ER or the staff's SEIS. The NRC staff uses the term SAMA to refer to SAMAs at the license renewal phase. In contrast, the term severe accident mitigation design alternative (SAMDA) refers to SAMAs at the initial licensing phase. The site-specific SAMDAs reviewed for applicability to LGS were evaluated in the 1989 SAMDA Analysis and also documented in GEIS Table 5.35. The staff examined each SAMDA (individually and, in some cases, in combination) to determine the potential SAMDA individual risk reduction potential. This risk reduction was then compared with the cost of implementing the SAMDA to provide cost-benefit evidence of its value. The staff concluded that:

> The risks of early fatality from potential accidents at the site are small in comparison with risks of early fatality from other human activities in a comparably sized population, and the accident risk will not add significantly to population exposure and cancer risks. Accident risks from Limerick are expected to be a small fraction of the risks the general public incurs from other sources. Further, the best estimates show that the risks of potential reactor accidents at Limerick are within the range of such risks from other nuclear power plants.

However, in the LGS specific 1989 SAMDA Analysis, the staff acknowledged:

> In the longer term, these same severe accident issues are currently being pursued by the NRC in a systematic way for all utilities through the Severe Accident Program described in SECY-88-147, "Integration Plan for Closure of Severe Accident Issues." The plan includes provisions for an Individual Plant Examination (IPE) for each operating reactor, a Containment Performance Improvement (CPI) program, and an Accident Management (AM) program. These programs will produce a more complete picture of the risks of operating plants and the benefits of potential design improvements, including SAMDAs. The staff believes that the severe accident program is the proper vehicle for further review of severe accidents at nuclear power plants, including Limerick.

Therefore, the Commission considers ways to mitigate severe accidents at a given site more than once. The Commission has considered alternatives for mitigating severe accidents at many sites, including LGS, multiple times through a variety of NRC programs. When it promulgated Table B-1 of 10 CFR Part 51, the Commission explained:

> The Commission has considered containment improvements for all plants pursuant to its Containment Performance Improvement (CPI) program…and the Commission has additional ongoing regulatory programs whereby licensees

> search for individual plant vulnerabilities to severe accidents and consider cost-beneficial improvements [(the individual plant examination "IPE" and individual plant examination of external events "IPEEE" programs)]. [61 FR 28467]

In light of these studies, the Commission believed that if the staff has already considered severe accident mitigation under NEPA once for a facility, it was "unlikely that any site-specific consideration of SAMAs for license renewal will identify major plant design changes or modifications that will prove to be cost-beneficial for reducing severe accident frequency or consequences" (61 FR 28467). In CLI-13-7, the Commission reaffirmed the conclusions in Table B-1 and 10 CFR 51.53(c)(3)(ii)(L) and stated that it promulgated those regulations "because we determined that one SAMA analysis would uncover most cost-beneficial measures to mitigate both the risk and the effects of severe accidents, thus satisfying our obligations under NEPA" (NRC 2013d).. Given the significant costs of a major plant design change, such an improvement must result in a substantial reduction in risk to be cost-beneficial. As discussed below, the NRC has thoroughly considered severe accidents and ways to mitigate their impacts, in the original SAMDA analysis for Limerick and other studies, and did not identify cost-beneficial major plant design changes or modifications for mitigating the impacts of severe accidents.

5.3.1 Containment Performance Improvement Program

One of the programs the Commission relied on in determining that SAMAs need not be performed at license renewal if the staff had already performed a SAMA review in an earlier NEPA document is the CPI program. With this program, the NRC examined each of five U.S. reactor containment types (BWR Mark I, II, and III; PWR Ice Condenser; and PWR Dry) with the purpose of examining the potential failure modes, potential fixes, and the cost benefit of such fixes. Tables 5.32 through 5.34 in the GEIS summarize the results of this program. As can be seen from these tables, many potential changes were evaluated but only a few containment improvements were identified for site-specific review. The items evaluated in the CPI program were also included in the list of plant-specific SAMDAs examined in the LGS FES supplement (NRC 1996). Furthermore, the CPI program issues applicable to Limerick were effectively subsumed into the IPE process in Supplements 1 and 3 to Generic Letter 88-20. Additionally, the Emergency Procedure Guidelines (EPG) and Severe Accident Management Guidelines (SAMGs) developed by the BWR Owners' Group (BWROG) and implemented at Limerick incorporate the accident management strategies identified in the CPI program (Exelon 2014a).

5.3.2 Individual Plant Examination

Another program the Commission relied on in determining that SAMAs need not be performed at license renewal if the staff had already performed a SAMA review in an earlier NEPA document is the Individual Plant Examination (IPE). The IPE's specific objective was to develop an appreciation of severe accident behavior, and to identify ways in which the overall probabilities of core damage and fission product releases could be reduced if deemed necessary. In general, the IPEs have resulted in plant procedural and programmatic improvements (i.e., accident management) and, in only a few cases, minor plant modifications, to further reduce the risk and consequences of severe accidents (NRC 1996).

In accordance with NRC's policy statement on severe accidents, the licensee performed an IPE to look for vulnerabilities to both internal and external initiating events (NRC 1988a). This examination considered potential improvements on a plant-specific basis. The core damage frequency (CDF) was found to be considerably less in the LGS IPE (4.3×10^{-6}) than in the original CDF value provided in NUREG-1068 (1.0×10^{-5}) for LGS and the 1989 PRA Update (1.0×10^{-5}) used in the 1989 SAMDA Analysis review. The staff further notes that the 2009 PRA Update (3.2×10^{-6}) is approximately an order of magnitude less than the 1989 PRA Update (Exelon ER) used in the 1989 SAMDA Analysis review. Plant improvements identified and implemented for LGS as a result of the IPE included: (1) relaxing restrictions on the drywell spray initiation curve in the Emergency Operating Procedures; (2) creating a procedure to cross-tie the 4-kilovolt (kV) safeguards electrical buses; (3) creating a procedure to power Unit 2 emergency service water (ESW) pumps from Unit 1; and (4) creating a cross-connection between the fire water and residual heat removal (RHR) systems (PECO 1992). Exelon request for additional information (RAI) response dated March 12, 2014, confirms these and other improvements were implemented to reduce risk at LGS as a result of the IPE (Exelon 2014a). These results at Limerick are also consistent with other IPEs in that they have resulted in only plant procedural and programmatic improvements (i.e., accident management) and, in only a few cases, minor plant modifications to further reduce the risk and consequences of severe accidents.

5.3.3 Individual Plant Examination of External Events

Another program the Commission relied on in determining that SAMAs need not be performed at license renewal if the staff had already performed a SAMA review in an earlier NEPA document is the Individual Plant Examination of External Events (IPEEE) program. While the IPE takes into account events that could challenge the design from things that could go awry internally (in the sense that equipment might fail because components do not work as expected), the IPEEE considers challenges such as earthquakes, internal fires, and high winds. The IPEEE program was initiated in the early 1990s. All operating plants in the United States (including LGS) performed an assessment to identify vulnerabilities to severe accidents initiated by external events and reported the results to the NRC, along with any identified improvements and/or corrective actions. *Perspectives Gained from the Individual Plant Examination of External Events (IPEEE) Program*, NUREG–1742 documents the perspectives derived from the technical reviews of the IPEEE results (NRC 2002). As a result of conducting the LGS IPEEE, PECO Energy identified seismic event and fire event findings. Actions were taken to address minor housekeeping and maintenance issues related to the seismic analysis such as unrestrained tools, lockers, hoist controllers and lifting devices for low voltage switchgear. In addition, fire brigade drill activities and fire brigade awareness were increased for three areas in the common control structure. Furthermore, actions credited in the fire analysis such as improved transient combustible controls, creation of transient combustible free zones and formal designation of certain fire rated doors as “fire” doors were implemented at LGS (PECO 1995). Exelon RAI response dated March 12, 2014, confirms these and other improvements were implemented to reduce risk at LGS as a result of the IPEEE (Exelon 2014a). These results at Limerick are also consistent with other IPEEEs in that they have resulted in only plant procedural and programmatic improvements (i.e., accident management) and, in only a few cases, minor plant modifications to further reduce the risk and consequences of severe accidents.

5.3.4 Accident Management Program

The staff specifically relied on the Accident Management Program as the proper avenue for addressing the improvements considered in the 1989 SAMDA Analysis. Accident management involves the development of procedures that promote the most effective use of available plant equipment and staff in the event of an accident. The staff indicated its intent (NRC 1988a) that licensees develop an accident management framework that will include implementation of accident management procedures, training, and technical guidance. Exelon developed an accident management program at LGS which factored insights gained as a result of the IPE. As discussed earlier, the improvements identified from the completed IPEs to date have been in the area of accident management or other procedural and programmatic improvements (NRC 1996 and NRC 1997). Additionally the EPG and SAMGs developed by the BWROG and implemented at Limerick incorporate the accident management strategies identified in the CPI program. Exelon RAI response dated March 12, 2014, confirms these and other improvements were implemented to reduce risk at LGS as a result of the IPE (Exelon 2014a).

5.3.5 NRC Efforts to Address Severe Accident-Related Issues Since the Publication of the 1996 GEIS

The evaluation of Limerick's 1989 SAMDA analysis is summarized in the 1996 GEIS. The NRC has continued to address severe accident-related issues since the GEIS was published and 10 CFR Part 51 changes related to license renewal were promulgated. The NRC and licensee efforts have reduced risks from accidents beyond that considered in the 1996 GEIS (summarized below) and the 2013 GEIS (NRC 2013a). In some cases, such as the agency response to Fukushima, these activities are ongoing. Each of the activities applied or continues to apply to all reactors, including LGS. The specific requirement for any given reactor was based either on a site-specific evaluation or a design-specific requirement.

5.3.6 10 CFR 50.54(hh) Conditions of License Regarding Loss of Large Areas of the Plant Caused by Fire or Explosions

Following September 11, 2001, the Commission issued Order EA-02-026 and ultimately a new regulation (10 CFR 50.54(hh)), which required commercial power reactor licensees to, among other things, adopt mitigation strategies using readily available resources to maintain or restore core cooling, containment, and spent fuel pool cooling capabilities to cope with the loss of large areas of the facility because of large fires and explosions from any cause, including beyond-design-basis aircraft impacts (See 74 FR 13926). The final rule also added several new requirements developed as a result of insights gained from implementation of the security orders, reviews of site security plans, and implementation of the enhanced baseline inspection program, and updated the NRC's security regulatory framework for the licensing of new nuclear power plants. Compliance with the final rule was required by March 31, 2010, for licensees, including Exelon, currently licensed to operate under 10 CFR Part 50. Exelon has updated its plant and procedures accordingly, and the NRC has inspected the guidelines and strategies that Exelon has implemented to meet the requirements of 10 CFR 50.54(hh)(2). The specifics of the enhancements are security related and not publicly available but are described, in general, in the 2013 GEIS. These enhancements include: (1) significant reinforcement of the defense capabilities for nuclear facilities, (2) better control of sensitive information, (3) enhancements in emergency preparedness (EP) to further strengthen the NRC's nuclear facility security program, and (4) implementation of mitigating strategies to deal with postulated events potentially causing loss of large areas of the plant caused by explosions or fires, including those that an aircraft impact might create. These measures are outlined in greater detail in NUREG/BR-0314 (NRC 2004), NUREG-1850 (NRC 2005), and Sandia National Laboratory's "Mitigation of Spent Fuel Loss-of-Coolant Inventory Accidents and Extension of Reference Plant Analyses to Other Spent Fuel Pools" (Wagner and Gaunt 2006).

As discussed in Section 5.3.3.1 of the 1996 GEIS, security-related events are addressed via deterministic criteria in 10 CFR Part 73, rather than by risk assessments or SAMAs. However, as provided above in the severe accident introduction (Section 5.3), the purpose of the evaluation of SAMAs is to identify design alternatives, procedural modifications, or training activities that are cost-beneficial and further reduce the risks of severe accidents (NRC 1999a). The analysis of SAMAs includes the identification and evaluation of alternatives that reduce the radiological risk from a severe accident by preventing substantial core damage (i.e., preventing a severe accident) or by limiting releases from containment in the event that substantial core damage occurs (i.e., mitigating the impacts of a severe accident) (NRC 1999b). Exelon's efforts to implement the deterministic requirements of 10 CFR 50.54(hh) and 10 CFR Part 73 were similar to the purpose of evaluating SAMAs because they mitigate the consequences of a beyond design basis accident. However, the implementation of deterministic 10 CFR 50.54(hh) and 10 CFR Part 73 requirements are required regardless of whether they are cost-beneficial or not. Nevertheless, these activities have further contributed to the reduction of risk at Limerick.

5.3.7 Severe Accident Management Guidelines

Exelon has also developed and implemented severe accident mitigation guidelines (SAMGs) at LGS, which further reduce risk at the facility. SAMGs were developed by the industry during the 1980s and 1990s in response to the Three Mile Island (TMI) Nuclear Station accident and follow-up activities. SAMGs are meant to "enhance the ability of the operators to manage accident sequences that progress beyond the point where emergency operating procedures (EOPs) and other plant procedures are applicable and useful" (NRC 2011a). The CPI program issues applicable to Limerick were effectively subsumed into the IPE process in Supplements 1 and 3 to Generic Letter 88-20. Additionally, the EPG and SAMGs developed by the BWROG and implemented at Limerick incorporate the accident management strategies identified in the CPI program and elsewhere (Exelon 2014a). The development and implementation of these guidelines are similar to SAMAs in that they are procedural modifications that further reduce the risks of severe accidents.

5.3.8 Fukushima-Related Activities

On March 11, 2011, a massive earthquake off the east coast of Honshu, Japan, produced a tsunami that struck the coastal town of Fukushima. The six-unit Fukushima Dai-ichi nuclear power plant was directly impacted by these events. The resulting damage caused the failure of several of the units' safety systems needed to maintain cooling water flow to the reactors. As a result of the loss of cooling, the fuel overheated, and there was a partial meltdown of the fuel contained in three of the reactors. Damage to the systems and structures containing reactor fuel resulted in the release of radioactive material to the surrounding environment (NRC 2013a).

In response to the earthquake, tsunami, and resulting reactor accidents at Fukushima Dai-ichi (hereafter referred to as the "Fukushima events"), the Commission directed the staff to convene an agency task force of senior leaders and experts to conduct a methodical and systematic review of the relevant NRC regulatory requirements, programs, and processes, including their implementation, and to recommend whether the agency should make near-term improvements to its regulatory system. As part of the short-term review, the task force concluded that, while improvements are expected to be made as a result of the lessons learned from the Fukushima events, the continued operation of nuclear power plants and licensing activities for new plants do not pose an imminent risk to public health and safety. During the time that the task force was conducting its review, groups of individuals and nongovernmental organizations petitioned the Commission to suspend all licensing decisions in order to conduct a separate, generic NEPA analysis to determine whether the Fukushima events constituted "new and significant information" under NEPA that must be analyzed as part of environmental reviews. The Commission found the request premature and noted, "In short, we do not know today the full implications of the [Fukushima] events for U.S. facilities." However, the Commission found that if "new and significant information comes to light that requires consideration as part of the ongoing preparation of application-specific NEPA documents, the agency will assess the significance of that information, as appropriate." The Federal courts of appeal and the Commission have interpreted NEPA such that an EIS must be updated to include new information only when that new information provides "a seriously different picture of the environmental impact of the proposed project from what was previously envisioned" (NRC 2013a).

The NRC also ensured U.S. nuclear power plants took action to prepare for a Fukushima-like event. The NRC told its inspectors to independently assess each plant's level of preparedness. The inspections covered procedures that compensate for extensive onsite damage, loss of all alternating current (AC) power, and seismic and flooding issues, as well as procedures for dealing with a damaged reactor.

The agency also created the Japan Lessons Learned-Project Directorate, or JLD, to lead the NRC efforts relating to Fukushima. The JLD's approximately 20 full-time employees work with experts from across the agency. The JLD is directed by a steering committee made up of NRC senior managers.

The agency issued three Orders in March 2012 requiring U.S. reactors to:

- Obtain and protect additional emergency equipment, such as pumps and generators, to support all reactors at a given site simultaneously following a natural disaster
- Install enhanced equipment for monitoring water levels in each plant's spent fuel pool.
- Improve/install emergency venting systems that can relieve pressure in the event of a serious accident (only for reactors with designs similar to the Fukushima plant).

The NRC strengthened the venting Order in 2013, requiring the vents to handle the pressures, temperatures, and radiation levels from a damaged reactor. The revised Order also calls for plants to ensure their personnel could operate the vents under those conditions (NRC 2013b).

The NRC has also asked all U.S. reactors to reconfirm their flooding and earthquake preparedness, as well as reanalyze their earthquake and flooding hazards. Other NRC activities include creating or revising rules related to maintaining key safety functions, if a plant loses all AC power, and several aspects of EP. The NRC's Web site includes more information on Fukushima-related actions.

Significantly, while the Commission did impose additional safety requirements on operating reactors following Fukushima as provided in the preceding paragraphs, the Commission did so on the basis of a safety analysis conducted under the Backfit Rule, not the results of a SAMA analysis conducted for NEPA purposes. Those SAMA analyses had long assumed that prolonged station blackouts, such as the one experienced by the Fukushima reactors, could yield devastating consequences. Therefore, subsequent events, including the Fukushima events, have confirmed the Commission's twin expectations that (1) future SAMA analyses would not likely find major plant improvements cost-beneficial and that (2) the NRC would continue to reduce risk at regulated facilities through its ongoing safety oversight (61 FR 28467; NRC 1996).

Given the many ways the NRC has and continues to address severe accident-related issues since the publication of the 1996 GEIS (Sections 5.3.5 to 5.3.8) and the 1989 SAMDA, the NRC concludes that the NRC does not need to reconsider SAMAs for LGS at the license renewal phase. See 10 CFR 51.53(c)(3)(ii)(L) and 10 CFR Part 51 Table B–1. As provided above, 10 CFR 51.53(c)(3)(ii)(L) and 10 CFR Part 51 Table B–1 rely on more than just the prior 1989 SAMDA Analysis; they also rest on the IPE, IPEEE, and CPI programs, to consider SAMAs in cases like LGS in which the NRC has already analyzed SAMAs. These plant-specific analyses did not identify major cost-beneficial mitigation measures that could substantially reduce offsite risk. Rather, they mostly uncovered minor improvements and programmatic fixes. The volume of plant-specific analyses cited by the Commission, and their ongoing nature, provide the type of "hard look" the Commission understood it must apply to the issue of SAMAs in its NEPA review for every license renewal proceeding (61 FR 28481). This approach is all the more reasonable in light of the Commission's finding that the probability-weighted environmental impacts of severe accidents are small.

Furthermore, the 2013 GEIS mentions the vast operating experience to support the safety of U.S. nuclear power plants. As with any technology, experience generally leads to improved plant performance and public safety. This additional experience has contributed to improved plant performance (e.g., as measured by trends in plant-specific performance indicators), a reduction in operating events, and lessons learned that improve the safety of all of the operating nuclear power plants. The items above contribute to improved safety as do those safety improvements not related to license renewal such as generic safety issues (e.g., Generic Safety Issue 191 on sump performance). Thus, the performance and safety record of nuclear power plants operating in the United States, including Limerick, continues to improve. This is also confirmed by analysis which indicates that, in many cases, improved plant performance and design features have resulted in reductions in initiating event frequency, CDF, and containment failure frequency (NRC 2013a).

5.3.9 Evaluation of Other New Information

Additionally, both the applicant and the NRC must consider whether new and significant information affects environmental determinations in the NRC's regulations, including the determination in 10 CFR 51.53(c)(3)(ii)(L) and Table B-1 that the agency need not reconsider SAMAs at license renewal if it has already done so in a NEPA document for the plant. See 61 FR 28467 to 28468; see *Marsh* v. *Oregon Natural Resources Council*, 490 U.S. 360, 373–374 (1989). As the Commission observed in CLI-13-7, the staff must consider whether there is new and significant information pertaining to the 1989 SAMDA analysis for Limerick's original operating licenses in the SEIS. If new and significant information is available, "then the original SAMA analysis may be inadequate to satisfy NEPA at the license renewal stage, and may require supplementation."

The 1989 SAMDA concluded, "The risks and environmental impacts of severe accidents at Limerick are acceptably low." We have found no new information that would call into question the FES conclusion that:

> [T]he risks of early fatality from potential accidents at the site are small in comparison with risks of early fatality from other human activities in a comparably sized population, and the accident risk will not add significantly to population exposure and cancer risks. Accident risks from Limerick are expected to be a small fraction of the risks the general public incurs from other sources. Further, the best estimate calculations show that the risks of potential reactor accidents at Limerick are within the range of such risks.

Furthermore, the 1989 SAMDA stated, "In light of these considerations, the staff has no clear basis at this time for concluding that modifications to the plant are justified for the purpose of further mitigating severe accident risks" and "The staff believes that the severe accident program is the proper vehicle for further review of severe accidents at nuclear power plants, including Limerick."

New information is significant if it provides a seriously different picture of the impacts of the Federal action under consideration. Thus, for mitigation alternatives such as SAMAs, new information is significant if it indicates that a mitigation alternative would substantially reduce an impact of the Federal action on the environment. Consequently, with respect to SAMAs, new information may be significant if it indicated a given cost-beneficial SAMA would substantially reduce the impacts of a severe accident or the probability or consequences (risk) of a severe accident occurring. As discussed below, none of the information identified by the applicant, commenters on the EIS, waiver petitions, or the staff indicates that any SAMAs would be cost-beneficial and likely to result in such a reduction of risk. Rather, new information indicates that further SAMA analyses are unlikely to identify a SAMA that substantially reduces the risk of a severe accident, such as major, cost-beneficial plant improvements, and that the overall probability of a severe accident has decreased at LGS. The following evaluation for new and significant information is to determine whether any new and significant information exists that provides a “seriously different picture of the environmental impacts than what was previously envisioned” regarding the determination in 10 CFR 51.53(c)(3)(ii)(L) Table B-1 and the clarifications in the statement of considerations.

The applicant relied on these requirements and did not submit a new SAMA analysis for license renewal. Specifically, the applicant cited 10 CFR 51.53(c)(3)(ii)(L) and stated that no SAMA was submitted as none was required as a matter of law (Exelon 2011c). Because the Commission stated in the statements of consideration for 10 CFR 51.53(c)(3)(ii)(L) that the 1989 SAMDA was a SAMA for purposes of the rule (61 FR 28481), the staff concluded that Exelon’s treatment of SAMA in its ER was in accordance with the Commission’s regulations. Exelon evaluated whether there was new and significant information with respect to the Commission’s regulation (Exelon 2011c). Specifically, Exelon analyzed whether potentially new and significant information would change the results of its 1989 SAMDA Analysis review. The Commission stated in CLI-12-19 that if the staff identifies new information that could invalidate the 1989 SAMDA Analysis, it should evaluate whether that information is significant under NEPA. The staff reviewed the applicant’s submitted information to assess if any of that information invalidated the 1989 SAMDA and also assessed if any new and significant information has been found that would change the generic conclusion codified by the NRC that Exelon need not reassess SAMAs at LGS for license renewal (10 CFR 51.53(c)(3)(ii)(L)) and the staff need not reconsider SAMAS at this stage (10 CFR 51, Table B-1). The following summarizes Exelon’s evaluation and the staff’s review of this information. In addition, the staff’s independent assessment did not identify any other new and significant information with respect to those regulations or the 1989 SAMDA. Hence, no new and significant information has been found with respect to the generic conclusion codified by the NRC that LGS need not reassess SAMAs for license renewal (10 CFR 51.53(c)(3)(ii)(L)) because neither the staff nor applicant uncovered any new and significant information that suggested another cost-beneficial SAMA that could substantially reduce the risk of a severe accident at Limerick.

5.3.10 The Applicant’s Evaluation of New and Significant Information

The applicant explained the process it used to identify any potentially new and significant information related to its existing 1989 SAMDA review in Section 5.3.1 of the ER (Exelon 2011c). As provided in Section 5.1 of Appendix E of the ER (Exelon 2011c), the new and significant assessment that Exelon conducted during preparation of this license renewal application included: (1) interviews with Exelon Generation subject-matter experts on the validity of the conclusions in the GEIS as they relate to LGS, (2) an extensive review of documents related to environmental issues at LGS, (3) a review of correspondence with State and Federal agencies to determine if the agencies had concerns relevant to their resource areas that had not been addressed in the GEIS, (4) a review of the results of LGS environmental monitoring and reporting, as required by regulations and oversight of plant facilities and operations by State and Federal regulatory agencies (i.e., the results of ongoing routine activities that could bring significant issues to Exelon Generation's attention), (5) a review for issues relevant to the LGS application of certain license renewal applications that have previously been submitted to the NRC by the operators of other nuclear plants, and (6) a review of information related to severe accident mitigation. The significance and materiality of the new information identified through this process was discussed further in ER Section 5.3.2, "Significance of New Information." Exelon used a methodical approach to identify new and significant information and the staff finds Exelon's process adequate to ensure a reasonable likelihood that the applicant would be aware of any new and significant information.

The following four items of new information were identified and evaluated by the applicant by comparing assumptions for the 1989 SAMDA Analysis with assumptions used for current-day assessments of SAMAs:

(1) population increase;

(2) consideration of offsite economic cost risk;

(3) changed criteria for assigning cost per person-rem averted; and

(4) changed seismic hazard proposed by GI-199, "Implications of Updated Probabilistic Seismic Hazard Estimates in Central and Eastern United States on Existing Plants."

Each item of new information was evaluated by the applicant and reviewed by the staff to determine whether it would materially alter the NRC's conclusions, as documented in the 1989 SAMDA Analysis. None of the items of new information led to the identification of a SAMA that was cost-beneficial. Consequently, the applicant's and staff's review of new and significant information with respect to the 1989 SAMDA review did not uncover any cost-beneficial plant improvements or SAMAs that would substantially decrease the risk of a severe accident. Instead, it indicated that no plant improvements that led to a substantial reduction in risk would be cost-beneficial. Therefore, the staff finds that none of the new information identified by the applicant affects the generic conclusion codified by the NRC that applicants need not reassess SAMAs for license renewal at facilities like LGS (10 CFR 51.53(c)(3)(ii)(L)) or the 1989 SAMDA analysis.

5.3.11 Risk

As provided in the discussion earlier regarding LGS's IPE, the CDF in the 2009 PRA Update (3.2×10^{-6}) is more than an order of magnitude less than the 1989 PRA Update (Exelon ER). Any change in the likelihood of accidents that release substantial amounts of radioactive material to the environment not only affects the human impact but also any environmental impact. For LGS, this decrease in CDF would demonstrate less impact to dose, economic, and environmental impact. The overall reduction in risk indicates that further SAMA analyses for LGS would be unlikely to uncover cost-beneficial major plant improvements or plant improvements that could substantially reduce risk. Furthermore, as improvements are implemented and risk decreases, not only is it more difficult to find a SAMA that yields significant reduction in CDF, but SAMAs which lead to a small reduction in risk are more likely not to be cost-beneficial. In light of the significant reductions in CDF at Limerick, no new information is likely to significantly affect the Commission's generic determination that the NRC need not reanalyze SAMAs at LGS for license renewal or invalidate the 1989 SAMDA.

5.3.12 Population Increase

A summary of Exelon's evaluation of population increase provided in the ER is as follows. Exelon provided population values within 50 miles growing from 6,819,505 in 1980 to 9,499,925 in 2030. They further assumed that this 39 percent increase in population would yield an approximate 39 percent increase in total off-site dose values. Assuming 2030 population numbers, the applicant determined that the highest benefit/cost ratio SAMDA (ATWS Vent) based on cost per person-rem averted would still not be cost-beneficial in the 1989 SAMDA Analysis.

There were also public comments that provided site specific information regarding population increases and economics around Limerick Generating Station. Comment 30-39-PA indicates that the impact of a severe accident at Limerick erroneously relies on data from an analysis done at TMI, a site that involves a markedly different and less economically developed area than the area within 50 miles of Limerick, which includes the densely populated urban environments of Philadelphia, PA; Camden and Trenton, NJ; and Wilmington, DE.

The staff reviewed the calculation provided by the applicant and considered the public comments regarding population growth.

GEIS section E.3.9.2 provides an evaluation of the population increase for multiple plants to determine the effect of population increases on the plants evaluated in the GEIS. The 2013 GEIS states,

> To adjust the impacts estimated in the NUREGs and NUREG/CRs to the mid-year of the assessed plant's license renewal period, the information (i.e., exposure indexes [EIs]) in the 1996 GEIS can be used. The EIs adjust a plant's airborne and economic impacts from the year 2000 to its mid-year license renewal period based on population increases. These adjustments result in anywhere from a 5- to a 30-percent increase in impacts, depending upon the plant being assessed. Given the range of uncertainty in these types of analyses, a 5- to 30-percent change is not considered significant. Therefore, the effect of increased population around the plant does not generally result in significant increases in impacts.

Exelon's population calculation was reviewed by the staff and found to be reasonable. Furthermore, the 39-percent increase in impacts determined at Limerick was more conservative than any of the other plants evaluated in the GEIS (a maximum of a 30-percent increase). Thus the Exelon calculation was determined to be reasonable and found acceptable by the staff. The staff also confirmed that the population increase would not make any of the 1989 SAMDAs cost-effective.

The staff acknowledges that a more precise estimate of this relationship could be obtained by using the MACCS2 code, performing a level 3 PRA, and completing a new SAMA analysis. However, the staff notes that improvements or mitigating strategies as a result of population increases at Limerick would be implemented as part of the current licensing basis in the plant's emergency plan. A key component of the mission of the NRC is to ensure adequate protective actions are in place to protect the health and safety of the public. Protective actions are taken to avoid or reduce radiation dose and are sometimes referred to as protective measures. The overall objective of emergency preparedness (EP) is to ensure that the nuclear power plant operator is capable of implementing adequate measures to protect public health and safety in the event of a radiological emergency. As a condition of their license, operators of these nuclear power plants must develop and maintain EP plans that meet comprehensive NRC EP requirements. Increased confidence in public protection is obtained through the combined inspection of the requirements of EP and the evaluation of their implementation. The NRC assesses the capabilities of the nuclear power plant operator to protect the public by requiring the performance of a full-scale exercise at least once every 2 years that includes the participation of government agencies. These exercises are performed in order to maintain the skills of the emergency responders and to identify and correct weaknesses. They are evaluated by NRC inspectors and FEMA evaluators. Between these 2-year exercises, additional drills are conducted by the nuclear power plant operators that are evaluated by NRC inspectors (NRC Website). An example where population is evaluated in the current term is found in the Limerick Generating Station Evacuation Time and Plume Exposure Pathway Estimates using 2010 Census population data (Exelon 2013b). Thus, Limerick's population-related mitigating alternatives are considered in the current term regardless of whether they are pursuing license renewal or not. The 2013 GEIS evaluation of population and economic consequences is described in Section 5.3.13.

Since Limerick's calculation was reasonable, more conservative than any of the population increase evaluations in the GEIS, and mitigation alternatives as a result of population increases are implemented in the current term, the staff finds Limerick's evaluation acceptable and population increases at Limerick are not new and significant information. Moreover, even if population increase led to another SAMA becoming cost-beneficial, that SAMA would still not likely result in a substantial reduction in offsite risk, given the substantial reduction in CDF at Limerick since the 1989 SAMDA analysis. In addition, the implementation of Limerick's improvements to reduce the CDF makes it more difficult to identify additional cost beneficial SAMAs, thus, it is unlikely that further consideration of economic risk would yield many cost-beneficial SAMAs. Consequently, the population increase within 50 miles of LGS does not suggest that additional cost-beneficial SAMAs could substantially reduce the risk of severe accidents and therefore does not constitute new and significant information with respect to the 1989 SAMDA or the generic conclusion codified by the NRC that SAMAs need not be reassessed at facilities like LGS for license renewal (10 CFR 51.53(c)(3)(ii)(L)).

5.3.13 Consideration of Offsite Economic Cost Risk

The applicant indicated that the 1989 SAMDA Analysis did not consider offsite economic cost risk. To account for the offsite economic cost risk, the applicant estimated these impacts by using data from the TMI license renewal application (Amergen 2008; Exelon 2011b). Using TMI data, the applicant determined offsite economic cost risk was approximately 70 percent larger than the offsite exposure cost risk at TMI. In order to apply the TMI data to LGS, the applicant applied a factor of 3 (300 percent) to analyze the impact on the 1989 SAMDA Analysis for LGS. Applying a factor of 3 reduction to the closest potential cost-beneficial SAMDA (ATWS Vent) would not result in a cost-beneficial SAMDA (Exelon 2011c).

The staff assessed the calculation provided by the applicant. The staff confirmed the applicant's value by using similar ratios to evaluate the cost impact of onsite exposure and economic costs for LGS ($2,000 and $400,000, respectively) to obtain the total offsite and onsite economic and exposure cost. The net value was determined by the staff to be −$284,000, indicating that the ATWS Vent SAMDA was still not cost-effective. Since this was applied to the SAMDA (ATWS Vent) that was closest to being cost-effective, none of the SAMDAs identified in the 1989 SAMDA Analysis would be cost-effective.

Additional conservatisms not mentioned by the applicant include converting the $3,000,000 cost of the ATWS Vent SAMA to 2012 dollars that would increase the cost of the SAMDA to over $5,000,000 (assuming similar engineering and construction practices). Considering the large conservatisms in the Exelon analysis, it is reasonable. Moreover, even if consideration of offsite economic risk increase led to another SAMA becoming cost-beneficial, that SAMA would still not likely result in a substantial reduction in offsite risk, given the substantial reduction in CDF at

Limerick since the 1989 SAMDA analysis. In addition, the implementation of Limerick's improvements to reduce the CDF makes it more difficult to identify additional cost beneficial SAMAs, therefore, it is unlikely that further consideration of economic risk would yield many cost-beneficial SAMAs. Therefore, consideration of offsite costs would not likely lead to discovery of a cost-beneficial SAMA that would substantially reduce risk of severe accidents and, therefore, does not constitute new and significant information with respect to the 1989 SAMDA or the generic conclusion codified by the NRC that applicants need not reassess SAMAs for facilities such as LGS for license renewal.

There were also public comments that provided site-specific information regarding offsite economic cost risk around Limerick Generating Station. Comment 30-39-PA indicates that the impact of a severe accident at Limerick erroneously relies on data from an analysis done at TMI. The commenter states that it was erroneous to rely on TMI data because TMI involves a markedly different and less economically developed area than the area within 50 miles of Limerick, which includes the densely populated urban environments of Philadelphia, PA; Camden and Trenton, NJ; and Wilmington, DE. The commenter also stated that the ER ignores new and significant information regarding the likely cost of cleanup from a severe accident in a metropolitan area like Philadelphia and thus understates the impact of a properly conducted economic analysis on the environmental consequences of a severe accident at Limerick.

The GEIS evaluated the economic impacts of accidents using plant-specific information. Chapter 5 of the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), Volumes 1 and 2 (NRC 1996), assessed the impacts of postulated accidents at nuclear power plants on the environment. The postulated accidents included design-basis accidents and severe accidents (e.g., those with core damage). The impacts considered included dose and health effects of accidents (Sections 5.3.3.2 through 5.3.3.4), economic impacts of accidents (Section 5.3.3.5), and the effect of uncertainties on the results (Section 5.3.4). Similar to Limerick:

> …the performance and safety record of nuclear power plants operating in the United States continues to improve. This is also confirmed by analysis which indicates that, in many cases, improved plant performance and design features have resulted in reductions in initiating event frequency, core damage frequency, and containment failure frequency (NRC 2013a).

To assess the impacts from the airborne pathway, the 1996 GEIS relied on severe accident analyses provided in 28 nuclear power plants (including Limerick) that included severe accident analyses in their plant-specific EISs. These 28 nuclear power plants are provided in Table 5-1 in the 1996 GEIS. These plant-specific EISs used site-specific meteorology, land topography, population distributions, and offsite emergency response parameters, along with generic or plant-specific source terms, to calculate offsite health and economic impacts. The offsite health effects included those from airborne releases of radioactive material and contamination of surface water and groundwater. The 1996 GEIS used the environmental impact information from the 28 plant-specific EISs and a metric called the exposure index (EI) to (1) scale up the radiological impact of severe accidents on the population due to demographic changes from the time the original EIS was done until the year representing the mid-license renewal period and (2) estimate the severe accident environmental impacts for the earlier plants (whose EISs did not include a quantitative assessment of severe accidents). The EI method uses the projected population distribution around each nuclear power plant site at the middle of its license renewal period and meteorology data for each site to provide a measure of the degree to which the population would be exposed to the release of radioactive material resulting from a severe accident (i.e., the EI method weights the population in each of 16 sectors around a nuclear power plant by the fraction of time the wind blows in that direction on an annual basis). The EI metric was also used to project economic impacts at the mid-year of the license renewal period. A more detailed description of the EI method is contained in Appendix G of the 1996 GEIS. The use of the EI method remains valid. Regarding economic impacts, the GEIS specifically provides that the "probability-weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to ground water, and societal and economic impacts from severe accidents are small for all plants."

The 2013 GEIS compares the CDFs that formed the basis for the 1996 GEIS, and offsite doses directly from the 1996 GEIS, to the newer information. The comparison is done for pressurized water reactors (PWRs) and boiling water reactors (BWRs) and covers each of the plants listed in Table 5.1 of the 1996 GEIS, which included Limerick Units 1 and 2. Changes in source terms (i.e., the quantity, form, and timing of radioactive material released to the environment) are assessed in Section E.3.3 of the 2013 GEIS. The 2013 GEIS concluded, "Given the discussion in this appendix, the staff concludes that the reduction in environmental impacts from the use of new information (since the 1996 GEIS analysis) outweighs any increases resulting from this same information."

Therefore, the 2013 GEIS analysis using plant-specific information was consistent with the evaluation for Limerick. The staff acknowledges that a more precise estimate of this relationship could be obtained by using the MACCS2 code, performing a Level 3 PRA, and completing a new SAMA analysis using site-specific data. However, most mitigation alternatives are identified at the Level 1 and Level 2 stages because relevant Level 1 and Level 2 improvements are physical or process changes to the plant to protect the reactor core in the case of Level 1 PRA, or containment in the case of Level 2 PRA. The Level 3 portion deals with the magnitude of the consequences. The change in magnitude of the consequences could possibly make some mitigation alternatives cost-beneficial. However, most of the benefit is ascertained by focusing on protecting the reactor core and the containment in the Level 1 and Level 2 stages. As provided in Section 5.3.17, specific improvements at Limerick have been implemented to drive the risk downward. Furthermore, if there is higher economic cost and dose consequence, more SAMAs could become cost-effective, however no SAMA is expected to be a major design change that will reduce the risk significantly because of the continuous implementation of improvements since the 1989 SAMDA.

The result of the applicant's and staff's analysis in this case is consistent with the GEIS. As provided in GEIS Table 3.8-8, the populations at both Limerick and TMI are considered high. Furthermore, the GEIS states, "The expected costs resulting from a severe accident at nuclear power plants during their renewal periods have been predicted from evaluations presented in 27 FESs. Estimates of the extent of land contamination have also been presented. In both cases, the conditional impacts are judged to be of small significance for all plants" (NRC 2013a).

5.3.14 Changed Criterion for Assigning Cost Per Person-Rem Averted

The 1989 SAMDA Analysis calculated the benefit of each proposed SAMDA based on a criterion of $1,000 per person-rem averted. Using a value of $2,000 per person-rem averted would increase the threshold and potentially result in new cost-beneficial SAMDAs. As described in the 1989 SAMDA Analysis, changing the cost/benefit threshold using the $2,000 per person-rem averted conversion would still not result in this or any other of the 1989 SAMDAs becoming cost-beneficial. Therefore, Exelon concludes that changing the criterion for assigning benefit (i.e., cost per person-rem averted) from $1,000 per person-rem averted to $2,000 per person-rem averted would not change the conclusions in the 1989 SAMDA Analysis. Hence, the new information represented by the changed criterion for assigning cost per person-rem averted was judged not to be significant by Exelon.

The staff reviewed the LGS analysis provided in the License Renewal ER and agrees that changing the criterion for assigning cost per person-rem averted would not result in a cost-beneficial SAMDA or change the conclusions in the 1989 SAMDA. As provided above, the ATWS Vent has the lowest cost/benefit ratio for the set, and it represents the SAMDA with the largest benefit potential. Even for this limiting SAMDA, changing the cost/benefit threshold to $2,000 per person-rem averted would still not result in this or any other of the SAMDAs becoming cost-beneficial. Since this was applied to the SAMDA (ATWS Vent) closest to being cost-effective, none of the 1989 SAMDAs are cost-effective. This conclusion is even more reasonable given that the 2013 GEIS concluded that the population dose estimates presented in Table E-3 demonstrate the conservatism in the older studies, both from the standpoint of reduced population dose from more recent estimates and the conservatism built into the earlier methodology (NRC 2013a). Additional conservatisms not mentioned by the applicant include that converting the $3,000,000 cost of the ATWS Vent SAMA to 2012 dollars would increase the cost of the SAMDA to over $5,000,000 (assuming similar engineering and construction practices). Considering all of the large conservatisms in the analysis, the applicant's analysis is reasonable. Moreover, even if the increase in cost per person-rem averted led to another SAMA becoming cost-beneficial, that SAMA would still not likely result in a substantial reduction in offsite risk, given the substantial reduction in CDF at Limerick since the 1989 SAMDA analysis. Therefore, consideration of the increased costs per person-rem averted would not likely lead to discovery of a cost-beneficial SAMA, let alone one that would substantially reduce offsite risk and therefore does not constitute new and significant information with respect to the generic conclusion codified by the NRC that Exelon need not reassess LGS SAMAs for license renewal.

5.3.15 Changed Seismic Hazard Proposed in GI-199

On June 9, 2005, the NRC opened GI-199 to assess the implications of updated seismic data and methods for Central and Eastern U.S. (CEUS) operating plants. The staff's confirmatory analysis of the seismic hazard concluded that the calculated seismic hazard for some operating plants in the CEUS had increased. The NRC issued IN 2010-18 to nuclear power plants and independent spent fuel storage installations. This information notice stated that the NRC would follow the appropriate regulatory process to request that operating plants provide specific information about their facilities to enable the staff to complete the regulatory assessment and to identify and evaluate candidate backfits. NRR developed a draft Generic Letter to request needed data from power reactor licensees. The NRC originally intended the request to apply only to power reactor licensees in the CEUS, but, in light of the March 2011 Japanese earthquake, NRR expanded the scope of the request to include all U.S. power reactor licensees. On March 12, 2012, the NRC issued a request for information pursuant to 10 CFR 50.54(f) (hereafter referred to as the 50.54(f) letter) (Agencywide Documents Access and Management System (ADAMS) Accession No. ML 12053A340). The purpose of that request was, in part, to gather updated information concerning the seismic hazards at operating reactor sites and to enable the NRC staff to determine whether licenses should be modified, suspended, or revoked. The "Required Response" section of Enclosure 1 of the 50.54(f) letter indicated that licensees and construction permit holders should provide a Seismic Hazard Evaluation and Screening report within 1.5 years from the date of the 50.54(f) letter for CEUS nuclear power plants and within 3 years of the 50.54(f) for western United States plants (NRC 2012f).

Limerick provided its submittal regarding the new seismic hazard. Limerick's response concluded:

> For LGS, the Safe Shutdown Earthquake envelopes the ground motion response spectra (GMRS) in the frequency range from 1 to 10 Hz. Therefore per the SPID Sections 3.2 and 7 (Reference 3), LGS screens out of further seismic risk assessments in response to NTTF 2.1: Seismic, including seismic probabilistic risk assessment (SPRA) or seismic margin assessment (SMA), as well as spent fuel pool integrity evaluations. Additionally, LGS screens out of the Expedited Seismic Evaluation Process (ESEP) interim action per the 'Augmented Approach' guidance document, Section 2.2 (Reference 4). Due to the GMRS exceeding the SSE in the frequency range above 10 Hz, high-frequency confirmations are needed for LGS in accordance with the SPID Sections 3.2 and 3.4 (Reference 3). Actions to address NTTF 2.1: Seismic for central and eastern United States nuclear plants will be performed in accordance with the schedule provided in the April 9, 2013, letter from the industry to the NRC (Reference 5), as agreed to by the NRC in the May 7, 2013, letter to the industry (Reference 23). [Exelon 2014b]

In a May 9, 2014, letter titled, "Screening And Prioritization Results Regarding Information Pursuant To Title 10 Of The *Code Of Federal Regulations* 50.54(F) Regarding Seismic Hazard Re-Evaluations For Recommendation 2.1 Of The Near-Term Task Force Review Of Insights From The Fukushima Dai-Ichi Accident," Limerick is conditionally screened in as a group 3 plant which means:

> Group 3 plants have GMRS to SSE ratios that are greater than 1, but the amount of exceedance in the 1–10 Hz range is relatively small, and the maximum ground motion in the 1–10 Hz range is also not high. Given the limited level of exceedance of the Group 3 plants, staff is evaluating the need for licensees to conduct a seismic risk evaluation in order for the staff to complete its regulatory decision making. However, the staff has had insufficient review time with the recently submitted seismic hazard submittals to reach a conclusion. After further review of the seismic hazard re-evaluations and the Expedited Approach submittals, the staff will decide which Group 3 plants need to complete a risk evaluation. Risk evaluations for Group 3 plants are due by December 31, 2020. [NRC 2014b]

As provided above, these evaluations and actions are ongoing and the regulatory response is independent of whether or not the plant is seeking license renewal or not. The applicant indicated that GI-199 issues related to the seismic hazard will not result in postulated accident scenarios not already considered for LGS. Seismologists are frequently refining seismic methodologies and results, which may increase the estimated frequency of seismic events with very low probability. Results from the LGS June 1989 PRA Update indicate that the contribution from seismic risk to the total CDF is approximately 25 percent, with fire risk contributing 31 percent to the total risk (Exelon 2011c). Therefore, based on the June 1989 Update, the major risk contributors for external hazards are approximately equal to the CDF computed for internal events only. Based on the ER, total CDF for internal and external events can generally be approximated by multiplying the CDF for internal events by a factor of 2. With a multiplication factor of 2 applied to the CDF estimated by the current model of record (CDF=3.2×10^{-6}), the revised CDF that accounts for both internal and external hazards (CDF=6.4×10^{-6}) would still be a factor of 6.5 below the value used in the 1989 SAMDA Analysis (CDF=4.2×10^{-5}). This demonstrates the excess margin in the 1989 SAMDA Analysis. A possible increase in risk beyond this assumption caused by an even larger seismic CDF would be more than offset by the factor of 6.5 reduction in the current CDF. Therefore, Exelon concludes that the new information represented by the changed seismic hazard proposed in GI-199 is not significant because it would not materially alter the SAMDA conclusions in the 1989 SAMDA (Exelon 2011c).

The staff reviewed the method the applicant used in determining the external events multiplier and its use and determined that it was consistent with the guidance provided in Nuclear Energy Institute (NEI) 05-01. Limerick's analysis is also consistent with similar analyses provided in section E.3.2.3 of the 2013 GEIS. The staff also confirmed that the risk has decreased since the 1989 SAMDA and agrees with Exelon's analysis that the new information represented by the changed seismic hazard proposed in GI-199 is not significant because it would not materially alter the SAMDA conclusions in the 1989 SAMDA Analysis. Considering the large conservatism in the 1989 SAMDA Analysis, the applicant's approach is reasonable. Moreover, even if the change in seismic hazard led to another SAMA becoming cost-beneficial, that SAMA would still not likely result in a substantial reduction in offsite risk, given the substantial reduction in CDF at Limerick since the 1989 SAMDA analysis. Therefore, consideration of GI-199 is not likely to lead to the discovery of a cost-beneficial SAMA that would substantially reduce offsite risk and, therefore, does not constitute new and significant information with respect to the generic conclusion codified by the NRC that SAMAs need not be reassessed at LGS for license renewal.

However, the NRC continues to review earthquakes as part of the reactor oversight process. As provided in the conclusions in Exelon's response to the 50.54(f) letter regarding Near-Term Task Force (NTTF) recommendation 2.3 (NRC 2011c):

> In response to NTTF 2.3, the 50.54(f) letter (Reference 1) also requested licensees to perform seismic walkdowns in order to, in the context of seismic response: (1) verify that the current plant configuration is consistent with the licensing basis; (2) verify the adequacy of current strategies, monitoring, and maintenance programs; and (3) identify degraded, nonconforming, or unanalyzed conditions. Exelon committed to and performed seismic walkdowns in accordance with the seismic walkdown guidance (Reference 27) as initially documented and supplemented in Exelon Correspondence Numbers RS-12-171 and RS-13-138 (References 11 and 29), respectively. The remaining walkdowns for initially inaccessible equipment are scheduled to be completed during the next Unit 1 Refueling Outage, 1 R 15, or during the next scheduled system outage window, whichever is applicable. The results will be reported to the NRC after completion of the follow-on walkdowns. [Exelon 2014b]

Exelon further confirmed that seismic vulnerabilities (similar to SAMAs) identified in the Limerick IPEEE have been implemented:

> Based on the successful completion of seismic walkdowns for all components to date in response to NTTF 2.3, and the lack of adverse seismic conditions identified, Exelon has directly concluded that the LGS current plant configuration is consistent with the plant licensing basis and can safely shut down the reactor and maintain containment integrity following the design-basis SSE event. Additionally, the findings of the seismic walkdown program indirectly verify that the current LGS strategies, monitoring, and maintenance programs are adequate for ensuring seismic safety consistent with the licensing basis. Plant vulnerabilities and commitments identified in the LGS IPEEE (Reference 10) were reviewed as part of the NTTF 2.3 seismic walkdowns (References 11 and 29). The seismic walkdown reports confirmed that there are no outstanding IPEEE vulnerabilities or commitments, and all previously identified IPEEE vulnerabilities and commitments have been resolved (References 11 and 29). [Exelon 2014b]

Exelon also confirmed that Limerick has significant seismic margin beyond design basis.

> An evaluation of beyond-design-basis ground motions was performed for LGS as part of the IPEEE program. The LGS IPEEE program demonstrated plant-level seismic capacity, which can be expressed in terms of a HCLPF. This plant-level

> seismic capacity is defined in Section 3.3.2 of the SPID (Reference 3) as the IHS. The LGS IPEEE seismic evaluation was initially submitted as a reduced scope SMA (Reference 10). Subsequent to the IPEEE submittal, LGS responded to a series of Requests for Additional Information (RAI) and provided additional information that justified the LGS IPEEE SMA as achieving the intent of a focused-scope EPRI SMA anchored at 0.3g PGA (References 19, 20, and 21). The IHS for LGS is defined by the median-shaped NUREG/CR-0098 spectra for rock sites per LGS IPEEE seismic demand analysis (Reference 22). As a result of the LGS IPEEE seismic evaluations, plant processes for seismic housekeeping were made to enhance the reliability and safety of the plant. There are no outstanding IPEEE vulnerabilities or commitments, and all previously identified IPEEE vulnerabilities and commitments have been resolved (Reference 11). The results of the LGS IPEEE showed there were no vulnerabilities to severe accident risk from external events, including seismic events (Reference 10). Based on the results of the IPEEE program for LGS, it may be qualitatively concluded that the plant has significant seismic margin beyond the design basis (Reference 28, Section 2.3.4) as evidenced by a comparison between the site SSE and the IHS in Figure 5.4-1. [Exelon 2014b]

Exelon's confirmation regarding Limerick having significant seismic margin beyond the design basis reinforces the NRC staff conclusion that further evaluation of GI-199 related issues is not likely to lead to the discovery of a cost-beneficial SAMA that would substantially reduce offsite risk and, therefore, does not constitute new and significant information with respect to the 1989 SAMDA or the generic conclusion codified by the NRC that SAMAs need not be reassessed at LGS for license renewal.

The staff has also estimated the seismic CDFs (ADAMS No. ML100270756) using various seismic hazard curves. The values cited for Limerick indicate that the seismic CDF is higher than used in the 1989 SAMDA. Note that these values were calculated using a simplified conservative methodology and have very large uncertainties, and more realistic values may be calculated by Limerick as a result of the NRC letter dated May 9, 2014, "Seismic Screening and Prioritization Results Regarding Information Pursuant to Title 10 of the *Code of Federal Regulations* 50.54(f) Regarding Seismic Hazard Reevaluations for Recommendation 2.1 of the Near-Term Task Force Review of Insights" (NRC 2014c). Even though the new seismic CDF is larger than the seismic value used in 1989, Fukushima orders have essentially bounded anything seismically the NRC could do as a result of SAMA analysis since Limerick has implemented the IPEEE seismic recommendations and performed a recent thorough formal seismic walkdown as provided above. Thus, it is unlikely that Exelon will identify any cost-beneficial SAMAs that would substantially reduce the off-site seismic risk and, therefore, does not constitute new and significant information with respect to the generic conclusion codified by the NRC that SAMAs need not be reassessed at LGS for license renewal.

5.3.16 Additional Staff Evaluation for New and Significant Information

The staff reviewed records of public meetings and correspondence related to the application and compared information presented by the public with information considered in NUREG-1437 to determine if there was any new and significant information with respect to the generic conclusion codified by the NRC, which indicates that SAMAs need not be reassessed at LGS for license renewal (10 CFR 51.53(c)(3)(ii)(L)). This consideration included an evaluation of whether any new information invalidated the 1989 SAMDA analysis.

5.3.17 Cost-Effective SAMAs Identified at Other Plants

SAMA evaluations have been completed for operating plant license renewal applications that were approved for over 75 nuclear power plants. Numerous potentially cost-beneficial SAMAs have been identified in U.S. operating nuclear power plant license renewal applications that have been approved. Most of these SAMAs are low-cost improvements such as modifications to plant procedures or training, minimal hardware changes to enable cross-tying existing pipes or electrical buses, and using portable equipment (e.g., generators and pumps) as backups.

Many of the SAMA recommendations identified from other plants are compiled in an NRC published paper entitled "Perspectives on Severe Accident Mitigation Alternatives for U.S. Plant License Renewal" (NRC 2009). The paper concludes, "SAMAs that are found to be potentially cost-beneficial tend to be low-cost improvements such as modifications to plant procedures or training, minimal hardware changes, and use of portable equipment." These potential cost-beneficial SAMAs are further evaluated and many times not found cost-beneficial because sufficient risk is not eliminated by the modification (which was assumed) or other factors. Furthermore, the staff found that SAMA analyses that have been performed to date have found SAMAs that were cost-beneficial, or at least possibly cost-beneficial subject to further analysis, in approximately half of the plants. In general, the cost-beneficial SAMAs were identified and considered by the licensee under the current operating license. In several cases, SAMA-related modifications were implemented at LGS, further reducing that probability of an additional SAMA substantially reducing severe accident risk (PECO 1992)(Exelon 2014). Examples are provided below.

As provided in the statement of considerations for 10 CFR 51.53(c)(3)(ii)(L), in forming its basis for determining which plants needed to submit a SAMA, the Commission noted that all licensees had undergone, or were in the process of undergoing, more detailed site-specific severe accident mitigation analyses through processes separate from license renewal, specifically the CPI, IPE, and IPEEE programs (61 FR 28467). These programs for LGS were discussed earlier. In light of these studies, the Commission stated that it did not expect future SAMA analyses in the license renewal stage to uncover "major plant design changes or modifications that will prove to be cost-beneficial" (61 FR 28467). As discussed above, the NRC's experience in completed license renewal proceedings has confirmed this assumption (NRC 2009). As a result, potentially cost-beneficial SAMAs at other facilities do not constitute new and significant information with respect to the 1989 SAMDA or the NRC's determination not to perform a second SAMA analysis at license renewal in the event the agency has previously considered such analysis, because even if cost-beneficial the NRC staff's experience shows that a new SAMA analysis will not likely yield a major reduction of risk, particularly in light of the many improvements already implemented at Limerick.

From the public comments (NRDC 2011) there was a recommendation that potential cost-effective SAMAs identified at other similar plants be addressed at LGS. Specifically, comment 30-38 from NRDC stated that Exelon omitted a required analysis of new and significant information regarding the potential new SAMAs previous considered for other BWR Mark II Containment reactors from its ER. In response, the staff sent a letter dated February 12, 2014 (NRC 2014a), to Exelon requesting additional information regarding potentially new SAMAs previously considered for other BWR Mark II Containment reactors. Exelon responded in a letter dated March 12, 2014 (Exelon 2014). In their response, Exelon provided a summary of the evaluation of each potentially cost-beneficial SAMA identified in the February 12, 2014, RAI. The evaluation identifies and eliminates from further consideration SAMAs that have already been implemented at Limerick. Then, the percent change in the maximum averted cost-risk (MACR) from implementing each remaining SAMA at the plant for which it was potentially cost-beneficial is estimated using cost benefit information from the respective plant's ER from which the SAMA was taken, and/or the GEIS. To determine whether the SAMA should be considered "new and significant information" with respect to the 1989 Limerick SAMDA analysis, the percent change in the MACR was verified to be less than 50 percent. Exelon selected a 50-percent reduction in the MACR as the threshold for what may be "significant" based on criteria provided in the American Society of Mechanical Engineers (ASME)/American Nuclear Society PRA Standard, NUMARC 93-01 and NEI 00-04 (Exelon 2014).

Changes at Limerick that are functionally equivalent but not identical to those named in a SAMA are also identified in the RAI response. Exelon determined that either the SAMA had already been implemented at Limerick or that there were no SAMAs that exceeded the 50-percent reduction in the MACR. Thus, there were no SAMAs identified at other plants with Mark II containments that were determined to be "new and significant" at Limerick. Hence, further assessment of such information was not needed (Exelon 2014).

The staff reviewed the information provided by Exelon. The staff determined that either the SAMA had already been implemented at Limerick or that there were no SAMAs that exceeded the 50-percent reduction in the MACR. The staff also found exceeding a 50-percent reduction in the MACR was a reasonable significance value based on the guidance provided in the ASME standard, NUMARC 93-01, and NEI 00-04. This determination is particularly reasonable in light of the already significant reductions achieved in severe accident risk at Limerick since 1989. Even 50-percent reduction in current MACR would represent a small reduction in estimated risk at the facility in 1989 because the CDF today is an order of magnitude smaller than used in the 1989 SAMDA. . Thus, there were no SAMAs identified at other plants with Mark II containments that were determined to be "new and significant" at Limerick.

The staff noted that many of the potential cost-beneficial SAMAs identified at the other Mark II containment plants were for SAMAs relating to loss of power. According to the LGS IPE, loss of power provided 31 percent of the CDF at Limerick (PECO 1992).

Table 6.2-2 of the Limerick IPE (PECO 1992) listed four improvement items that were planned as part of the IPE and which were implemented prior to or shortly after the 1992 IPE submittal. Three of the improvements related to loss of power. These improvements are listed below along with their current status.

(1) Create procedure to crosstie 4-kV electrical buses. (Capability maintained in current site response procedures which allow for alignment of alternate power supply for any 4-kV safeguard bus using any diesel generator.)

(2) Create procedure to power C & D ESW pumps from Unit 1, Division 3 & 4 respectively. (Capability maintained in a current station procedure.)

(3) Create cross connection between diesel driven fire pump and fire water system and RHR. (Capability maintained in a current station procedure.)

Thus Limerick has continued to improve the risk associated with loss of power by implementing related items.

The staff further notes that Limerick is implementing the Fukushima orders and provided the Limerick Generating Station, Units 1 and 2, "Overall Integrated Plan in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)," dated February 28, 2013 (RS-13-022). This order specified that these strategies must be capable of mitigating a simultaneous loss of all AC power and loss of normal access to the ultimate heat sink and have adequate capacity to address challenges to core cooling, containment, and SFP cooling capabilities at all units on a site subject to the Order.

By letter dated January 10, 2014, the NRC staff determined that, based on a review of Exelon's plan, including the 6-month update dated August 28, 2013, and information obtained through the mitigation strategies audit process, the NRC concludes that the licensee has provided sufficient information to determine that there is reasonable assurance that the plan, when properly implemented, will meet the requirements of Order EA-12-049 at Limerick Generating Station, Units 1 and 2 (NRC 2014b). Thus, as a result of this order, Limerick will be implementing several improvements or mitigation alternatives whether they are cost-beneficial or not.

Therefore, the staff does not expect further SAMA analyses at the license renewal stage to uncover major plant design changes or modifications that will prove to be cost-beneficial. As discussed above, the NRC's experience in completed license renewal proceedings has confirmed this assumption (Ghosh 2009). As a result, potentially cost-beneficial SAMAs at other facilities do not constitute new and significant information with respect to Limerick's 1989 SAMDA or the NRC's determination not to perform a second SAMA analysis at license renewal in the event the agency has previously considered the issue, because, even if cost-beneficial, the NRC staff's experience shows that they will not likely yield a major reduction of risk, particularly in light of the many improvements already implemented at Limerick. Moreover, in light of Limerick's reduction in CDF and the propensity of cost-beneficial SAMAs to further eliminate risk and thereby make it less likely for other SAMA candidates to be cost-beneficial, it is unlikely that further consideration of these other SAMA candidates would yield many cost-beneficial SAMAs.

5.3.18 Current State of the Art Knowledge for Performing SAMA Analysis

Modern SAMA analysis has evolved over the years. Currently, SAMA analyses typically follow the guidance provide in NEI guidance (NEI O5-01), which is endorsed by the NRC in Regulatory Guide 4.2, supplement 1 (NRC 2013c). Offsite consequence codes used in SAMA analyses use plant-specific inputs related to core inventory, meteorology, population, evacuation, and economic impacts.

A current detailed SAMA analysis has the ability to analyze numerous plant-specific variables and the sensitivity of a SAMA analysis to these variables. In the scoping comments, numerous variables were identified that could potentially cast doubt on the results of the initial 1989 SAMDA Analysis. To thoroughly evaluate all of these variables would require a *de novo* SAMA analysis, which is not required by 51.53(c)(3)(ii)(L) and Table B-1. However, the applicant evaluated some of the changes at LGS that could have a significant impact on the SAMDA analysis such as population increase, consideration of offsite economic cost risk, changed criteria for assigning cost per person-rem averted, and changed seismic hazard proposed by GI-199 and found that none of the items of new information was found to be significant. As provided earlier, the staff independently reviewed the applicant's information, independently evaluated other potentially new and significant information, and determined that they would not lead to identification of a SAMA that would significantly reduce offsite risks, but acknowledges that a more precise answer could be found with a detailed modern SAMA analysis. However, the staff believes that this more precise answer would still not identify significant cost-beneficial SAMAs. As explained above, new and significant information must provide a seriously different picture of the consequences of the Federal action under consideration. With respect to SAMAs, new information may be significant if it indicated a given SAMA would substantially reduce the probability or consequences of a severe accident. None of the information identified by the applicant or the staff indicates that any SAMAs would be likely to lead to such results. Instead, as discussed above, new information indicates that further SAMA analyses are unlikely to identify many cost-beneficial SAMAs or major, cost-beneficial plant improvements, particularly in light of the substantial reduction in the CDF for Limerick since the 1989 SAMDA analysis.

The GEIS evaluated some of the differences in older methods and newer methods for performing risk analysis, which is the basis for SAMAs. The data selected for use in the 1996 GEIS analysis were taken from the FESs published since 1981, which is near the time of Limerick's 1989 SAMDA analysis. As discussed previously, these FES analyses are based upon source terms resulting from the Reactor Safety Study (NUREG-75/014, formerly WASH-1400), rebaselined in NUREG-0773. As such, these source terms (and the resulting risk and environmental impacts calculated using them) reflect the plant designs used in WASH-1400. However, this approach is considered conservative because the source terms developed in WASH-1400 generally reflect a 1970s-era plant and, as such, do not reflect the improvements that have been made in nuclear industry plant design and operations since the early 1980s. Accordingly, the use of WASH-1400 source terms in the FESs may, in many cases, tend to overestimate the actual environmental consequences and risks.

Furthermore, as provided in Section 5.3.3.1 of the 1996 GEIS, the source terms (i.e., the magnitude, timing, and characteristics of the radioactive material released to the environment) used in the EIS analyses for the 28 sites, including Limerick, were generally based on the 95 percent upper confidence bound (UCB) and analysis documented in NUREG-0773 . The NUREG-0773 source terms represented an update (re-baseline) of the source terms used in WASH-1400 (NRC 1996).

NUREG-0773 indicates that the provided source terms are based on models that tend to give overestimates of the magnitude of the releases." Based on the comparisons with newer information such as NUREG/CR 6295, the expected impacts (i.e., the frequency-weighted consequences) from the airborne pathway using the updated source term information would be much lower than previously predicted (NRC 2013). Therefore, the source terms used in the 1989 SAMDA were more conservative than the source terms used today. This provides additional support for the conclusion that SAMA analyses for LGS would be unlikely to uncover cost-beneficial major plant improvements or plant improvements that could substantially result in lower doses to offsite populations in the event of a severe accident.

5.3.19 Enrichment of Fuel (Power Uprates)

Another potentially new and significant item that could impact the 1989 SAMDA analysis is increases in the enrichment of the fuel in the core. The following is the staff's review for any substantial changes to the fuel enrichment design basis at LGS by reviewing LGS docketed information regarding power uprates. Extended power uprates require using fuel with a higher percentage of uranium-235 or additional fresh fuel to derive more energy from the operation of the reactor. This results in a larger radionuclide inventory (particularly short-lived isotopes, assuming no change in burnup limits) in the core, than the same core at a lower power level. The larger radionuclide inventory represents a larger source term for accidents and can result in higher doses to offsite populations in the event of a severe accident. Typically, short-lived isotopes are the main contributor to early fatalities. As stated in NUREG-1449 (NRC 1993), short-lived isotopes make up 80 percent of the dose following early release. The staff found that LGS had received two power uprate approvals since 1989. One uprate occurred in 1995, and was based on a1993 license amendment request that requested an increase in the licensed thermal power level of the reactor from 3,293 megawatts thermal (MWt) to 3,458 MWt, primarily by increasing the licensed core flow. In the staff's Environmental Assessment and Finding of No Significant Impact related to the LGS application for the amendment, the staff found, "the radiological and nonradiological environmental impacts associated with the proposed small increase in power are very small and do not change the conclusion in the FES that the operation of LGS, Units 1 and 2, would cause no significant adverse impact upon the quality of the human environment." Furthermore, in the January 23, 1995 submittal relating to increasing core flow, the licensee indicated that while fuel burnup and enrichment levels may increase as a result of operation at uprated power, the burnup and enrichment will remain within the 5 percent enrichment and 60,000 MWd/MT value previously evaluated by the staff. Thus, the fuel enrichment did not exceed the previously licensed value (NRC 1995).

By application dated March 25, 2010 (Exelon 2010), Exelon submitted a license amendment request for the LGS Units 1 and 2 Facility Operating Licenses and Technical Specifications. The proposed amendment consisted of a 1.65 percent measurement uncertainty recapture (MUR) power uprate that will increase each unit's rated thermal power from 3,458 megawatts (MWt) to 3,515 MWt. The proposed amendment was characterized as a MUR power uprate, which uses a Cameron International (formerly Caldon) CheckPlus™ Leading Edge Flow Meter (LEFM) system to improve plant calorimetric heat balance measurement accuracy. This flowmeter provides a more accurate measurement of feedwater (FW) flow and thus reduces the uncertainty in the FW flow measurement. This submittal did not change the fuel enrichment design basis (NRC 2011b).

Neither of these power uprates increased the fuel enrichment any higher than was previously evaluated by the staff before the 1989 SAMDA Analysis was completed. Since the fuel enrichment was not increased, further SAMA analyses for LGS would be unlikely to uncover cost-beneficial major plant improvements or plant improvements that could substantially result in lower doses to offsite populations in the event of a severe accident.

Furthermore, as provided in Section 5.3.3.1 of the 1996 GEIS, the source terms (i.e., the magnitude, timing, and characteristics of the radioactive material released to the environment) used in the GEIS analyses for the 28 sites, including Limerick, were generally based on the 95-percent UCB and analysis documented in NUREG-0773 (NRC 1996).

NUREG-0773 states that the provided source terms are based on models that tend to give overestimates of the magnitude of the releases. Based on the comparisons with newer information such as NUREG/CR 6295, the expected impacts (i.e., the frequency-weighted consequences) from the airborne pathway using the updated source term information would be much lower than previously predicted (NRC 2013a). Therefore, the source terms used in the 1989 SAMDA were more conservative than the source terms used today, providing additional confidence that SAMA analyses for LGS would be unlikely to uncover cost-beneficial major plant improvements or plant improvements that could substantially result in lower doses to offsite populations in the event of a severe accident. Also, it reinforces the Commission's generic determinations that the NRC need not reanalyze SAMAs at LGS for license renewal and that a subsequent SAMA analysis would not likely uncover many cost-beneficial SAMAs.

5.3.20 Conclusion

In conclusion, 10 CFR 51.53(c)(3)(ii)(L) states that, "[i]f the staff has not previously considered SAMAs for the applicant's plant, in an environmental impact statement or related supplement or in an environmental assessment, a consideration of alternatives to mitigate severe accidents must be provided." Table B-1 in 10 CFR Part 51, which governs the scope of the staff's environmental review for license renewal, echoes this regulation. Applicants for plants that have already had a SAMA analysis considered by the NRC as part of an EIS, supplement to an EIS, or EA, do not need to have a SAMA analysis reconsidered for license renewal. In forming its basis for determining which plants needed to submit a SAMA at license renewal, the

Commission noted that all licensees had undergone, or were in the process of undergoing, more detailed site-specific severe accident mitigation analyses through processes separate from license renewal, specifically the CPI, IPE, and IPEEE programs (61 FR 28467). In light of these studies, the Commission stated that it did not expect future SAMA analyses to uncover "major plant design changes or modifications that will prove to be cost-beneficial" (61 FR 28467). The NRC's experience in completed license renewal proceedings has confirmed this assumption.

LGS is a plant that had a previous SAMA documented in a NEPA document. Therefore, Exelon was not required to, and did not, submit a SAMA in its license renewal ER. Exelon and staff did evaluate whether there was new and significant information with respect to the Commission's prior determination not to require a SAMA analysis at license renewal for those plants that were already the subject of a SAMA analysis by the staff. This evaluation included an evaluation of whether any new information invalidated the 1989 SAMDA. The staff analyzed information in the applicant's ER with respect to the 1989 SAMDA Analysis for LGS, public comments, and its own review of information relevant to LGS to search for new and significant information with respect to the NRC's determination not to conduct a second SAMA analysis at LGS for license renewal and the studies and assumptions underlying that determination. In conducting that search, the staff considered whether new information provided a seriously different picture of the environmental impact of the proposed project from what was previously envisioned. For a mitigation analysis, such as a SAMA analysis, such information would need to demonstrate a substantial change in the environmental impact sought to be mitigated, in this case severe accidents. In doing its review of new information, the staff found that since the 1989 SAMDA Limerick's CDF has decreased, past current licensing bases initiatives have addressed known weaknesses, and implementation costs are high for design retrofits.

Given the discussion above, it is unlikely that further SAMA analyses for LGS could uncover many cost-beneficial SAMAs or cost-beneficial SAMAs that would substantially reduce the risk of severe accidents because of implementation of programs to reduce the severe accident risk outweighs any increases resulting from the new considerations described above. Therefore, the staff did not identify any new and significant information that would invalidate the 1989 SAMDA.

The staff also did not identify any new and significant information that rises to a level that requires staff to seek Commission approval to conduct a new SAMA analysis (similar to the waiver requirement that applies for Category 1 issues when staff identifies new and significant information). The impacts of all other new information do not contribute sufficiently to the environmental impacts to warrant their inclusion in a SAMA analysis, since the likelihood of finding cost-effective plant improvements that substantially reduce risk is small. Additionally, the staff did not identify a significant environmental issue not covered in the GEIS, or that was not considered in the analysis in the GEIS and leads to an impact finding that is different from the finding presented in the GEIS.

The staff identified no new and significant information related to postulated accidents during the review of LGS's ER (Exelon 2011c) or evaluation of other available information. Therefore, there are no impacts related to these issues beyond those discussed in the GEIS. In accordance with 10 CFR 51.53(c)(3)(ii)(L), the staff did not repeat the review of SAMAs for LGS.

Therefore, as provided in the 1989 SAMDA, "The risks and environmental impacts of severe accidents at Limerick are acceptably low."

The staff has found no new information that would call into question the FES conclusion that:

> [T]he risks of early fatality from potential accidents at the site are small in comparison with risks of early fatality from other human activities in a comparably sized population, and the accident risk will not add significantly to population

exposure and cancer risks. Accident risks from Limerick are expected to be a small fraction of the risks the general public incurs from other sources. Further, the best estimate calculations show that the risks of potential reactor accidents at Limerick are within the range of such risks.

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[NRC] U.S. Nuclear Regulatory Commission. 2014c. Letter from E. Leeds, Director, to all power reactor licensees and holders of construction permits in active or deferred status. Subject: Screening and prioritization results regarding information pursuant to Title 10 of the *Code of Federal Regulations* 50.54(f) regarding seismic hazard reevaluations for Recommendation 2.1 of the Near-Term Task Force review of insights from the Fukushima Dai-ichi accident. May 9, 2014. ADAMS No. ML14111A147.

[NRDC] Natural Resources Defense Council. 2011. Letter from NRDC to C. Bladey. "Natural Resources Defense Council comments on Limerick EIS scoping process." October 28, 2011. ADAMS No. ML11307A456.

[PECO] Philadelphia Electric Company. 1992. Limerick Generating Station, Units 1 and 2: Individual plant examination volume 1. July 1992. ADAMS No. ML080030106 and ML080030104.

[PECO] Philadelphia Electric Company. 1995. Limerick Generating Station, Units 1 and 2 response to NRC Generic Letter 88-20, supplement 4, "Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities." June 1995. ADAMS No. ML073610238.

[PECO] Philadelphia Electric Company. 1996. Letter from G.A. Hungar, Jr., Director–Licensing, to NRC Document Control Desk. Limerick Generating Station, Units 1 and 2: Response to request for additional information regarding review of individual plant examination of external events. June 28, 1996. ADAMS No. ML073610237.

Commission. The proposed rule for license renewal had included a cost-benefit analysis and consideration of licensee economics as part of the NEPA review. However, during the comment period, State, Federal, and licensee representatives expressed concern about the use of economic costs and cost-benefit balancing in the proposed rule and the GEIS. They noted that the President's CEQ regulations interpret NEPA to require only an assessment of the cumulative effects of a proposed Federal action on the natural and man-made environment and that the determination of the need for generating capacity has always been the States' responsibility. For this reason, the purpose and need for the proposed action (i.e., license renewal) is defined in the 1996 GEIS as follows:

> *The purpose and need for the proposed action (renewal of an operating license) is to provide an option that allows for power generation capability beyond the term of a current nuclear power plant operating license to meet future system generating needs, as such needs may be determined by State, licensee, and, where authorized, Federal (other than NRC) decision-makers.*
>
> *The purpose and need for NRC's proposed action is to provide an option to continue plant operations beyond the current licensing term to meet future system generating needs, as such needs may be determined by State, utility, system, and, where authorized, Federal (other than NRC) decision-makers*

Section 51.95(c)(2) of 10 CFR states that:

> *The supplemental environmental impact statement for license renewal is not required to include discussion of need for power or the economic costs and economic benefits of the proposed action or of alternatives to the proposed action except insofar as such benefits and costs are either essential for a determination regarding the inclusion of an alternative in the range of alternatives considered or relevant to mitigation.*

The comment is outside the scope of the license renewal review and will not be evaluated further in the development of the draft SEIS.

A.2.16 Postulated Accidents & SAMA (PA)

In CLI-13-07, the Commission directed the staff to review the significance of any new SAMA-related information in its environmental review of Exelon's license renewal application, including the information presented in NRDC's waiver petition (NRDC 2012), and to discuss its review in the final supplemental EIS (NRC 2013b). Comments numbered 30-XX-PA were NRDC comments relating to SAMA, including those in the waiver petition. Similar comments submitted by other stakeholders are binned with the NRDC comments.

Comment: 30-3-PA; (Section 5.3, pages 5-3 to 5-14) The NRC begins this section by recounting the reasons the Commission concluded in 1999 that future updating of the 1989 Severe Accident Mitigation Design Alternatives (SAMDA) analysis would be unnecessary-the basis for 10 CFR 51.53(c)(3)(ii)(L). To the contrary, as shown here, subsequent events have proven that the Commission's earlier thinking was flawed. We begin by quoting from the GEIS Supplement: "The staff has previously performed a site-specific analysis of severe accident mitigation in a NEPA document for LGS in the Final Environmental Statement Related to Operation of LGS Units 1 and 2 in NUREG-0974, Supplement 1 (NRC 1989) ("1989 SAMDA Analysis")." (Page 5-3, lines 13-15). The staff concluded that: "The risks of early fatality from potential accidents at the site are small in comparison with risks of early fatality from other human activities in a comparably sized population, and the accident risk will not add significantly to population exposure and cancer risks. Accident risks from Limerick are expected to be a small fraction of the risks the general public incurs from other sources. Further, *the best* *estimates show that the risks of potential reactor accidents at Limerick are within the range of such risks from other nuclear power plants* (emphasis added)." (page 5-3, lines 25-31). The last sentence in the quote above is false, in that the theoretical "best estimate" calculation of core damage frequency is orders of magnitude lower than the historical risk, when world data are used, as described below.

The staff goes on to say: "However, in the LGS specific 1989 SAMDA Analysis, the staff acknowledged: In the longer term, these same severe accident issues are currently being pursued by the NRC in a systematic way for all utilities through the Severe Accident Program described in SECY-88-147, "Integration Plan for Closure of Severe Accident Issues" (NRC 1988c). The plan includes provisions for an Individual Plant Examination (IPE) for each operating reactor, a Containment Performance Improvement (CPI) program, and an Accident Management (AM) program. These programs will produce a more complete picture of the risks of operating plants and the benefits of potential design improvements, including SAMDAs. The *staff believes that the severe accident program is the proper vehicle for further review of severe accidents at nuclear power plants, including Limerick."* (page 5-3, lines 32-43, emphasis supplied). Of course subsequent to the Fukushima Dai-ichi accident, the last sentence in the quote above turned out to be incorrect, in that the Staff and Commission have decided to address most of the Fukushima issues in separate venues.

The staff then go on to observe: "In light of these studies, the Commission believed [in 1996] it was "unlikely that any site-specific consideration of SAMAs for license renewal will identify major plant design changes or modifications that will prove to be cost-beneficial for reducing severe accident frequency or consequences" (61 FR 28467)." (page 5-4, lines 5-8). Again, the Commission programs for addressing a wide range of safety issues requiring potential plant design changes as a follow up to the accident at Fukushima Dai-ichi have proven that the Commission's earlier conclusion was short sighted and in error.

Beginning on page 5-7, the Staff correctly observes: "Additionally, both the applicant and the NRC must consider whether new and significant information affects environmental determinations in the NRC's regulations, including the determination in 10 CFR 51.53(c)(3)(ii)(L) and Table B-1 that the agency need not reconsider SAMAs at license renewal if it has already done so in a NEPA document for the plant." (page 5-7, lines 10-13). The Staff then sets a high bar: "New information is significant if it provides a seriously different picture of the impacts of the Federal action under consideration. Thus, for mitigation alternatives such as SAMAs, new information is significant if it indicates that a mitigation alternative would substantially reduce an impact of the Federal action on the environment. Consequently, with respect to SAMAs, new information may be significant if it indicated a given cost-beneficial SAMA *would substantially reduce the impacts of a severe accident, the probability or consequences (risk) of a severe accident occurring."* (page 5-7, lines 13-15, emphasis added).

Having set the bar high, the staff proceeds to analyze four issues, and does so individually, rather than collectively. The Staff ignores an issue we raised in NRDC's intervention in the Limerick license renewal proceeding. The Declaration of Thomas B. Cochran, Ph.D., Matthew G McKinzie, Ph.D., And Christopher J. Weaver, Ph.D. on behalf of the Natural Resources Defense Council, In the Matter of Exelon Generating Company, LLC, (Limerick Generating Station License Renewal Application) Dockets No. 50-352-LR and 50-353-LR), November 22, 2011, namely, that the risk of a core damage accident at Limerick is likely to be much greater than the theoretical estimate based on the Limerick Probabilistic Risk Assessment (PRA). In the Cochran, McKinzie, Weaver declaration we stated: "The Limerick SAMDA analysis relies on a Core Damage Frequency (CDF) of 4.2×10^{-5} per year (NRC, 1989) and the Environmental Report submitted by the applicant cites an estimate of CDF, which only includes internal events, for Limerick Units 1 and 2 of 3.2×10^{-6} per year based on a Probabilistic Risk Assessment

(PRA) (Exelon, 2011b). In a recent update to the licensee's IPEEE model to include internal fire risks as well as internal events in its PRA, the license calculated a total CDF of 1.8 x 10' per year for these hazard groups (NRC, 2011b). Because the PRA is based on modeling assumptions that contain a large number of approximations, large uncertainties, and omissions, the absolute value of a CDF calculated using PRA is not a reliable predictor of the actual CDF value."

Worldwide, NRDC calculates that there have been approximately 429 light water reactors (LWR) that have operated approximately 11,500 reactor-years, and that five of these LWRs (Three Mile Island Unit 2, Greifswald Unit 5, Fukushima Daiichi Units 1, 2, and 3) have experienced core damage as CDF is defined in NUREG-1150 Vol. 1, pg. 2-3. Thus, for this class of nuclear power reactors, LWRs, the CDF is approximately 4.3 x 10^{-4} per reactor-year based on the historical record. I calculate that in the United States there have been approximately 116 LWRs that have operated approximately 4,100 reactor years. One of these LWRs (Three Mile Island Unit 2) experienced core damage as defined by NUREG-1150. Thus, for this class of nuclear power reactors the CDF is approximately 2.4 x 10^{-4} per reactor-year based on the historical record. The Limerick reactors, BWRs with Mark 2 containments, are similar in many respects to Fukushima Daiichi Units 1, 2 and 3, BWRs with Mark 1 containments. While no U.S. BWRs have experienced core damage as defined by NUREG-1150, I calculate that worldwide there have been approximately 117 BWRs that have operated approximately 3,300 reactor years. Three of these BWRs (Fukushima Daiichi Units 1, 2, and 3) have experienced core damage as defined by NUREG-1150. Thus, for this class of nuclear power reactors worldwide the CDF is approximately 9 x 10^{-4} per reactor-year based on the historical record.

In sum, the global CDFs for all LWRs and the subset of BWRs based on historical data are much greater than the theoretical value calculated by the applicant for Limerick Units 1 and 2, as is the U.S. historical CDF for LWRs. If a larger CDF is assumed in a PRA, then the calculated cost of severe accidents within a SAMA analysis would be increased proportionally, and thus it would be more likely that the economic viability of the measures to mitigate such accidents would be cost-beneficial.

We do not argue that any of the above CDF estimates based on the historical evidence represent the most accurate CDFs for Limerick Units 1 and 2. In our judgment the most accurate values of CDF probably lie somewhere between the theoretical values calculated by the applicant and one or more of the U.S. or global values based on the historical record. However, the CDFs used in a Limerick SAMA analysis should be evidence based. The applicant's estimates of CDF are non-conservative and a Limerick SAMA analysis would benefit from a sensitivity analysis in which higher core damage frequencies are assumed. Given the historical operating record of similar reactors, we assert that it is simply not credible to assume the CDF for older BWR reactors in the United States, such as Limerick Units 1 and 2, to be as low as 1.8 x 10^{-5} per reactor year, i.e., about one core damage event per 55,000 reactor-years of operation.

A range of CDF values including values close to those estimated from the global historical evidence should be used in the SAMA analyses for Limerick Units 1 and 2. This issue should be analyzed and discussed in the Limerick environmental report and the final environmental impact statement.

In our view a current-day SAMA analysis is required in the NEPA analysis of severe accidents one that includes the cumulative impacts of a severe accident based on new and significant information, including a range of core damage frequencies between the very low frequency estimated by the theoretical PRA process and the high frequency estimated using historical world data.

Response: *The commenter states, "the global CDFs for all LWRs and the subset of BWRs based on historical data are much greater than the theoretical value calculated by the applicant for Limerick Units 1 and 2." The staff recognizes that the CDF could be calculated on a generic basis from direct experience or on a site-specific basis using probabilistic risk assessment. This is also recognized by the commenter. The commenter states, "First, the probability can be estimated using the techniques of probabilistic risk assessment [PRA]. In a PRA study, analytic techniques such as fault trees are used to predict the occurrence of comparatively rare sequences of events that would lead to severe fuel damage and, potentially, a radioactive release. Second, the probability can be estimated from direct experience."*

The staff disagrees that a SAMA is not credible because the CDF is not estimated generically from direct experience. The site-specific, plant-specific PRA takes into account site-specific hazards, design of the plant, and plant specific operational practices that affect how a particular plant responds to potential challenges. This site-specific PRA is expected to yield a much more accurate estimate of risk (including CDF) than a historical rate calculation using an extremely limited set of data points that aggregates all different plant designs, operational practices, and site conditions around the world. The SAMA analysis for license renewal is a Category 2 issue, which means that it should be evaluated on a site-specific bases. In the Limerick example, Exelon calculates the current CDF using plant specific fault trees, event trees and reliability information. This approach is consistent with the current guidance for preparing a SAMA analysis provided in Revision A of Nuclear Energy Institute (NEI) 05-01, "Severe Accident Mitigation Alternatives (SAMA) Analysis" (NEI 2005), which was endorsed by the staff for use in SAMA analysis. This guidance provides the applicant guidance to use the plant-specific PRA model. Based on this site specific information, the applicant is to estimate the severe accident risk, off-site dose and economic impacts of a severe accident.

While the commenter further suggests that the direct experience model could help refine site-specific PRA estimates, the commenter does not provide specific proposals on how the direct experience model could improve those estimates, other than to state that the true CDF for Limerick might lie between the two. The staff believes that, the plant-specific estimate, based on the most current information regarding the plant design, appears to be the most accurate measure of risk at Limerick.

The NRC also recognizes that newer calculation methods could be developed or operating experience could occur that might identify a new SAMA candidate for consideration (See CLI-10-11) (noting that while "there will always be more data that could be gathered, agencies must have some discretion to draw the line and move forward"). In promulgating the license renewal rule, the Commission recognized that additional SAMAs could be identified. However, the Commission indicated that future SAMAs would only likely identify cost-beneficial changes that "generally would be procedural and programmatic fixes, with any hardware changes being only minor in nature and few in number." Therefore, the Commission explicitly determined that, if a consideration of SAMA was completed, another need not be completed at license renewal, despite the fact that future SAMA analyses may uncover additional, cost-beneficial SAMAs. This is because the NRC has evaluated and continues to evaluate severe accidents in the current operating term. Significantly, while the Commission did impose additional safety requirements on operating reactors following Fukushima, the Commission did so on the basis of a safety analysis conducted under the Backfit Rule, not the results of a SAMA analysis conducted for NEPA purposes. Those SAMA analyses had long assumed that prolonged station blackouts, such as the one experienced by the Fukushima reactors, could yield devastating consequences. Therefore subsequent events, including the Fukushima events, *have confirmed the Commission's twin expectations that 1) future SAMA analyses would not likely find major plant improvements cost beneficial and that 2) the NRC would continue to reduce risk at regulated facilities through its ongoing safety oversight.*

Finally, the comment suggests that the Staff erred by considering the challenges (earthquakes, population increases, etc.) to the Limerick SAMDA analysis separately, instead of collectively. However, considering the challenges to the Limerick SAMDA analysis collectively in an undisciplined fashion may yield unrealistic results. Therefore , the staff evaluated the challenges separately, as provided in Chapter 5 of the Limerick environmental impact statement. Moreover, as discussed in Chapter 5, the CDF at Limerick has decreased dramatically since 1989 and the 1989 SAMDA analysis rested on many conservatisms. Therefore, the Staff finds it unlikely that these challenges, even considered together, would constitute new and significant information with respect to severe accident mitigation at Limerick and no changes were made to the SEIS.

Comment: 2-74-PA; Exelon and NRC want to exempt Limerick, as one of three nuclear plants that never again have to consider an updated Severe Accident Mitigation Analysis in connection with new and significant environmental information under NEPA in relicensing.

Comment: 2-75-PA; The National Resource Defense Council (NRDC) Filed a Legal Appeal and won in the 3rd Circuit Court of Appeals in Philadelphia, Against Exelon's Attempt To Circumvent a Safety Analysis Requirement for Limerick Nuclear Plant's Outdated, Unacceptable Accident Mitigation Analysis.

- The judge agreed with NRDC's conclusion that ignoring the population growth around Limerick is unacceptable if an emergency evacuation at Limerick becomes necessary.
- Common sense planning is needed stating that what was acceptable in 1989 is not good enough now and in the future.
- Limerick's Severe Accident Mitigation analysis was last completed in 1989, relying on the census for 1980 population.

Even after Fukushima, involving boiling water reactors similar to Limerick's, and drastically increased populations that would clearly be impacted by a Fukushima-type disaster at Limerick, NRC illogically joined Exelon in an appeal against a federal court decision, in order to avoid an updated safety analysis for Limerick. The federal court decision stated that Limerick can't be exempted.

Comment: 2-79-PA; Exelon should not be using decades-old 1989 information to determine health and economic impacts. It is inexcusable for NRC to allow Exelon to use decades old comparisons for anything, especially population. NRC is letting Exelon get away with declaring its review of new and significant information compared to 1989, claiming Exelon did not uncover any cost beneficial plant improvements or SAMAs that would substantially decrease risk of a severe accident. That doesn't even make sense considering NRC's own post-Fukushima recommendations. Cost beneficial to whom? Certainly NOT public interests!

- Exelon's evaluations and claims are based strictly on their costs. That leads to decisions ignoring unacceptable risks to the public.
- NRC's job is to ensure public safety, not protect Exelon's profits.
- NRC is supposed to protect the public's interests. NRC has failed to consider and compare impacts and costs to the public for Exelon not being required to spend the money for the safest accident mitigation.

<u>Costs to the public for an accident/meltdown at Limerick Nuclear Plant could be astronomical, in terms of suffering, health care costs, and financial costs.</u>

- Off-site economic costs for multiple radiation accidents/meltdowns in Limerick's reactors and/or fuel pools, in the densely populated Greater Philadelphia region surrounding Limerick Nuclear Plant have not been accurately assessed by anyone.
- Millions of people would need temporary housing and/or permanent relocation. In today's economy and political dysfunction, the millions of people in the Greater Philadelphia Region who could lose everything would get no help.
- Costs for dealing with a Limerick disaster are estimated to be a trillion dollars, with taxpayers paying all but $12 billion.
- In addition to complete loss of property, possessions, businesses, and jobs, the short and long term health-care costs would be staggering. There would not even be enough treatment centers or hospitals to deal with the numbers of people who could end up with acute radiation poisoning or worse. In Japan, people, including children, were turned away because they were too radioactive.

NRC never bothered to address any of the public interest issues above in Limerick's DRAFT EIS. NRC is only considering costs to Exelon and Exelon's profits, NOT costs to the public for a Limerick accident/meltdown because NRC failed to require the safest accident mitigation strategies. That is profoundly negligent!

IF NRC CONSIDERED DRASTIC INCREASES IN POPULATION, RELATED TO THE COSTS FOR LOSSES, NRC SHOULD COME TO THE CONCLUSION THAT IT IS JUST TOO RISKY TO CONTINUE TO OPERATE LIMERICK NUCLEAR PLANT.

In NRC's FINAL LIMERICK EIS, THE PUBLIC'S OFF-SITE COSTS FOR A LIMERICK RADIATION ACCIDENT/MELTDOWN MUST BE ACCURATELY ESTIMATED BY AN INDEPENDENT ECONOMIC EXPERT WHO UNDERSTANDS WHAT TOTAL RADIOACTIVE CONTAMINTION WOULD DO TO THE ENVIRONMENT AND THE POPULATION.

Comment: 5-14-PA; NRC's refusal to update Limerick's SAMA:

NRC has allowed many of its regulations to be systematically re-written by the NEI (Nuclear Energy Institute), the powerful lobbying arm of the nuclear industry. The NRC has allowed the NEI to thus create more regulatory protection for the industry, which significantly weakens safety for the public.

An example is the difficulty encountered by the NRDC, when it attempted to require an updated SAMA for Limerick. The NRC would not consider it. NRC's stubborn position is reinforced by the legal armature designed to preserve Limerick for financial reasons, without consideration of whether there's a need for nuclear energy. NRC stated its SAMA position in the federal register (2007): "Staff Position: The NRC staff recommends that applicants for license renewal follow the guidance provided in Nuclear Energy Institute (NEI) 0501, Severe Accident Mitigation Alternatives (SAMA) Analysis Guidance Document, Revision A, when preparing their SAMA analysis."

In 2012, the NRC Commission refused the National Defense Resource Council's request (submitted in 2011) for an update of Limerick's SAMA on the grounds that the request was "an impermissible attack on our regulations".

Comment: 30-4-PA; On page 5-4 of the GEIS Supplement, the NRC discusses the Containment Performance Improvement (CPI) Program and the Individual Plant Examination (IPE), and in this discussion the GEIS Supplement repeatedly states that the NRC relies on these programs in determining that Severe Accident Mitigation Alternatives (SAMAs) need not be performed at license renewal if the staff had already performed a SAMA review in an earlier NEPA document. The phrasing clearly implies that any new and significant information that may be discovered in the intervening years between initial licensing and the license renewal stage will have been adequately considered and should satisfy all requirements pursuant to NEPA, namely a thorough analysis of environmental impacts. However, the CPI, IPE, Individual Plant Examination of External Events (IPEEE), or any other accident management programs or processes, cannot substitute for NEPA review under the legal precedent *United States v. Coalition for Buzzards Bay,* 644 F.3d 26, 38 (1st Cir. 2011), which rejected arguments that alternative process can substitute for NEPA. In addition, the case *Limerick Ecology Action, Inc. v. NRC,* 869 F.2d 719, 729 (3rd Cir. 1989)) established that Atomic Energy Act procedures cannot substitute for compliance with NEPA.

Response: *Several comments were made regarding the need to perform an updated SAMA analysis. As provided in the introductory section of Section 5.3 of this SEIS, the Commission made the generic determination, codified in Table B-1 of Part 51 and 10 C.F.R. § 51.53(c)(3)(ii)(L), that if the NRC had conducted a site-specific consideration of severe accident mitigation alternatives ("SAMA") for a plant in a previous EIS or environmental assessment ("EA"), another SAMA need not be done for license renewal.*

The Staff has previously performed a site-specific analysis of severe accident mitigation design alternatives ("SAMDA") in a NEPA document for LGS in the Final Environmental Statement Related to Operation of Limerick Generating Station, Units 1 and 2, NUREG-0974 Supplement 1 (ADAMS Accession No. ML112221A204)). Therefore, the applicant's license renewal ER for Limerick and the Staff's SEIS do not have to reassess the issue.

Importantly, this does not mean that the Commission only considers ways to mitigate severe accidents at a given site once. Instead, the Commission has considered alternatives for mitigating severe accidents at many sites, including Limerick, multiple times through a variety of NRC programs. Examples of these NRC programs include the containment improvement program, Individual Plant Examination, Individual Plant Examination of External Events, Accident Management Program, 10 CFR 50.54(hh) rulemaking Regarding Loss of Large Areas of the Plant Caused by Fire or Explosions, Severe Accident Mitigation Guidelines, and Fukushima-Related Activities. These NRC programs are described in sections 5.3.1 through 5.3.8 of Chapter 5 of this FSEIS.

Chapter 5 of Exelon's ER also contained an evaluation of new information to determine whether it was significant as required by 10 CFR 51.53(c)(3)(iv). The assessment described in Section 5.1 found no new and significant information that would change the small impact determination for severe accidents set forth in the GEIS (NRC, 1996a, Sec. 5.5.2). Also, the applicant determined that no new and significant information has been found that would change the generic conclusion codified by the NRC that LGS need not reassess severe accident mitigation alternatives for license renewal [10 CFR 51.53(c)(3)(ii)(L)].

Furthermore, the Staff's independent evaluation of new and significant information is discussed in sections 5.3.9 through 5.3.17 of this Limerick SEIS. The Staff took a hard look at new information to determine if it was significant for purposes of the National Environmental Policy Act (NEPA). The Staff did not identify any new and significant information that would invalidate the 1989 Limerick SAMDA Analysis or the Commission's generic conclusions in 51.53(c)(3)(ii)(L). In making this determination, the NRC reasonably relied on the studies *mentioned above, among other things, to inform its analysis of SAMAs under NEPA. This is discussed in sections 5.3.1 through 5.3.8 of Chapter 5 of this FSEIS.*

Comment: 30-38-PA; Exelon has omitted from its ER a required analysis of new and significant information regarding the potential new severe accident mitigation alternatives previous considered for other BWR Mark II Containment reactors.

Response: *Regarding this comment, the staff sent a letter dated February 12, 2014, to Exelon requesting additional information about potentially new SAMAs previously considered for other plants. The staff's review of this information is provided in section 5.3.17 of the SEIS.*

During the litigation on this issue the staff extensively discussed these claims and provided further analysis in its legal filings. The staff's briefs to the Commission are available at ML13072A804 and ML13079A501 and provide the staff's position on the issue. The Commission's rulings on the issue are in CLI-12-19 (NRC 2012a) and CLI-13-07 (NRC 2013b).

Comment: 30-39-PA; Exelon's reliance on data from TMI in its analysis of the significance on new information regarding economic cost risks constitute an inadequate analysis of new and significant information.

The ER analysis of the significance of including information regarding the potential economic impact of a severe accident at Limerick erroneously relies on data from an analysis done at TMI, a site that involves a markedly different and less economically developed area than the area within 50 miles of Limerick, which includes the densely populated urban environments of Philadelphia, PA, Camden and Trenton, NJ and Wilmington, DE. The ER thus fails to evaluate the impact of a properly conducted economic analysis on the assessment of the environmental consequences of a severe accident at Limerick.

The ER ignores new and significant information regarding the likely cost of cleanup from a severe accident in a metropolitan area like Philadelphia and thus understates the impact of a properly conducted economic analysis on the environmental consequences of a severe accident at Limerick.

Response: *The staff's review of this information is provided in section 5.3.12 and 5.3.13 of the SEIS. Since Limerick's calculation was reasonable, more conservative than any of the population increase evaluations found in the GEIS, and mitigation alternatives as a result of population increases are implemented in the current term, the staff find's Limerick's evaluation acceptable and population increases at Limerick are not new and significant information. Moreover, even if population increase led to another SAMA becoming cost beneficial, that SAMA would still not likely result in a substantial reduction in offsite risk, given the substantial reduction in CDF at Limerick since the 1989 SAMDA analysis.*

During the litigation on this issue the staff extensively discussed these claims and provided further analysis in its legal filings. The staff's briefs to the Commission are available at ML13072A804 and ML13079A501 and provide the staff's position on the issue. The Commission's rulings on the issue are in CLI-12-19 (NRC 2012a) and CLI-13-07 (NRC 2013b).

Comment: 30-40-PA; A legally sufficient analysis of newly identified severe accident mitigation alternatives for Limerick must utilize modern techniques for assessing whether those alternatives are cost-beneficial, and Exelon's ER erroneously concluded that new mitigation alternatives can be evaluated without use of those modern techniques.

Response: *The staff review of this comment determined that a modern SAMA analyses for LGS would be unlikely to uncover cost-beneficial major plant improvements or plant improvements that could substantially result in lower doses to offsite populations in the event of* *a severe accident. The staff's review of this information is provided in section 5.3.18 of the SEIS.*

During the litigation on this issue the staff extensively discussed these claims and provided further analysis in its legal filings. The staff's briefs to the Commission are available at ML13072A804 and ML13079A501 and provide the staff's position on the issue. The Commission's rulings on the issue are in CLI-12-19 (NRC 2012a) and CLI-13-07 (NRC 2013b).

Comment: 2-4-PA; NRC must stop and delay all activities and actions related to Limerick Nuclear Plant's relicensing including finalizing this EIS until after several issues are addressed or take place.

……Number two, the National Resource Defense Council legal action appeals on Limerick's severe accident mitigation analysis requirements have been resolved. That's an open, legal issue…

Comment: 23-41-PA; Page 5-1, Postulated Accidents leads to 5.3 SAMA. I concur with NRDC.

Response: *The comments above are in support of the NRDC's contentions and waiver petiton submitted regarding the need to perform an updated SAMA analysis.*

As provided in the introductory section of Section 5.3 of this SEIS, the Commission made the generic determination, codified in Table B-1 of Part 51 and 10 C.F.R. § 51.53(c)(3)(ii)(L), that if the NRC had conducted a site-specific consideration of SAMA for a plant in a previous EIS or environmental assessment, another SAMA need not be done for license renewal.

The staff has previously performed a site-specific analysis of SAMDA in a NEPA document for LGS in the Final Environmental Statement Related to Operation of Limerick Generating Station, Units 1 and 2, NUREG-0974 Supplement 1 (ADAMS Accession No. ML112221A204)). Therefore, the applicant's license renewal ER for Limerick and the staff's SEIS do not have to reassess the issue.

On October 31, 2013, the Commission issued order CLI-13-07 (ML13304B417), which denied NRDC's waiver request but indicated that the issues raised in the NRDC's waiver petition bear consideration in the staff's environmental review of the Exelon's application outside the adjudicatory process. The Commission referred the waiver petition to the Staff as additional comments on the Limerick DSEIS for the Staff's consideration and response. The Commission also directed the Staff to review the significance of any new SAMA-related information in its environmental review of Exelon's application, including information presented in the NRDC waiver petition, and to discuss its review in the FSEIS. The staff has reviewed all potentially new and significant SAMA-related information, including information presented in the NRDC waiver petition and discussed its review in Chapter 5 this SEIS as directed by the Commission in CLI-13-07. Additionally, the staff has considered the information in the NRDC waiver petition as public comments on the DSEIS and responded to these comments in Appendix A of this SEIS.

Comment: 2-76-PA; Limerick is the 2nd most densely populated nuclear plant in the nation. Still, NRC is refusing to consider increased population and health risks associated with a Limerick Nuclear Plant accident/meltdown.

- Due to Limerick's location, the potential impact of a severe accident would be far greater than at most other U.S. nuclear plants (NRDC research).
- Over 8 million people live within 50 miles of Limerick, the radius NRC told Americans to evacuate in Japan during the Fukushima accident.

CERTIFICATE OF SERVICE

I hereby certify that on September 24, 2014, undersigned counsel for Petitioner Natural Resources Defense Council, Inc. filed the foregoing Joint Appendix with the U.S. Court of Appeals for the District of Columbia Circuit by filing the same with the Court's CM/ECF filing system. The following counsel will be served through this filing:

James Adler
Andrew Averbach
U.S. Nuclear Regulatory Commission
Office of the General Counsel
Division of Legal Counsel
Mailstop O-15 D21
Rockville, MD 20852

John E. Arbab, Esq.
U.S. Department of Justice
Environment & Natural Resources Division
P.O. Box 7415
Washington, DC 20044

Counsel for Respondents

Brad Fagg
Morgan, Lewis & Bockius LLP
1111 Pennsylvania Avenue, NW
Washington, DC 20004

Counsel for Intervenor

Counsel have also been served with a hardcopy of the Appendix.

/s/ Howard M. Crystal
Howard M. Crystal