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ATTENTION: "REPLACE" directions do not affect the Table of Contents, Therefore no TOC will be issued with the updated material.

TSB2 - TECHNICAL SPECIFICATIONS BASES UNIT 2 MANUAL

REMOVE MANUAL TABLE OF CONTENTS DATE: 01/19/2009

ADD MANUAL TABLE OF CONTENTS DATE: 01/30/2009

CATEGORY: DOCUMENTS TYPE: TSB2

AOO1
NRB

ID: TEXT 3.1.4
REMOVE: REV:3

ADD: REV: 4

CATEGORY: DOCUMENTS TYPE: TSB2
ID: TEXT LOES
ADD: REV: 93

REMOVE: REV:92

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SSES MANUAL

Manual Name: TSB2

Manual Title: TECHNICAL SPECIFICATIONS BASES UNIT 2 MANUAL

Table Of Contents

Issue Date: 01/30/2009

<u>Procedure Name</u>	<u>Rev</u>	<u>Issue Date</u>	<u>Change ID</u>	<u>Change Number</u>
TEXT LOES Title: LIST OF EFFECTIVE SECTIONS	93	01/30/2009		
TEXT TOC Title: TABLE OF CONTENTS	13	04/23/2008		
TEXT 2.1.1 Title: SAFETY LIMITS (SLS) REACTOR CORE SLS	3	10/04/2007		
TEXT 2.1.2 Title: SAFETY LIMITS (SLS) REACTOR COOLANT SYSTEM (RCS) PRESSURE SL	1	10/04/2007		
TEXT 3.0 Title: LIMITING CONDITION FOR OPERATION (LCO) APPLICABILITY	2	10/12/2006		
TEXT 3.1.1 Title: REACTIVITY CONTROL SYSTEMS SHUTDOWN MARGIN (SDM)	1	03/24/2005		
TEXT 3.1.2 Title: REACTIVITY CONTROL SYSTEMS REACTIVITY ANOMALIES	0	11/18/2002		
TEXT 3.1.3 Title: REACTIVITY CONTROL SYSTEMS CONTROL ROD OPERABILITY	2	01/19/2009		
TEXT 3.1.4 Title: REACTIVITY CONTROL SYSTEMS CONTROL ROD SCRAM TIMES	4	01/30/2009		
TEXT 3.1.5 Title: REACTIVITY CONTROL SYSTEMS CONTROL ROD SCRAM ACCUMULATORS	1	07/06/2005		
TEXT 3.1.6 Title: REACTIVITY CONTROL SYSTEMS ROD PATTERN CONTROL	2	03/24/2005		

SSES MANUAL

Manual Name: TSB2

Manual Title: TECHNICAL SPECIFICATIONS BASES UNIT 2 MANUAL

TEXT 3.1.7 3 10/04/2007
Title: REACTIVITY CONTROL SYSTEMS STANDBY LIQUID CONTROL (SLC) SYSTEM

TEXT 3.1.8 2 10/04/2007
Title: REACTIVITY CONTROL SYSTEMS SCRAM DISCHARGE VOLUME (SDV) VENT AND DRAIN VALVES

TEXT 3.2.1 3 04/09/2007
Title: POWER DISTRIBUTION LIMITS AVERAGE PLANAR LINEAR HEAT GENERATION RATE (APLHGR)

TEXT 3.2.2 2 04/03/2007
Title: POWER DISTRIBUTION LIMITS MINIMUM CRITICAL POWER RATIO (MCPR)

TEXT 3.2.3 1 10/04/2007
Title: POWER DISTRIBUTION LIMITS LINEAR HEAT GENERATION RATE LHGR

TEXT 3.3.1.1 3 04/09/2007
Title: INSTRUMENTATION REACTOR PROTECTION SYSTEM (RPS) INSTRUMENTATION

TEXT 3.3.1.2 2 01/19/2009
Title: INSTRUMENTATION SOURCE RANGE MONITOR (SRM) INSTRUMENTATION

TEXT 3.3.2.1 2 04/09/2007
Title: INSTRUMENTATION CONTROL ROD BLOCK INSTRUMENTATION

TEXT 3.3.2.2 0 11/18/2002
Title: INSTRUMENTATION FEEDWATER - MAIN TURBINE HIGH WATER LEVEL TRIP INSTRUMENTATION

TEXT 3.3.3.1 7 10/27/2008
Title: INSTRUMENTATION POST ACCIDENT MONITORING (PAM) INSTRUMENTATION

TEXT 3.3.3.2 1 04/18/2005
Title: INSTRUMENTATION REMOTE SHUTDOWN SYSTEM

TEXT 3.3.4.1 0 11/18/2002
Title: INSTRUMENTATION END OF CYCLE RECIRCULATION PUMP TRIP (EOC-RPT) INSTRUMENTATION

SSES MANUAL

Manual Name: TSB2

Manual Title: TECHNICAL SPECIFICATIONS BASES UNIT 2 MANUAL

TEXT 3.9.8	0	11/18/2002	Title: REFUELING OPERATIONS RESIDUAL HEAT REMOVAL (RHR) - LOW WATER LEVEL
TEXT 3.10.1	1	01/23/2008	Title: SPECIAL OPERATIONS INSERVICE LEAK AND HYDROSTATIC TESTING OPERATION
TEXT 3.10.2	0	11/18/2002	Title: SPECIAL OPERATIONS REACTOR MODE SWITCH INTERLOCK TESTING
TEXT 3.10.3	0	11/18/2002	Title: SPECIAL OPERATIONS SINGLE CONTROL ROD WITHDRAWAL - HOT SHUTDOWN
TEXT 3.10.4	0	11/18/2002	Title: SPECIAL OPERATIONS SINGLE CONTROL ROD WITHDRAWAL - COLD SHUTDOWN
TEXT 3.10.5	0	11/18/2002	Title: SPECIAL OPERATIONS SINGLE CONTROL ROD DRIVE (CRD) REMOVAL - REFUELING
TEXT 3.10.6	0	11/18/2002	Title: SPECIAL OPERATIONS MULTIPLE CONTROL ROD WITHDRAWAL - REFUELING
TEXT 3.10.7	1	03/24/2005	Title: SPECIAL OPERATIONS CONTROL ROD TESTING - OPERATING
TEXT 3.10.8	2	04/09/2007	Title: SPECIAL OPERATIONS SHUTDOWN MARGIN (SDM) TEST - REFUELING

SUSQUEHANNA STEAM ELECTRIC STATION
LIST OF EFFECTIVE SECTIONS (TECHNICAL SPECIFICATIONS BASES)

<u>Section</u>	<u>Title</u>	<u>Revision</u>
TOC	Table of Contents	13
B 2.0	SAFETY LIMITS BASES	
	Page TS / B 2.0-1	1
	Page TS / B 2.0-2	3
	Page TS / B 2.0-3	4
	Page TS / B 2.0-4	6
	Page TS / B 2.0-5	1
	Pages TS / B 2.0-6 through TS / B 2.0-8	1
B 3.0	LCO AND SR APPLICABILITY BASES	
	Page TS / B 3.0-1	1
	Pages TS / B 3.0-2 through TS / B 3.0-4	0
	Pages TS / B 3.0-5 through TS / B 3.0-7	1
	Pages TS / B 3.0-8 through TS / B 3.0-9	2
	Page TS / B 3.0-10	1
	Page TS / B 3.0-11	2
	Page TS / B 3.0-11a	0
	Page TS / B 3.0-12	1
	Pages TS / B 3.0-13 through TS / B 3.0-15	2
	Pages TS / B 3.0-16 and TS / B 3.0-17	0
B 3.1	REACTIVITY CONTROL BASES	
	Pages B 3.1-1 through B 3.1-4	0
	Page TS / B 3.1-5	1
	Pages TS / B 3.1-6 and TS / B 3.1-7	2
	Pages B 3.1-8 through B 3.1-13	0
	Page TS / B 3.1-14	1
	Page TS / B 3.1-15	0
	Page TS / B 3.1-16	1
	Pages TS / B 3.1-17 through TS / B 3.1-19	0
	Pages TS / B 3.1-20 and TS / B 3.1-21	1
	Page TS / B 3.1-22	0
	Page TS / B 3.1-23	1
	Page TS / B 3.1-24	0
	Pages TS / B 3.1-25 through TS / B 3.1-27	1
	Page TS / B 3.1-28	2
	Page TS / 3.1-29	1
	Pages B 3.1-30 through B 3.1-33	0
	Pages TS / B 3.1-34 through TS / B 3.1-36	1
	Pages TS / B 3.1-37 and TS / B 3.1-38	2
	Pages TS / B 3.1-39 and TS / B 3.1-40	2
	Page TS / B 3.1-40a	0
	Page TS / B 3.1-41	1

SUSQUEHANNA STEAM ELECTRIC STATION
LIST OF EFFECTIVE SECTIONS (TECHNICAL SPECIFICATIONS BASES)

<u>Section</u>	<u>Title</u>	<u>Revision</u>
	Page TS / B 3.1-42	2
	Pages TS / B 3.1-43	1
	Page TS / B 3.1-44	0
	Page TS / B 3.1-45	3
	Page TS / B 3.1-46	0
	Page TS / B 3.1-47	1
	Pages TS / B 3.1-48 and TS / B 3.1-49	1
	Page B 3.1-50	0
	Page TS / B 3.1-51	2
B 3.2	POWER DISTRIBUTION LIMITS BASES	
	Page TS / B 3.2-1	2
	Page TS / B 3.2-2	1
	Page TS / B 3.2-3	3
	Page TS / B 3.2-4	1
	Pages TS / B 3.2-5 and TS / B 3.2-6	3
	Page TS / B 3.2-7	2
	Pages TS / B 3.2-8 and TS / B 3.2-9	4
	Page TS / B 3.2-10	2
	Pages TS / B 3.2-11 through TS / B 3.2-13	1
B 3.3	INSTRUMENTATION	
	Pages TS / B 3.3-1 through TS / B 3.3-4	1
	Page TS / B 3.3-5	2
	Page TS / B 3.3-6	1
	Pages TS / B 3.3-7 through TS / B 3.3-12	3
	Page TS / B 3.3-13	2
	Page TS / B 3.3-14	3
	Pages TS / B 3.3-15 and TS / B 3.3-16	2
	Pages TS / B 3.3-17 and TS / B 3.3-18	3
	Pages TS / B 3.3-19 through TS / B 3.3-27	2
	Pages TS / B 3.3-28 through TS / B 3.3-30	3
	Page TS / B 3.3-31	2
	Page TS / B 3.3-32	4
	Page TS / B 3.3-33	3
	Page TS / B 3.3-34	2
	Pages TS / B 3.3-34a though TS / B 3.3-34i	0
	Pages TS / B 3.3-35 and TS / B 3.3-36	2
	Pages TS / B 3.3-37 and TS / B 3.3-38	1
	Page TS / B 3.3-39	2
	Pages TS / B 3.3-40 through TS / B 3.3-43	2
	Pages TS / B 3.3-44 through TS / B 3.3-54	3
	Pages TS / B 3.3-54a through TS / B 3.3-54e	0
	Pages B 3.3-55 through B 3.3-63	0
	Pages TS / B 3.3-64 and TS / B 3.3-65	2
	Page TS / B 3.3-66	4

SUSQUEHANNA STEAM ELECTRIC STATION
LIST OF EFFECTIVE SECTIONS (TECHNICAL SPECIFICATIONS BASES)

<u>Section</u>	<u>Title</u>	<u>Revision</u>
	Page TS / B 3.3-67	3
	Page TS / B 3.3-68	4
	Page TS / B 3.3-69	5
	Page TS / B 3.3-70	4
	Page TS / B 3.3-71	3
	Pages TS / B 3.3-72 and TS / B 3.3-73	2
	Page TS / B 3.3-74	3
	Page TS / B 3.3-75	2
	Pages TS / B 3.3-75a and TS / B 3.3-75 b	6
	Page TS / B 3.3-75c	5
	Pages B 3.3-76 and TS / B 3.3-77	0
	Page TS / B 3.3-78	1
	Pages B 3.3-79 through B 3.3-91	0
	Pages TS / B 3.3-92 through TS / B 3.3-103	1
	Page TS / B 3.3-104	2
	Pages TS / B 3.3-105 and TS / B 3.3-106	1
	Page TS / B 3.3-107	2
	Page TS / B 3.3-108	1
	Page TS / B 3.3-109	2
	Pages TS / B 3.3-110 through TS / B 3.3-112	1
	Page TS / B 3.3-113	2
	Page TS / B 3.3-114	1
	Page TS / B 3.3-115 through TS / B 3.3-118	2
	Pages TS / B 3.3-119 through TS / B 3.3-120	1
	Pages TS / B 3.3-121 and TS / B 3.3-122	2
	Page TS / B 3.3-123	1
	Page TS / B 3.3-124	2
	Page TS / B 3.3-124a	0
	Page TS / B 3.3-125	1
	Page TS / B 3.3-126	2
	Page TS / B 3.3-127	3
	Page TS / B 3.3-128	2
	Pages TS / B 3.3-129 through TS / B 3.3-131	1
	Page TS / B 3.3-132	2
	Pages TS / B 3.3-133 and TS / B 3.3-134	1
	Pages B 3.3-135 through B 3.3-137	0
	Page TS / B 3.3-138	1
	Pages B 3.3-139 through B 3.3-149	0
	Pages TS/ B 3.3-150 and TS / B 3.3-151	1
	Page TS / B 3.3-152	2
	Page TS / B 3.3-153	1
	Page TS / B 3.3-154	2
	Page TS / B 3.3-155	1
	Pages TS / B 3.3-156 through TS / B 3.3-158	2
	Pages TS / B 3.3-159 through TS / B 3.3-161	1
	Page TS / B 3.3-162	1

SUSQUEHANNA STEAM ELECTRIC STATION
LIST OF EFFECTIVE SECTIONS (TECHNICAL SPECIFICATIONS BASES)

<u>Section</u>	<u>Title</u>	<u>Revision</u>
	Page TS / B 3.3-163	2
	Page TS / B 3.3-164	1
	Pages TS / B 3.3-165 and TS / B 3.3-166	2
	Pages TS / B 3.3-167 and TS / B 3.3-168	1
	Pages TS / B 3.3-169 and TS / B 3.3-170	2
	Pages TS / B 3.3-171 through TS / B 3.3-177	1
	Page TS / B 3.3-178	2
	Page TS / B 3.3-179	3
	Page TS / B 3.3-179a	2
	Page TS / B 3.3-180	1
	Page TS / B 3.3-181	3
	Page TS / B 3.3-182	1
	Page TS / B 3.3-183	2
	Page TS / B 3.3-184	1
	Page TS / B 3.3-185	3
	Page TS / B 3.3-186	1
	Pages TS / B 3.3-187 and TS / B 3.3-188	2
	Pages TS / B 3.3-189 through TS / B 3.3-191	1
	Page TS / B 3.3-192	0
	Page TS / B 3.3-193	1
	Pages TS / B 3.3-194 and TS / B 3.3-195	0
	Page TS / B 3.3-196	2
	Pages TS / B 3.3-197 through TS / B 3.3-205	0
	Page TS / B 3.3-206	1
	Pages B 3.3-207 through B 3.3-209	0
	Page TS / B 3.3-210	1
	Page TS / B 3.3-211	2
	Pages TS / B 3.3-212 and TS / B 3.3-213	1
	Pages B 3.3-214 through B 3.3-220	0
B 3.4	REACTOR COOLANT SYSTEM BASES	
	Pages TS / B 3.4-1 and TS / B 3.4-2	1
	Pages TS / B 3.4-3 and TS / B 3.4-4	4
	Pages TS / B 3.4-5 and TS / B 3.4-9	3
	Pages B 3.4-10 through B 3.4-14	0
	Page TS / B 3.4-15	1
	Pages TS / B 3.4-16 through TS / B 3.4-18	2
	Pages B 3.4-19 through B 3.4-27	0
	Pages TS / B 3.4-28 and TS / B 3.4-29	1
	Pages B 3.4-30 through B 3.3-31	0
	Page TS / B 3.4-32	1
	Page B 3.4-33 and B 3.4-34	0
	Pages TS / B 3.4-35 and TS / B 3.4-36	1
	Page TS / B 3.4-37	2
	Page B 3.4-38	1
	Pages B 3.4-39 and B 3.4-40	0

SUSQUEHANNA STEAM ELECTRIC STATION
LIST OF EFFECTIVE SECTIONS (TECHNICAL SPECIFICATIONS BASES)

<u>Section</u>	<u>Title</u>	<u>Revision</u>
	Page TS / B 3.4-41	1
	Pages B 3.4-42 through B 3.4-48	0
	Page TS / B 3.4-49	3
	Pages TS / B 3.4-50 through TS / B 3.4-52	2
	Page TS / B 3.4-53	1
	Pages TS / B 3.4-54 and TS / B 3.4-55	2
	Page TS / B 3.4-56	1
	Page TS / B 3.4-57	2
	Pages TS / B 3.4-58 through TS / B 3.4-60	1
B 3.5	ECCS AND RCIC BASES	
	Pages TS / B 3.5-1 and TS / B 3.5-2	1
	Pages TS / B 3.5-3 through TS / B 3.5-6	2
	Pages TS / B 3.5-7 through TS / B 3.5-10	1
	Pages TS / B 3.5-11 and TS / B 3.5-12	2
	Pages TS / B 3.5-13 and TS / B 3.5-14	1
	Pages TS / B 3.5-15 and TS / B.3.5-16	2
	Page TS / B 3.5-17	3
	Page TS / B 3.5-18	1
	Pages B 3.5-19 through B 3.5-24	0
	Pages TS / B 3.5-25 through TS / B 3.5-27	1
	Pages B 3.5-28 through B 3.5-31	0
B 3.6	CONTAINMENT SYSTEMS BASES	
	Page TS / B 3.6-1	2
	Page TS / B 3.6-1a	3
	Page TS / B 3.6-2 and TS / B 3.6-3	3
	Page TS / B 3.6-4	4
	Page TS / B 3.6-5	3
	Page TS / B 3.6-6	4
	Pages TS / B 3.6-6a and TS / B 3.6-6b	2
	Page TS / B 3.6-6c	0
	Pages B 3.6-7 through B 3.6-14	0
	Page TS / B 3.6-15	3
	Page TS / B 3.6-15a	0
	Page TS / B 3.6-15b	2
	Pages TS / B 3.6-16 and TS / B 3.6-17	2
	Page TS / B 3.6-17a	0
	Pages TS / B 3.6-18 and TS / B 3.6-19	1
	Page TS / B 3.6-20	2
	Page TS / B 3.6-21	3
	Pages TS / B 3.6-21a and TS / B 3.6-21b	0
	Pages TS / B 3.6-22 and TS / B 3.6-23	2
	Pages TS / B 3.6-24 and TS / B 3.6-25	1
	Page TS / B 3.6-26	3
	Page TS / B 3.6-27	3

SUSQUEHANNA STEAM ELECTRIC STATION
LIST OF EFFECTIVE SECTIONS (TECHNICAL SPECIFICATIONS BASES)

<u>Section</u>	<u>Title</u>	<u>Revision</u>
	Page TS / B 3.6-28	6
	Page TS / B 3.6-29	3
	Page TS / B 3.6-29a	0
	Page TS / B 3.6-30	2
	Page TS / B 3.6-31	3
	Page TS / B 3.6-32	1
	Page TS / B 3.6-33	2
	Page TS / B 3.6-34	1
	Page TS / B 3.6-35	3
	Pages TS / B 3.6-36 and TS / B 3.6-37	2
	Page TS / B 3.6-38	3
	Page TS / B 3.6-39	7
	Pages B 3.6-40 through B 3.6-42	0
	Pages TS / B 3.6-43 and TS / B 3.6-44	1
	Page TS / B 3.6-45	2
	Pages TS / B 3.6-46 through TS / B 3.6-50	1
	Page TS / B 3.6-51	2
	Pages B 3.6-52 through B 3.6-55	0
	Pages TS / B 3.6-56 and TS / B 3.6-57	2
	Pages B 3.6-58 through B 3.6-62	0
	Pages TS / B 3.6-63 and TS / B 3.6-64	1
	Pages B 3.6-65 through B 3.6-68	0
	Pages B 3.6-69 through B 3.6-71	1
	Page TS / B 3.6-72	2
	Pages TS / B 3.6-73 and TS / B 3.6-74	1
	Pages B 3.6-75 and B 3.6-76	0
	Page TS / B 3.6-77	1
	Pages B 3.6-78 through B 3.6-82	0
	Page TS / B 3.6-83	3
	Page TS / B 3.6-84	2
	Page TS / B 3.6-85	4
	Page TS / B 3.6-86 through TS / B 3.6-87a	2
	Page TS / B 3.6-88	4
	Page TS / B 3.6-89	2
	Page TS / B 3.6-90	3
	Pages TS / B 3.6-91 through TS / B 3.6-95	1
	Page TS / B 3.6-96	2
	Pages TS / B 3.6-97 and TS / B 3.6-98	1
	Page TS / B 3.6-99	2
	Page TS / B 3.6-99a	0
	Pages TS / B 3.6-100 and TS / B 3.6-101	1
	Pages TS / B 3.6-102 and TS / B 3.6-103	2
	Page TS / B 3.6-104	3
	Page TS / B 3.6-105	2
	Page TS / B 3.6-106	3

SUSQUEHANNA STEAM ELECTRIC STATION
LIST OF EFFECTIVE SECTIONS (TECHNICAL SPECIFICATIONS BASES)

<u>Section</u>	<u>Title</u>	<u>Revision</u>
B 3.7	PLANT SYSTEMS BASES	
	Page TS / B 3.7-1	3
	Page TS / B 3.7-2	4
	Pages TS / B 3.7-3 through TS / B 3.7-5	3
	Page TS / B 3.7-5a	0
	Page TS / B 3.7-6 and TS / B 3.7-6a	2
	Pages TS / B 3.7-6b and TS / B 3.7-6c	1
	Page TS / B 3.7-7	3
	Page TS / B 3.7-8	2
	Pages B 3.7-9 through B 3.7-11	0
	Pages TS / B 3.7-12 and TS / B 3.7-13	1
	Pages TS / B 3.7-14 through TS / B 3.7-18	2
	Page TS / B 3.7-18a	0
	Pages TS / B 3.7-19 through TS / B 3.7-24	1
	Pages TS / B 3.7-25 and TS / B 3.7-26	0
	Pages TS / B 3.7-27 through TS / B 3.7-29	2
	Pages TS / B 3.7-30 and TS / B 3.7-31	1
	Page TS / B 3.7-32	0
	Page TS / B 3.7-33	1
B 3.8	ELECTRICAL POWER SYSTEMS BASES	
	Pages B 3.8-1 through B 3.8-3	0
	Page TS / B 3.8-4	1
	Pages TS / B 3.8-4a and TS / B 3.8-4b	0
	Pages TS / B 3.8-5 and TS / B 3.8-6	3
	Page TS / B 3.8-6a	1
	Pages B 3.8-7 and B 3.8-8	0
	Page TS / B 3.8-9	2
	Pages TS / B 3.8-10 and TS / B 3.8-11	1
	Pages B 3.8-12 through B 3.8-18	0
	Page TS / B 3.8-19	1
	Pages B 3.8-20 through B 3.8-22	0
	Page TS / B 3.8-23	1
	Page B 3.8-24	0
	Pages TS / B 3.8-25 and TS / B 3.8-26	1
	Pages B 3.8-27 through B 3.8-35	0
	Page TS / B 3.8-36	1
	Page TS / B 3.8-37	0
	Page TS / B 3.8-38	1
	Pages TS / B 3.8-39 through TS / B 3.8-46	0
	Page TS / B 3.8-47	1
	Pages TS / B 3.8-48 through TS / B 3.8-50	0
	Page TS / B 3.8-51	1
	Pages TS / B 3.8-52 through TS / B 3.8-55	0

SUSQUEHANNA STEAM ELECTRIC STATION
LIST OF EFFECTIVE SECTIONS (TECHNICAL SPECIFICATIONS BASES)

<u>Section</u>	<u>Title</u>	<u>Revision</u>
	Pages TS / B 3.8-56 through TS / B 3.8-59	2
	Pages TS / B 3.8-60 through TS / B 3.8-64	3
	Page TS / B 3.8-65	4
	Page TS / B 3.8-66	5
	Pages TS / B 3.8-67 and TS / B 3.8-68	4
	Page TS / B 3.8-69	5
	Pages TS / B 3.8-70 through TS / B 3.8-83	1
	Pages TS / B 3.8-83A through TS / B 3.8-83D	0
	Pages B 3.8-84 through B 3.8-85	0
	Page TS / B 3.8-86	1
	Page TS / B 3.8-87	2
	Pages TS / B 3.8-88 through TS / B 3.8-93	1
	Pages B 3.8-94 through B 3.8-99	0
B 3.9	REFUELING OPERATIONS BASES	
	Pages TS / B 3.9-1 and TS / B 3.9-2	1
	Page TS / B 3.9-2a	1
	Pages TS / B 3.9-3 and TS / B 3.9-4	1
	Pages B 3.9-5 through B 3.9-18	0
	Pages TS / B 3.9-19 through TS / B 3.9-21	1
	Pages B 3.9-22 through B 3.9-30	0
B 3.10	SPECIAL OPERATIONS BASES	
	Page TS / B 3.10-1	2
	Pages TS / B 3.10-2 through TS / B 3.10-5	1
	Pages B 3.10-6 through B 3.10-32	0
	Page TS / B 3.10-33	2
	Page B 3.10-34	0
	Page B 3.10-35	1
	Pages B 3.10-36 and B 3.10-37	0
	Page B 3.10-38	1
	Page TS / B 3.10-39	2

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B 3.1 REACTIVITY CONTROL SYSTEMS

B 3.1.4 Control Rod Scram Times

BASES

BACKGROUND The scram function of the Control Rod Drive (CRD) System controls reactivity changes during abnormal operational transients to ensure that specified acceptable fuel design limits are not exceeded (Ref. 1). The control rods are scrammed by positive means using hydraulic pressure exerted on the CRD piston.

When a scram signal is initiated, control air is vented from the scram valves, allowing them to open by spring action. Opening the exhaust valve reduces the pressure above the main drive piston to atmospheric pressure, and opening the inlet valve applies the accumulator or reactor pressure to the bottom of the piston. Since the notches in the index tube are tapered on the lower edge, the collet fingers are forced open by cam action, allowing the index tube to move upward without restriction because of the high differential pressure across the piston. As the drive moves upward and the accumulator pressure reduces below the reactor pressure, a ball check valve opens, letting the reactor pressure complete the scram action. If the reactor pressure is low, such as during startup, the accumulator will fully insert the control rod in the required time without assistance from reactor pressure.

APPLICABLE SAFETY ANALYSES The analytical methods and assumptions used in evaluating the control rod scram function are presented in References 2, 3, and 4. The Design Basis Accident (DBA) and transient analyses assume that all of the control rods scram at a specified insertion rate. The resulting negative scram reactivity forms the basis for the determination of plant thermal limits (e.g., the MCPR). Other distributions of scram times (e.g., several control rods scramming slower than the average time with several control rods scramming faster than the average time) can also provide sufficient scram reactivity. Surveillance of each individual control rod's scram time ensures the scram reactivity assumed in the DBA and transient analyses can be met.

(continued)

BASES

APPLICABLE
SAFETY
ANALYSES
(continued)

The scram function of the CRD System protects the MCPR Safety Limit (SL) (see Bases for SL 2.1.1, "Reactor Core SLs," and LCO 3.2.2, "MINIMUM CRITICAL POWER RATIO (MCPR)") and the 1% cladding plastic strain fuel design limit (see Bases for LCO 3.2.3, "LINEAR HEAT GENERATION RATE (LHGR)" and LCO 3.2.4, "Average Power Range Monitor (APRM) Gain and Setpoints"), which ensure that no fuel damage will occur if these limits are not exceeded. Above 800 psig, the scram function is designed to insert negative reactivity at a rate fast enough to prevent the actual MCPR from becoming less than the MCPR SL, during the analyzed limiting power transient. Below 800 psig, the scram function is assumed to perform during the control rod drop accident and, therefore, also provides protection against violating fuel damage limits during reactivity insertion accidents (Ref. 5) (see Bases for LCO 3.1.6, "Rod Pattern Control"). For the reactor vessel overpressure protection analysis, the scram function, along with the safety/relief valves, ensure that the peak vessel pressure is maintained within the applicable ASME Code limits.

Control rod scram times satisfy Criterion 3 of the NRC Policy Statement (Ref. 6).

LCO

The scram times specified in Table 3.1.4-1 (in the accompanying LCO) are required to ensure that the scram reactivity assumed in the DBA and transient analysis is met (Ref. 7). To account for single failures and "slow" scrambling control rods, the scram times specified in Table 3.1.4-1 are faster than those assumed in the design basis analysis. The scram times have a margin that allows up to approximately 7% of the control rods (e.g., $185 \times 7\% \approx 13$) to have scram times exceeding the specified limits (i.e., "slow" control rods) including a single stuck control rod (as allowed by LCO 3.1.3, "Control Rod OPERABILITY") and an additional control rod failing to scram per the single failure criterion. The scram times are specified as a function of reactor steam dome pressure to account for the pressure dependence of the scram times. The scram times are specified relative to measurements based on reed switch positions, which provide the control rod position indication. The reed switch closes ("pickup") when the index tube passes a specific location and then opens ("dropout") as the index tube travels upward. Verification of the specified scram times in Table 3.1.4-1 is

(continued)

BASES

LCO
(continued)

accomplished through measurement of the "dropout" times. To ensure that local scram reactivity rates are maintained within acceptable limits, no more than one "slow" control rod may occupy a face or diagonally adjacent location to any other "slow" or stuck control rod.

Table 3.1.4-1 is modified by two Notes which state that control rods with scram times not within the limits of the table are considered "slow" and that control rods with scram times > 7 seconds are considered inoperable as required by SR 3.1.3.4.

This LCO applies only to OPERABLE control rods since inoperable control rods will be inserted and disarmed (LCO 3.1.3). Slow scrambling control rods may be conservatively declared inoperable and not accounted for as "slow" control rods.

APPLICABILITY

In MODES 1 and 2, a scram is assumed to function during transients and accidents analyzed for these plant conditions. These events are assumed to occur during startup and power operation; therefore, the scram function of the control rods is required during these MODES. In MODES 3 and 4, the control rods are not able to be withdrawn (except as permitted by LCO 3.10.3 and LCO 3.10.4) since the reactor mode switch is in shutdown and a control rod block is applied. This provides adequate requirements for control rod scram capability during these conditions. Scram requirements in MODE 5 are contained in LCO 3.9.5, "Control Rod OPERABILITY—Refueling."

ACTIONS

A.1

When the requirements of this LCO are not met, the rate of negative reactivity insertion during a scram may not be within the assumptions of the safety analyses. Therefore, the plant must be brought to a MODE in which the LCO does not apply. To achieve this status, the plant must be brought to MODE 3 within 12 hours. The allowed Completion Time of 12 hours is reasonable, based on operating experience, to reach MODE 3 from full power conditions in an orderly manner and without challenging plant systems.

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BASES (continued)

SURVEILLANCE REQUIREMENTS The four SRs of this LCO are modified by a Note stating that during a single control rod scram time surveillance, the CRD pumps shall be isolated from the associated scram accumulator. With the CRD pump isolated, (i.e., charging valve closed) the influence of the CRD pump head does not affect the single control rod scram times. During a full core scram, the CRD pump head would be seen by all control rods and would have a negligible effect on the scram insertion times.

SR 3.1.4.1

The scram reactivity used in DBA and transient analyses is based on an assumed control rod scram time. Measurement of the scram times with reactor steam dome pressure ≥ 800 psig demonstrates acceptable scram times for the transients analyzed in References 3 and 4.

Maximum scram insertion times occur at a reactor steam dome pressure of approximately 800 psig because of the competing effects of reactor steam dome pressure and stored accumulator energy. Therefore, demonstration of adequate scram times at reactor steam dome pressure ≥ 800 psig ensures that the measured scram times will be within the specified limits at higher pressures. Limits are specified as a function of reactor pressure to account for the sensitivity of the scram insertion times with pressure and to allow a range of pressures over which scram time testing can be performed. To ensure that scram time testing is performed within a reasonable time following a shutdown ≥ 120 days or longer, control rods are required to be tested before exceeding 40% RTP following the shutdown. This Frequency is acceptable considering the additional surveillances performed for control rod OPERABILITY, the frequent verification of adequate accumulator pressure, and the required testing of control rods affected by fuel movement within the associated core cell and by work on control rods or the CRD System.

(continued)

BASES

SURVEILLANCE
REQUIREMENTS
(continued)

SR 3.1.4.2

Additional testing of a sample of control rods is required to verify the continued performance of the scram function during the cycle. A representative sample contains at least 10% of the control rods. The sample remains representative if no more than 7.5% of the control rods in the sample tested are determined to be "slow." With more than 7.5% of the sample declared to be "slow" per the criteria in Table 3.1.4-1, additional control rods are tested until this 7.5% criterion (e.g., 7.5% of the entire sample size) is satisfied, or until the total number of "slow" control rods (throughout the core, from all surveillances) exceeds the LCO limit. For planned testing, the control rods selected for the sample should be different for each test. Data from inadvertent scrams should be used whenever possible to avoid unnecessary testing at power, even if the control rods with data may have been previously tested in a sample. The 200 day Frequency is based on operating experience that has shown control rod scram times do not significantly change over an operating cycle. This Frequency is also reasonable based on the additional Surveillances done on the CRDs at more frequent intervals in accordance with LCO 3.1.3 and LCO 3.1.5, "Control Rod Scram Accumulators."

SR 3.1.4.3

When work that could affect the scram insertion time is performed on a control rod or the CRD System, testing must be done to demonstrate that each affected control rod retains adequate scram performance over the range of applicable reactor pressures from zero to the maximum permissible pressure. The scram testing must be performed once before declaring the control rod OPERABLE. The required scram time testing must demonstrate the affected control rod is still within acceptable limits. The limits for reactor pressures < 800 psig are established based on a high probability of meeting the acceptance criteria at reactor pressures \geq 800 psig. Limits for \geq 800 psig are found in Table 3.1.4-1. If testing demonstrates the affected control rod does not meet these limits, but is within the 7-second limit of Table 3.1.4-1, Note 2, the control rod can be declared OPERABLE and "slow."

(continued)

BASES

SURVEILLANCE REQUIREMENTS SR 3.1.4.3 (continued)

Specific examples of work that could affect the scram times are (but are not limited to) the following: removal of any CRD for maintenance or modification; replacement of a control rod; and maintenance or modification of a scram solenoid pilot valve, scram valve, accumulator, isolation valve or check valve in the piping required for scram.

The Frequency of once prior to declaring the affected control rod OPERABLE is acceptable because of the capability to test the control rod over a range of operating conditions and the more frequent surveillances on other aspects of control rod OPERABILITY.

SR 3.1.4.4

When work that could affect the scram insertion time is performed on a control rod or CRD System, or when fuel movement within the affected core cell occurs, testing must be done to demonstrate each affected control rod is still within the limits of Table 3.1.4-1 with the reactor steam dome pressure ≥ 800 psig. Where work has been performed at high reactor pressure, the requirements of SR 3.1.4.3 and SR 3.1.4.4 can be satisfied with one test. For a control rod affected by work performed while shut down, however, a zero pressure and high pressure test may be required. This testing ensures that, prior to withdrawing the control rod for continued operation, the control rod scram performance is acceptable for operating reactor pressure conditions. Alternatively, a control rod scram test during hydrostatic pressure testing could also satisfy both criteria. When fuel movement within the reactor pressure vessel occurs, only those control rods associated with the core cells affected by the fuel movement are required to be scram time tested. During a routine refueling outage, it is expected that all control rods will be affected.

The Frequency of once prior to exceeding 40% RTP is acceptable because of the capability to test the control rod over a range of operating conditions and the more frequent surveillances on other aspects of control rod OPERABILITY.

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- REFERENCES
1. 10 CFR 50, Appendix A, GDC 10.
 2. FSAR, Section 4.3.2.
 3. FSAR, Section 4.6.

(continued)

BASES

- REFERENCES (continued)
4. FSAR, Section 15.0
 5. FSAR, Section 15.4.9.
 6. Final Policy Statement on Technical Specifications Improvements, July 22, 1993 (58 FR 39132).
 7. Letter from R. F. Janecek (BWROG) to R.W. Starostecki (NRC), "BWR Owners Group Revised Reactivity Control System Technical Specifications," BWROG-8754, September 17, 1987.
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