NUCLEAR ENERGY INSTITUTE

Alan Nelson
SENIOR PROJECT MANAGER
PLANT SUPPORT
NUCLEAR GENERATION DIVISION

February 28, 2000

Mr. Edwin F. Fox Jr.
Emergency Preparedness and
Radiation Protection Section
Office of Nuclear Reactor Regulations
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

SUBJECT: "Methodology for Development of Emergency Action Levels," Final NEI 99-01, Rev. 4, February 2000
Request NRC Endorsement

The NEI Emergency Action Level Issue Task Force has finalized "Methodology for Development of Emergency Action Levels," NEI 99-01, Revision 4, February 2000. This document presents the methodology for development of emergency action levels as an alternative to NRC/FEMA guidelines contained in Appendix 1 of NUREG-0654/FEMA-REP-1, Rev. 2, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants," October 1980 and 10 CFR 50.47 (a)(4). Revision 4 (NEI 99-01) enhances Revision 3 (NEI 97-03) by consolidating the system malfunction initiating conditions and example emergency action levels which address conditions that may be postulated to occur at nuclear power plants during plant shutdown conditions (Recognition Category C). Also included are initiating conditions and example emergency action levels that fully address conditions that may be postulated to occur at permanently Defueled Stations (Recognition Category D) and Independent Spent Fuel Storage Installations (Recognition Category E).

Recognition Category C, D, and E initiating conditions and associated emergency action levels were written so that they could be implemented by both NUMARC/NESP-007 and NUREG-0654/FEMA-REP-1 users.

Revision 4, incorporates concerns identified by the NRC in a teleconference with the staff on February 11, and February 25, 2000.

Enclosed for your endorsement in Regulatory Guide 1.101, "Emergency Planning and Preparedness for Nuclear Power Reactors," is the Final Draft, "Methodology for Development of Emergency Action Levels," NEI 99-01, Revision 4, February 2000.

The industry appreciates the efforts that you and your staff made over this past year to finalize the methodolgy. If you have any questions please contact me at (202) 739-8110 or by e-mail (apn@nei.org).

Sincerely,

Alan Nelson

APN/dc

Enclosure

Revision 021500

NEI 99-01

Final Draft Rev. 4

(NUMARC/NESP-007)

Methodology for Development of Emergency Action Levels

February 2000

ACKNOWLEDGEMENTS

Revision 4 of this report incorporates new Emergency Action Levels (EALs) for Cold Shutdown and Refueling modes, Independent Spent Fuel Storage Installations (ISFSI), and permanently Defueled Stations. The EAL changes are based on numerous suggestions provided by utilities and input provided by the staff of the NRC. NEI acknowledges the valuable input provided, and the extensive technical support provided by the members of the EAL Task Force.

NOTICE

FOREWORD

Revision 4 to NUMARC/NESP-007 presents the methodology for development of emergency action levels as an alternative to NRC/FEMA guidelines contained in Appendix 1 of NUREG-0654/FEMA-REP-1, Rev. 2 "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants," October 1980 and 10 CFR 50.47 (a)(4). Revision 4 (NEI 99-01) enhances Revision 3 (NEI 97-03) by consolidating the system malfunction initiating conditions and example emergency action levels which address conditions that may be postulated to occur at nuclear power plants during plant shutdown conditions (Recognition Category C). Also included are initiating conditions and example emergency action levels that fully address conditions that may be postulated to occur at permanently Defueled Stations (Recognition Category D) and Independent Spent Fuel Storage Installations (Recognition Category E).

Recognition Category C, D, and E initiating conditions and associated emergency action levels were written so that they could be implemented by both NUMARC/NESP-007 and NUREG-0654/FEMA-REP-1 users. As described in Appendix B, the industry anticipates that the NRC will provide written position so that NUREG-0654/FEMA-REP-1 users may implement Recognition Category C, D, and E even though they may have chosen to not fully implement the NUMARC/NESP-007 methodology.

EAL Revision Task Force 1996-2000

Chris Boone	Southern Nuclear Operating Company
Rodney Brown	Duke Power Company
Gary Cerkas	Arizona Public Service Company
John Costello	Virginia Power
Dennis M. Emborsky	Northeast Utilities
James D. Jones	Niagara Mohawk Power Corporation
Ron Jorgensen	Washington Public Power Supply System
John Kaminski	Niagara Mohawk Power Corporation
Stephen F. LaVie	Duquesne Light Company
Walter H. Lee	Southern Nuclear Operating Company
Mark Luksic	Tennessee Valley Authority
Alan Nelson	Nuclear Energy Institute
Kevin Morris	Detroit Edison Company
David W. Stobaugh	Commonwealth Edison Company
Martin Vonk	Commonwealth Edison Company

Additional technical assistance on Shutdown EALs was provided by the following individuals:

Roy K. Brosi	Duquesne Light Company
George W. Busch	GPU Nuclear
Neil Coddington	Pennsylvania Power & Light Company
Mitchell S. Dior	Public Service Electric & Gas Company
Albert L. Garrou	Carolina Power & Light
Larry E. Gifford	GE Nuclear Energy
John Jenkins	Duke Power Company
John F. Lohr	Baltimore Gas & Electric Company
Robert D. Mandik	PECO Energy Company
Frank L. Pavlechko	Tennessee Valley Authority
Charles Sawyer	Duke Power Company

Liaison to the Task Force

Charles Miller	U.S. Nuclear Regulatory Commission
Frederick Hasselberg	U.S. Nuclear Regulatory Commission
James O'Brien	U.S. Nuclear Regulatory Commission
Randy Sullivan	U.S. Nuclear Regulatory Commission
Serge Roudier	U.S. Nuclear Regulatory Commission
P. A. Milligan	U.S. Nuclear Regulatory Commission

Revision 021500

The following persons participated in the development of Revision 2 of the NUMARC/NESP-007 document.

EAL Revision Task Force

Reginald C. Rodgers, Chairman	Northeast Utilities
Thomas B. Blount	GPU Nuclear Corporation
Roy K. Brosi	Duquesne Light Company
Nick S. Catron	Tennessee Valley Authority
David L. Fugere	Consumers Power Company
Albert L. Garrou	Carolina Power & Light Company
George J. Giangi	GPU Nuclear Corporation
Terry Gilman	Commonwealth Edison Company
Ronald E. Harris	Duke Power Company
Roger Hoyt	Wolf Creek Nuclear Operating Corporation
John Jenkins	Duke Power Company
Stephen F. LaVie	Duquesne Light Company
Theresa M. Lechton	Commonwealth Edison Company
James M. Minneman	Pennsylvania Power & Light Company
Kevin Moles	Wolf Creek Nuclear Operating Corporation
Patrick Taylor	Pennsylvania Power & Light Company
Alan P. Nelson, Project Manager	NUMARC

Independent Industry Review Group

Craig Adams	Public Service Electric & Gas Company
Rod Krieger	Indiana & Michigan Electric Company
Milton Stiller	Union Electric Company

Liaison to the Task Force

Frederick Hasselberg	U.S. Nuclear Regulatory Commission
Michael Jamgochian	U.S. Nuclear Regulatory Commission
Aby Mohseni	U.S. Nuclear Regulatory Commission
Edward Podolak	U.S. Nuclear Regulatory Commission
William Reckley	U.S. Nuclear Regulatory Commission
Craig Wingo	Federal Emergency Management Agency
Edison Carmack	Institute of Nuclear Power Operations

ERC Environmental and Energy Services Company (ERCE) Study Team

John S. Fuoto, Study Team Leader

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EXECUTIVE SUMMARY

Nuclear utilities must respond to a formal set of threshold conditions that require plant personnel to take specific actions with regard to notifying state and local governments and the public when certain off-normal indicators or events are recognized. Emergency classes are defined in 10 CFR 50. Levels of response and the conditions leading to those responses are defined in a joint NRC/FEMA guidelines contained in Appendix 1 of NUREG-0654/ FEMA-REP-1, Rev. 1, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants," October 1980.

In 1988, A NUMARC/NESP project was initiated to re-evaluate the emergency action levels (EALs) in the context of utility operating experience. At that time, the nuclear utility industry had over ten years of experience in adapting the NRC guidelines to specific plant configurations, using them both in exercises and under actual emergency conditions. As a result, a number of improvements had been identified as NUREG-0654, Appendix 1 guidelines had been applied in the development of plant EALs.

The NUMARC/NESP EAL Task Force developed a systematic approach and supporting basis for EAL development. This methodology developed a set of generic EAL guidelines, together with the basis for each, such that they could be used and adapted by each utility on a consistent basis. The review of the industry's experiences with EALs, in conjunction with regulatory considerations, was applied directly to the development of this generic set of EAL guidelines. The generic guidelines were intended to clearly define conditions that represent increasing risk to the public and can give consistent classifications when applied at different sites. The NUMARC/NESP-007 document resulted from that effort. The draft NUMARC/NESP-007 methodology was reviewed by individuals from the industry, independent of the task force, was submitted to the entire industry for review, was exercised in a table top exercise with the NRC, underwent a regulatory analysis by the NRC, was published for public comment in the Federal Register, and was endorsed by the NRC as an acceptable alternative to the guidance in NUREG-0654 in Revision 3 to Regulatory Guide 1.101, "Emergency Planning and Preparedness for Nuclear Power Reactors". The methodology was presented to the industry in a workshop conducted in St Louis in September 1992.

Close to the end of the process described above, concerns developed regarding the classification of events which occur during periods of plant shutdowns and refueling. Industry experience had shown that plants could be susceptible to a variety of events that could challenge safety during shutdown operations. While these events had neither posed nor indicated an undue risk to public health and safety, they did indicate the need to consider emergency action levels applicable during shutdown modes. Since the issue was still under evaluation, shutdown EALs were not included in Revision 2, but were deferred to a later revision of NUMARC/NESP-007. A special task force was formed to address this issue and draft shutdown EALs were prepared in conjunction with efforts of the NUMARC Shutdown Plant Issues Working Group to coordinate industry activities relating to shutdown safety.

As utilities implemented the NUMARC/NESP-007 areas of possible improvement were identified. In addition, the staff of the NRC provided suggestions for improvement based on their review of utility submittals. A task force was assembled to incorporate the implementation experiences. NEI 97-03, Revision 3, was the successor to NUMARC/NESP-007 that incorporated these implementation experiences

The special task force that was formed to address EALs associated with shutdown plant issues also was assigned the task of addressing the need for EALs that relate to permanently defueled stations and 10 CFR 72.32 (c) independent spent fuel storage installations. NEI 99-01, Revision 4, is the successor to NEI 97-03 that addresses all of these issues.

The guidance presented here is not intended to be applied to plants as-is. It is intended to give the user the logic for developing site-specific EALs (i.e., instrument readings, etc.) using site-specific EAL presentation methods (formats). Basis information is provided to aid station personnel in preparation of their own site-specific EALs, to provide necessary information for training, and for explanation to state and local officials. In addition, state and local requirements have not been reflected in the generic guidance and should be considered on a case-by-case basis with appropriate state and local emergency response organizations.

It is important that the NEI EALs be treated as an integrated package. Selecting only portions of this guidance for use in developing site-specific EALs could lead to inconsistent or incomplete EALs unless explicitly allowed. An example of such an allowance may be found in the NRC's Branch Technical Position Paper dated 7/11/94. As discussed in Appendix B, the industry anticipates that the NRC may endorse similar Branch Technical Position guidance for implementation of Recognition Category C, D, and E initiating conditions by NUREG-0654/FEMA-REP-1 users who have chosen not to implement NEI EALs. Note that the Branch Technical Position was subsequently incorporated into EPPOS 1.

Although the basic concerns with barrier integrity and the major safety problems of nuclear power plants are similar across plant types, design differences will have a substantial effect on EALs. The major differences are found between a BWR and a PWR. In these cases, EAL guidelines unique to BWRs and PWRs must be specified. Even among PWRs, however, there are substantial differences in design and in types of containment used. There is enough commonality among plants that many ICs will be the same or very similar. However, others will have to match plant features and safety system designs that are unique to the plant type or even to the specific plant. The EAL Task Force believes that there is sufficient information provided in the basis of the EALs to allow the EALs to be implemented at plants from all NSSS LWR vendors. However, this generic guidance is not considered to be applicable to advanced LWR designs or to away from site radioactive material storage facilities.

The original EAL Task Force identified eight characteristics that were to be incorporated into model EALs. Experience to date has shown these considerations to be VALID. These were:

(1) Consistency (i.e., the EALs would lead to similar decisions under similar circumstances at different plants);

(2) Human engineering and user friendliness;

(3) Potential for classification upgrade only when there is an increasing threat to public health and safety;

(4) Ease of upgrading and downgrading;

(5) Thoroughness in addressing, and disposing of, the issues of completeness and accuracy raised regarding NUREG-0654, Appendix 1;

(6) Technical completeness and appropriateness for each classification level;

(7) A logical progression in classification for combinations of multiple events;

(8) Objective, observable values.

Based on the information gathered and reviewed, the Task Force has developed generic EAL guidance. Because of the wide variety of presentation methods (formats) used at different utilities, the Task Force believes that specifying guidance as to what each IC and EAL should address, and including sufficient basis information for each EAL will best assure uniformity of approach. The information is presented by Recognition Category:

- A - Abnormal Rad Levels/Radiological Effluent
- C - Cold Shutdown./ Refueling System Malfunction
- D – Permanently Defueled Station Malfunction
- E - Events Related to Independent Spent Fuel Storage Installations (ISFSI)
- F - Fission Product Barrier Degradation
- H - Hazards and Other Conditions Affecting Plant Safety
- S - System Malfunction

Each of the EAL guides in Recognition Categories A, C, D, E, H, and S is structured in the following way:

- Recognition Category - As described above.
- Emergency Class - NOUE, Alert, Site Area Emergency or General Emergency.
- Initiating Condition - Symptom- or Event-Based, Generic Identification and Title.
- Operating Mode Applicability - Power Operation, Hot Standby, Hot Shutdown, Cold Shutdown, Refueling, Defueled, All, or Not Applicable.
- Example Emergency Action Level(s) corresponding to the IC.
- Basis information for plant-specific readings and factors that may relate to changing the generic IC or EAL to a different emergency class, such as for Loss of All AC Power.

For Recognition Category F, the EAL information is presented in a matrix format. The presentation method was chosen to clearly show the synergism among the EALs and to support more accurate dynamic assessments. For category F, the EALs are arranged by safety function, or fission product barrier. Classifications are based on various combinations of function or barrier challenges.

The EAL Guidance has the primary threshold for NOUE as operation outside the safety envelope for the plant as defined by plant technical specifications, including LCOs and Action Statement Times. In addition, certain precursors of more serious events such as loss of offsite AC power and earthquakes are included in NOUE EALs. This provides a clear demarcation between the lowest emergency class and "non-emergency" notifications specified by 10 CFR 50.72.

ACRONYMS

AC	Alternating Current
AEOD	NRC Office for Analysis and Evaluation of Operational Data
ATWS	Anticipated Transient Without Scram
B&W	Babcock and Wilcox
BWR	Boiling Water Reactor
CCW	Component Cooling Water
CDE	Committed Dose Equivalent
CE	Combustion Engineering
CFR	Code of Federal Regulations
CMT	Containment
CSF	Critical Safety Function
CSFST	Critical Safety Function Status Tree
DC	Direct Current
DHR	Decay Heat Removal
DOT	Department of Transportation
EAL	Emergency Action Level
ECCS	Emergency Core Cooling System
ECL	Emergency Classification Level
EOF	Emergency Operations Facility
EOP	Emergency Operating Procedure
EPA	Environmental Protection Agency
EPG	Emergency Procedure Guideline
EPIP	Emergency Plan Implementing Procedure
EPRI	Electric Power Research Institute
ERG	Emergency Response Guideline
ESF	Engineered Safeguards Feature
ESW	Emergency Service Water
FEMA	Federal Emergency Management Agency
FSAR	Final Safety Analysis Report
GE	General Electric
HPCI	High Pressure Coolant Injection
HPSI	High Pressure Safety Injection
IC	Initiating Condition
IDLH	Immediately Dangerous to Life and Health
IPEEE	Individual Plant Examination of External Events (Generic Letter 88-20)
ISFSI	Independent Spent Fuel Storage Installation

ACRONYMS (continued)

LCO	Limiting Condition of Operation
LER	Licensee Event Report
LFL	Lower Flammability Limit
LOCA	Loss of Coolant Accident
LPSI	Low Pressure Safety Injection
LWR	Light Water Reactor
MSIV	Main Steam Isolation Valve
mR	milliRem
Mw	Megawatt
NEI	Nuclear Energy Institute
NESP	National Environmental Studies Project
NRC	Nuclear Regulatory Commission
NSSS	Nuclear Steam Supply System
NOUE	Notification Of Unusual Event
NUMARC	Nuclear Management and Resources Council
OBE	Operating Basis Earthquake
ODCM	Offsite Dose Calculation Manual
PRA/PSA	Probabilistic Risk Assessment / Probabilistic Safety Assessment
PWR	Pressurized Water Reactor
PSIG	Pounds per Square Inch Gauge
R	Rem
RCIC	Reactor Core Isolation Cooling
RCS	Reactor Coolant System
RPS	Reactor Protection System
RPV	Reactor Pressure Vessel
RVLIS	Reactor Vessel Level Indicating System
SBGTS	Stand-By Gas Treatment System
SG	Steam Generator
SI	Safety Injection
SPDS	Safety Parameter Display System
SRO	Senior Reactor Operator
SSE	Safe Shutdown Earthquake
TEDE	Total Effective Dose Equivalent
TOAF	Top of Active Fuel
TSC	Technical Support Center
WE	Westinghouse Electric
WOG	Westinghouse Owners Group

1.0 METHODOLOGY FOR DEVELOPMENT OF EMERGENCY ACTION LEVELS

1.1 Background

Nuclear utilities must respond to a formal set of threshold conditions that require plant personnel to take specific actions with regard to notifying state and local governments and the public when certain off-normal indicators or events are recognized. Emergency classes are defined in 10 CFR 50. Levels of response and the conditions leading to those responses are defined in a joint NRC/FEMA guideline contained in Appendix 1 of NUREG-0654/ FEMA-REP-1, Rev. 1, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants," October 1980.

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The NUMARC/NESP EAL Task Force developed a systematic approach and supporting basis for EAL development. This methodology developed a set of generic EAL guidelines, together with the basis for each, such that they could be used and adapted by each utility on a consistent basis. The review of the industry's experiences with EALs, in conjunction with regulatory considerations, was applied directly to the development of this generic set of EAL guidelines. The generic guidelines were intended to clearly define conditions that represent increasing risk to the public and can give consistent classifications when applied at different sites. The NUMARC/NESP-007 document resulted from that effort. The draft NUMARC/NESP-007 methodology was reviewed by individuals from the industry, independent of the task force, was submitted to the entire industry for review, was exercised in a table top exercise with the NRC, underwent a regulatory analysis by the NRC, was published for public comment in the Federal Register, and was endorsed by the NRC as an acceptable alternative to the guidance in NUREG-0654 in Revision 3 to Regulatory Guide 1.101, "Emergency Planning and Preparedness for Nuclear Power Reactors". The methodology was presented to the industry in a workshop conducted in St Louis in September 1992.

As utilities implemented the NUMARC/NESP-007, areas of possible improvement were identified. In addition, the staff of the NRC provided suggestions for improvement based on their review of utility submittals. A task force was assembled to incorporate the improvements. NEI-97-03, Revision 3, was the successor to NUMARC/NESP-007 that incorporated these improvements.

Close to the end of the process of developing Revision 2 described above, concerns developed regarding the classification of events which occur during periods of plant shutdowns and refueling. Industry experience had shown that plants could be susceptible to a variety of events that could challenge safety during shutdown operations. While these events had neither posed nor indicated an undue risk to public health and safety, they did indicate the need to consider emergency action levels applicable during shutdown modes. Since the issue was still under evaluation, shutdown EALs were not included in Revision 2 or 3 but were deferred. Guidance which addresses cold shutdown/refueling, permanently defueled, and independent spent fuel storage EALs have been included as part of NEI 99-01. NEI 99-01 addresses both NUMARC/NESP-007 and NUREG-0654 users for these important issues.

2.0 CHANGES INCORPORATED WITH REVISION 4

This section summarizes the more significant changes made to the EAL methodology with Revision 4. This is not intended to be a complete tabulation. Minor editorial changes were made in the interest of clarity and/or consistent formatting. These changes are not tabulated herein.

2.1 Section 3.0, Development of Basis for Generic Approach

Discussion was added to make recommendations regarding (1) Cold Shutdown/Refueling IC/EALs, (2) Permanently Defueled Station IC/EALs, and (3) Independent Spent Fuel Storage Installations (ISFSI) IC/EALs.

2.2 Section 4.0, Human Factors Considerations

No significant changes.

2.3 Section 5.0, Generic EAL Guidance

Discussion was added concerning: (1) Cold Shutdown/Refueling IC/EALs, (2) Permanently Defueled Station IC/EALs, and (3) ISFSI IC/EALs.

Additional information regarding site-specific implementation was added in response to numerous questions received during utility implementation efforts.

The definitions section was revised to incorporate new terms that relate to Cold Shutdown/Refueling, Permanently Defueled Station, and ISFSI issues. These words and phrases are defined terms having specific meanings as they relate to the EALs. These terms appear in capital letters in the IC/EALs, and bases

Some of the Revision 3 Recognition Category S IC/EALs that addressed shutdown events have been incorporated into the new Recognition Category C. The EALs affected include SU1, SU4, SU5, SU6, SU7, SU8, SA1, SA3, and SS5. EALs SU7, SA1, SA3, and SS5 have been deleted. In order to preserve consistency with Revision 3, the IC designations, e.g., AU1, SS1, etc., have not been revised. Because of this, there are gaps in the IC designation sequences. The initiating condition matrices for each recognition category were re-arranged slightly to align event progressions where possible. While the individual ICs are presented in sequence by IC designator, the IC entries in the initiating condition matrices may not be in sequence.

2.4 Section 5.0, Recognition Category A

No change in the philosophy of classifying abnormal radiological effluent events was incorporated in Revision 4. Users should note that all Recognition Category A IC/EALs are applicable for all operating modes including the cold shutdown and refueling modes. The Category A IC/EALs are not applicable for Permanently Defueled stations nor are they applicable for potential releases associated with ISFSIs. Separate Radiological effluent IC/EALs have been included in Section D and E to address potential effluent releases or radiological concerns. Initiating Conditions D-AU1, D-AU2, D-AA1, and D-AA2 were added to Recognition Category D. Initiating Condition E-AU1 was added to Recognition Category E.

2.5 Section 5.0, Recognition Category C

Recognition Category C is a new category of IC/EALs which completely replaces Recognition Category S when in Cold Shutdown and Refueling modes. As discussed previously, some of the Revision 3 Recognition Category S IC/EALs that addressed shutdown events have been incorporated into the Recognition Category C. The following Category S IC/EALs were included in Category C: SU1 (CU3), SU4 (CU5), SU5 (CU1), SU6 (CU6), SU7 (CU7), SU8 (CU8), SA1 (CA3), SA3 (CA4), and SS5. (CS1 and CS2). In order to adequately address shutdown loss of inventory and loss of decay heat removal capability events the following new IC/EALs were added: CU2 (Unplanned Loss of inventory – Refueling), CU4 (Unplanned Loss of Decay Heat Removal Capability - Cold Shutdown and Refueling), CA1 (Loss of RCS Inventory – Cold Shutdown), CA2 (Loss of RPV Inventory – Refueling), and CG1 (Loss of RPV Inventory Affecting Fuel Integrity with Containment Challenged – Cold Shutdown and Refueling).

Appendix C was added to provide a common location for describing the basis for the Recognition Category C IC/EALs.

2.6 Section 5.0, Recognition Category D

Recognition Category D is a new category that provides IC/EALs for Permanently Defueled stations. Category D was written to provide a stand alone set of IC/EALs for Permanently Defueled Stations. IC/EALs from Recognition Category A, C, F, S, and H were reviewed for applicability and where applicable have been included to address all Permanently Defueled station events.

Appendix D was added to provide a common location for describing the basis for the Recognition Category D IC/EALs.

2.7 Section 5.0, Recognition Category E

Recognition Category E is a new category that provides IC/EALs for events related to Independent Spent Fuel Storage Installations (ISFSI). Category E was written to provide a stand alone set of IC/EALs for sites having ISFSI. IC/EALs from Recognition Category A, C, F, S, and H were reviewed for applicability and where applicable have been included to address all events related to the ISFSI.

Appendix E was added to provide a common location for describing the basis for the Recognition Category E IC/EALs.

2.8 Section 5.0, Recognition Category F

No significant changes were made.

2.9 Section 5.0, Recognition Category H

No significant changes were made.

2.10 Section 5.0, Recognition Category S

Some of the Revision 3 Recognition Category S IC/EALs that addressed shutdown events have been incorporated into the new Recognition Category C. The EALs affected include SU1, SU4, SU5, SU6, SU7, SU8, SA1, SA3, and SS5. EALs SU7, SA1, SA3, and SS5 have been deleted. In order to preserve consistency with Revision 3, the IC designations, e.g., AU1, SS1, etc., have not been revised. Because of this, there are gaps in the IC designation sequences. The initiating condition matrices for each recognition category were re-arranged slightly to align event progressions where possible. While the individual ICs are presented in sequence by IC designator, the IC entries in the initiating condition matrices may not be in sequence.

3.0 DEVELOPMENT OF BASIS FOR GENERIC APPROACH

This section addresses several key considerations that were incorporated into the development of the original NUMARC/NESP EALs. An understanding of these considerations will facilitate the implementation of this generic guidance into site-specific programs. In prior revisions to this document, this section described the process by which the Task Force identified and resolved these considerations. Since much of this was deemed to be historical in nature, it has been removed from this revision.

Literature reviews, review of plant-specific EALs, and on-site utility interviews were performed as preparation for the drafting of the generic guidance. The review led to the conclusion that the current regulatory structure was not an impediment to the development of the appropriate EALs. Rather, the detailed guidance currently in place could be enhanced.

The generic guidance provided in this document is intended to address radiological emergency preparedness. Non-radiological events are included in the classification scheme only to the extent that these events represent challenges to the continued safety of the reactor plant and its operators. There are existing reporting requirements (EPA, OSHA) under which utilities operate. There are also requirements for emergency preparedness involving hazardous chemical releases. While the proposed classification structure could be expanded to include these non-radiological hazards, these events are beyond the scope of this document.

This classification scheme is based on the four classification levels promulgated by the NRC as the standard for the United States. This scheme is different from the international severity scale, which is not addressed in this generic guidance. The NRC has determined that US nuclear facilities would continue to classify events using the four classification levels and that the NRC would re-classify the event in any international communication.

3.1 Regulatory Context

Title 10, Code of Federal Regulations, Part 50 provides the regulations that govern emergency preparedness at nuclear power plants. Nuclear power reactor licensees are required to have NRC-approved "emergency response plans" for dealing with "radiological emergencies." The requirements call for both onsite and offsite emergency response plans, with the offsite plans being those approved by FEMA and used by the State and local authorities. This document deals with the utilities' approved onsite plans and procedures for response to radiological emergencies at nuclear power plants, and the links they provide to the offsite plans.

Section 50.47 of Title 10 of the Code of Federal Regulations (10 CFR 50.47), entitled "Emergency Plans," states the requirement for such plans. Part (a)(1) of this regulation states that "no operating license will be issued unless a finding is made by NRC that there is reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency."

The major portion of 10 CFR 50.47 lists "standards" that emergency response plans must meet. The standards constitute a detailed list of items to be addressed in the plans. Of particular importance to this project is the fourth standard, which addresses "emergency classification" and "action levels." These terms, however, are not defined in the regulation.

10 CFR 50.54, "Conditions of licenses," emphasizes that power reactor licensees must "follow, and maintain in effect, emergency plans which meet the standards in Part 50.47(b) and the requirements in Appendix E to this part." The remainder of this part deals primarily with required implementation dates.

10 CFR 50.54(q) allows licensees to make changes to emergency plans without prior Commission approval only if: (a) the changes do not decrease the effectiveness of the plans and (b) the plans, as changed, continue to meet 10 CFR 50.47(b) standards and 10 CFR 50 Appendix E requirements. The licensee must keep a record of any such changes. Proposed changes that decrease the effectiveness of the approved emergency plans may not be implemented without application to and approval by the Commission.

10 CFR 50.72 deals with "Immediate notification requirements for operating nuclear power reactors." The "immediate" notification section actually includes three types of reports: (1) immediately after notification of State or local agencies (for emergency classification events); (2) one-hour reports; and, (3) four-hour reports.

Although 10 CFR 50.72 contains significant detail, it does not define either "Emergency Class" or "Emergency Action Level." But one-hour and four-hour reports are listed as "non-emergency events," namely, those which are "not reported as a declaration of an Emergency Class." Certain 10 CFR 50.72 events can also meet the Notification of Unusual Event emergency classification if they are precursors of more serious events. These situations also warrant anticipatory notification of state and local officials. (See Section 3.7, "Emergency Class Descriptions".)

By footnote, the reader is directed from 10 CFR 50.72 to 10 CFR 50 Appendix E, for information concerning "Emergency Classes."

10 CFR 50.73 describes the "Licensee event report system," which requires submittal of follow-up written reports within thirty days of required notification of NRC.

10 CFR 50 Appendix E, Section B, "Assessment Actions," mandates that emergency plans must contain "emergency action levels." EALs are to be described for: (1) determining the need for notification and participation of various agencies, and (2) determining when and what type of protective measures should be considered. Appendix E continues by stating that the EALs are to be based on: (1) in-plant conditions; (2) in-plant instrumentation; (3) onsite monitoring; and (4) offsite monitoring.

10 CFR 50 Appendix E, Section C, "Activation of Emergency Organization," also addresses "emergency classes" and "emergency action levels." This section states that EALs are to be based on: (1) onsite radiation monitoring information; (2) offsite radiation monitoring information; and, (3) readings from a number of plant sensors that indicate a potential emergency, such as containment pressure and the response of the Emergency Core Cooling System. This section also states that "emergency classes" shall include: (1) Notification of Unusual Events (NOUEs), (2) Alert, (3) Site Area Emergency, and (4) General Emergency.

These regulations are supplemented by various regulatory guidance documents. A significant document that has dealt specifically with EALs is NUREG-0654/FEMA-REP-1, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants," October 1980.

Recognition Category D (Permanently Defueled Station) is based on the assumption that the spent fuel was generated by an operating nuclear power station under a 10 CFR 50 license that has ceased operations and intends to store the spent fuel for some period of time. The emergency classifications for Recognition Category D are those provided by NUREG 0654/FEMA Rep.1. The Unusual Event classifications are provided as an increased awareness for abnormal conditions. The Alert classifications are specific to the actual or potential effects on the spent fuel in storage.

In order for Permanently Defueled Stations to relax their existing emergency plan requirements these stations must verify that credible events cannot result in significant radiological releases beyond the site boundary. It is expected that this verification will confirm that the source term and motive force available in the permanently defueled condition is insufficient to warrant classifications of Site Area Emergency or General Emergency levels. Analyses for the credible design basis accidents are provided in the SAR.

Recognition Category E (Events Related to ISFSI) is applicable to licensees using their 10 CFR 50 emergency plan to fulfill the requirements of 10 CFR 72.32. Recognition Category E is not applicable to stand alone ISFSIs, Monitored Retrievable Storage Facilities (MRS), or ISFSIs that may process and/or repackage spent fuel. The emergency classifications for Recognition Category E are those provided by NUREG 0654/FEMA Rep.1 in accordance with 10 CFR 50.47. The classification of an ISFSI event under provisions of a 10 CFR 50.47 emergency plan should be consistent with the definitions of the emergency classes as used by that plan. A site-specific analysis would make this determination, but in most cases it is expected that classification of an NOUE would be appropriate. It is expected that the initiating conditions germane to a 10 CFR 72.32 emergency plan (described in NUREG-1567 Appendix C) are subsumed within 10 CFR 50.47 emergency plan's classification scheme.

3.2 Definitions Used in Developing EAL Methodology

Based on the above review of regulations, review of common utility usage of terms, discussions among Task Force members, and existing published information, the following definitions apply to the generic EAL methodology:

EMERGENCY CLASS: One of a minimum set of names or titles, established by the Nuclear Regulatory Commission (NRC), for grouping off-normal nuclear power plant conditions according to (1) their relative radiological seriousness, and (2) the time-sensitive onsite and off-site radiological emergency preparedness actions necessary to respond to such conditions. The existing radiological emergency classes, in ascending order of seriousness, are called:

- Notification of Unusual Event
- Alert
- Site Area Emergency
- General Emergency

INITIATING CONDITION (IC): One of a predetermined subset of nuclear power plant conditions where either the potential exists for a radiological emergency, or such an emergency has occurred.

Discussion:

In NUREG-0654, the NRC introduced, but does not define, the term "initiating condition." Since the term is commonly used in nuclear power plant emergency planning, the definition above has been developed and combines both regulatory intent and the greatest degree of common usage among utilities.

Defined in this manner, an IC is an emergency condition which sets it apart from the broad class of conditions that may or may not have the potential to escalate into a radiological emergency. It can be a continuous, measurable function that is outside technical specifications, such as elevated RCS temperature or falling reactor coolant level (a symptom). It also encompasses occurrences such as FIRE (an event) or reactor coolant pipe failure (an event or a barrier breach).

EMERGENCY ACTION LEVEL (EAL): A pre-determined, site-specific, observable threshold for a plant Initiating Condition that places the plant in a given emergency class. An EAL can be: an instrument reading; an equipment status indicator; a measurable parameter (onsite or offsite); a discrete, observable event; results of analyses; entry into specific emergency operating procedures; or another phenomenon which, if it occurs, indicates entry into a particular emergency class.

Discussion:

The term "emergency action level" has been defined by example in the regulations, as noted in the above discussion concerning regulatory background. The term had not, however, been defined operationally in a manner to address all contingencies.
There are times when an EAL will be a threshold point on a measurable continuous function, such as a primary system coolant leak that has exceeded technical specifications for a specific plant.

At other times, the EAL and the IC will coincide, both identified by a discrete event that places the plant in a particular emergency class. For example, "Train Derailment Onsite" is an example of an "NOUE" IC in NUREG-0654 that also can be an event-based EAL.

3.3 Differences In Perspective

The purpose of this effort is to define a methodology for EAL development that will better assure a consistent emergency classification commensurate with the level of risk. The approach must be easily understood and applied by the individuals responsible for onsite and offsite emergency preparedness and response. In order to achieve consistent application, this recommended methodology must be accepted at all levels of application (e.g., licensed operators, health physics personnel, facility managers, offsite emergency agencies, NRC and FEMA response organizations, etc.).

Commercial nuclear facilities are faced with a range of public service and public acceptance pressures. It is of utmost importance that emergency regulations be based on as accurate an assessment of the risk as possible. There are evident risks to health and safety in understating the potential hazard from an event. However, there are both risks and costs to alerting the public to an emergency that exceeds the true threat. This is true at all levels, but particularly if evacuation is recommended.

3.4 Recognition Categories

ICs and EALs can be grouped in one of several schemes. This generic classification scheme incorporates symptom-based, event-based, and barrier-based ICs and EALs.

The symptom-based category for ICs and EALs refers to those indicators that are measurable over some continuous spectrum, such as core temperature, coolant levels, containment pressure, etc. When one or more of these indicators begin to show off-normal readings, reactor operators are trained to identify the probable causes and potential consequences of these "symptoms" and take corrective action. The level of seriousness indicated by these symptoms depends on the degree to which they have exceeded technical specifications, the other symptoms or events that are occurring contemporaneously, and the capability of the licensed operators to gain control and bring the indicator back to safe levels.

Event-based EALs and ICs refer to occurrences with potential safety significance, such as the failure of a high-pressure safety injection pump, a safety valve failure, or a loss of electric power to some part of the plant. The range of seriousness of these "events" is dependent on the location, number of contemporaneous events, remaining plant safety margin, etc.

Barrier-based EALs and ICs refer to the level of challenge to principal barriers used to assure containment of radioactive materials contained within a nuclear power plant. For radioactive materials that are contained within the reactor core, these barriers are: fuel cladding, reactor coolant system pressure boundary, and containment. The level of challenge to these barriers encompasses the extent of damage (loss or potential loss) and the number of barriers concurrently under challenge. In reality, barrier-based EALs are a subset of symptom-based EALs that deal with symptoms indicating fission product barrier challenges. These barrier-based EALs are primarily derived from Emergency Operating Procedure (EOP) Critical Safety Function (CSF) Status Tree Monitoring (or their equivalent). Challenge to one or more barriers generally is initially identified through instrument readings and periodic sampling. Under present barrier-based EALs, deterioration of the reactor coolant system pressure boundary or the fuel clad barrier usually indicates an "Alert" condition, two barriers under challenge a Site Area Emergency, and loss of two barriers with the third barrier under challenge is a General Emergency. The fission product barrier matrix described in Section 5-F is a hybrid approach that recognizes that some events may represent a challenge to more than one barrier, and that the containment barrier is weighted less than the reactor coolant system pressure boundary and the fuel clad barriers.

Symptom-based ICs and EALs are most easily identified when the plant is in a normal startup, operating or hot shutdown mode of operation, with all of the barriers in place and the plant's instrumentation and emergency safeguards features fully operational as required by technical specifications. It is under these circumstances that the operations staff has the most direct information of the plant's systems, displayed in the main control room. As the plant moves through the decay heat removal process toward cold shutdown and refueling, barriers to fission products are reduced (i.e., reactor coolant system pressure boundary may be open) and fewer of the safety systems required for power operation are required to be fully operational. Under these plant operating modes, the identification of an IC in the plant's operating and safety systems becomes more event-based, as the instrumentation to detect symptoms of a developing problem may not be fully effective; and engineered safeguards systems, such as the Emergency Core Cooling System (ECCS), are partially disabled as permitted by the plant's Technical Specifications.

Barrier-based ICs and EALs also are heavily dependent on the ability to monitor instruments that indicate the condition of plant operating and safety systems. Fuel cladding integrity and reactor coolant levels can be monitored through several indicators when the plant is in a normal operating mode, but this capability is much more limited when the plant is in a refueling mode, when many of these indicators are disconnected or off-scale. The need for this instrumentation is lessened, however, and alternate instrumentation is placed in service when the plant is shut down.

It is important to note that in some operating modes there may not be definitive and unambiguous indicators of containment integrity available to control room personnel. For this reason, barrier-based EALs should not place undue reliance on assessments of containment integrity in all operating modes. Generally, Technical Specifications relax maintaining containment integrity requirements in modes 5 and 6 in order to provide flexibility in performance of specific tasks during shutdown conditions. Containment pressure and temperature indications may not increase if there is a pre-existing breach of containment integrity. At most plants, a large portion of the containment's exterior cannot be monitored for leakage by radiation monitors.

Several categories of emergencies have no instrumentation to indicate a developing problem, or the event may be identified before any other indications are recognized. A reactor coolant pipe could break; FIRE alarms could sound; radioactive materials could be released; and any number of other events can occur that would place the plant in an emergency condition with little warning. For emergencies related to the reactor system and safety systems, the ICs shift to an event based scheme as the plant mode moves toward cold shutdown and refueling modes. For non-radiological events, such as FIRE, external floods, wind loads, etc., as described in NUREG-0654 Appendix 1, event-based ICs are the norm.

In many cases, a combination of symptom-, event- and barrier-based ICs will be present as an emergency develops. In a loss of coolant accident (LOCA), for example:

- Coolant level is dropping; (symptom)
- There is a leak of some magnitude in the system (pipe break, safety valve stuck open) that exceeds plant capabilities to make up the loss; (barrier breach or event)
- Core (coolant) temperature is rising; (symptom) and
- At some level, fuel failure begins with indicators such as high off-gas, high coolant activity samples, etc. (barrier breach or symptom)

3.5 Design Differences

Although the same basic concerns with barrier integrity and the major safety problems of nuclear power plants are similar across plant types, design differences will have a substantial effect on EALs. The major differences are found between a BWR and a PWR. In these cases, EAL guidelines unique to BWRs and PWRs must be specified. Even among PWRs, however, there are substantial differences in design and in types of containment used.

There is enough commonality among plants that many ICs will be the same or very similar. However, others will have to match plant features and safety system designs that are unique to the plant type or even to the specific plant. The basis for each EAL guideline should supply sufficient information as to what is required for a site-specific EAL.

3.6 Required Characteristics

Eight characteristics that should be incorporated into model EALs are identified below:

(1) Consistency (i.e., the EALs would lead to similar decisions under similar circumstances at different plants);

(2) Human engineering and user friendliness;

(3) Potential for classification upgrade only when there is an increasing threat to public health and safety;

(4) Ease of upgrading and downgrading;

(5) Thoroughness in addressing, and disposing of, the issues of completeness and accuracy raised regarding NUREG-0654 Appendix 1;

(6) Technical completeness for each classification level;

(7) A logical progression in classification for multiple events; and

(8) Objective, observable values.

The EAL development procedure pays careful attention to these eight characteristics to assure that all are addressed in the proposed EAL methodology. The most pervasive and complex of the eight is the first—"consistency." The common denominator that is most appropriate for measuring consistency among ICs and EALs is relative risk. The approach taken in the development of these EALs is based on risk assessment to set the boundaries of the emergency classes and assure that all EALs that trigger that emergency class are in the same range of relative risk. Precursor conditions of more serious emergencies also represent a potential risk to the public and must be appropriately classified.

3.7 Emergency Class Descriptions

There are three considerations related to emergency classes. These are:

(1) The potential impact on radiological safety, either as now known or as can be reasonably projected;

(2) How far the plant is beyond its predefined design, safety, and operating envelopes; and

(3) Whether or not conditions that threaten health are expected to be confined to within the site boundary.

The ICs deal explicitly with radiological safety impact by escalating from levels corresponding to releases within regulatory limits to releases beyond EPA Protective Action Guideline (PAG) plume exposure levels. In addition, the "Discussion" sections below include offsite dose consequence considerations which were not included in NUREG-0654 Appendix 1.

NOTIFICATION OF UNUSUAL EVENT: Events are in process or have occurred which indicate a potential degradation of the level of safety of the plant. No releases of radioactive material requiring offsite response or monitoring are expected unless further degradation of safety systems occurs.

Discussion:

Potential degradation of the level of safety of the plant is indicated primarily by exceeding plant technical specification Limiting Condition of Operation (LCO) allowable action statement time for achieving required mode change. Precursors of more serious events should also be included because precursors do represent a potential degradation in the level of safety of the plant. Minor releases of radioactive materials are included. In this emergency class, however, releases do not require monitoring or offsite response (e.g., dose consequences of less than 10 millirem).

ALERT: Events are in process or have occurred which involve an actual or potential substantial degradation of the level of safety of the plant. Any releases are expected to be limited to small fractions of the EPA Protective Action Guideline exposure levels.

Discussion:

Rather than discussing the distinguishing features of "potential degradation" and "potential substantial degradation," a comparative approach would be to determine whether increased monitoring of plant functions is warranted at the Alert level as a result of safety system degradation. This addresses the operations staff's need for help, independent of whether an actual decrease in plant safety is determined. This increased monitoring can then be used to better determine the actual plant safety state, whether escalation to a higher emergency class is warranted, or whether de-escalation or termination of the emergency class declaration is warranted. Dose consequences from these events are small fractions of the EPA PAG plume exposure levels, i.e., about 10 millirem to 100 millirem TEDE.

SITE AREA EMERGENCY: Events are in process or have occurred which involve actual or likely major failures of plant functions needed for protection of the public. Any releases are not expected to result in exposure levels which exceed EPA Protective Action Guideline exposure levels beyond the site boundary.

Discussion:

The discriminator (threshold) between Site Area Emergency and General Emergency is whether or not the EPA PAG plume exposure levels are expected to be exceeded outside the site boundary. This threshold, in addition to dynamic dose assessment considerations discussed in the EAL guidelines, clearly addresses NRC and offsite emergency response agency concerns as to timely declaration of a General Emergency.

GENERAL EMERGENCY: Events are in process or have occurred which involve actual or imminent substantial core degradation or melting with potential for loss of containment integrity. Releases can be reasonably expected to exceed EPA Protective Action Guideline exposure levels offsite for more than the immediate site area.

Discussion:

The bottom line for the General Emergency is whether evacuation or sheltering of the general public is indicated based on EPA PAGs, and therefore should be interpreted to include radionuclide release regardless of cause. In addition, it should address concerns as to uncertainties in systems or structures (e.g. containment) response, and also events such as waste gas tank releases and severe spent fuel pool events postulated to occur at high population density sites. To better assure timely notification, EALs in this category must primarily be expressed in terms of plant function status, with secondary reliance on dose projection. In terms of fission product barriers, loss of two barriers with potential loss of the third barrier constitutes a General Emergency.

3.8 Emergency Class Thresholds

The most common bases for establishing these boundaries are the technical specifications and setpoints for each plant that have been developed in the design basis calculations and the Final Safety Analysis Report (FSAR).

For those conditions that are easily measurable and instrumented, the boundary is likely to be the EAL (observable by plant staff, instrument reading, alarm setpoint, etc.) that indicates entry into a particular emergency class. For example, the main steam line radiation monitor may detect high radiation that triggers an alarm. That radiation level also may be the setpoint that closes the main steam isolation valves (MSIV) and initiates the reactor scram. This same radiation level threshold, depending on plant-specific parameters, also may be the appropriate EAL for a direct entry into an emergency class.

In addition to the continuously measurable indicators, such as coolant temperature, coolant levels, leak rates, containment pressure, etc., the FSAR provides indications of the consequences associated with design basis events. Examples would include steam pipe breaks, MSIV malfunctions, and other anticipated events that, upon occurrence, place the plant immediately into an emergency class.

Another approach for defining these boundaries is the use of a plant-specific probabilistic safety assessment (PSA - also known as probabilistic risk assessment, PRA). PSAs have been completed for several individual plants, but this is by no means comprehensive. There are, however, PSAs that have been completed for representative plant types such as is done in NUREG-1150, "Severe Accident Risks: An Assessment for Five Nuclear Power Plants," as well as several other utility-sponsored PSAs. Existing PSAs can be used as a good first approximation of the relevant ICs and risk associated with emergency conditions for existing plants. Generic insights from PSAs and related severe accident assessments which apply to EALs and emergency class determinations are:

1. Core damage frequency at many BWRs is dominated by sequences involving prolonged loss of all AC power. In addition, prolonged loss of all AC power events are extremely important at PWRs. This would indicate that should this occur, and AC power is not restored within 15 minutes, entry into the emergency class at no lower than a Site Area Emergency, when the plant was initially at power, would be appropriate. This implies that precursors to loss of all AC power events should appropriately be included in the EAL structure.

2. For severe core damage events, uncertainties exist in phenomena important to accident progressions leading to containment failure. Because of these uncertainties, predicting containment integrity may be difficult in these conditions. This is why maintaining containment integrity alone following sequences leading to severe core damage may be an insufficient basis for not escalating to a General Emergency.

3. A review of four full-scope PRAs (3 PWR, 1 BWR) showed that leading contributors to latent fatalities were containment bypass, large LOCA with early containment failure, station blackout greater than 6 hours (e.g., LOCA consequences of Station Blackout), and reactor coolant pump seal failure. This indicates that generic EAL methodology must be sufficiently rigorous to cover these sequences in a timely fashion.

Another critical element of the analysis to arrive at these threshold (boundary) conditions is the time that the plant might stay in that condition before moving to a higher emergency class. In particular, station blackout coping analyses performed in response to 10 CFR 50.63 and Regulatory Guide 1.155, "Station Blackout," may be used to determine whether a specific plant enters a Site Area Emergency or a General Emergency directly, and when escalation to General Emergency is indicated. The time dimension is critical to the EAL since the purpose of the emergency class for state and local officials is to notify them of the level of mobilization that may be necessary to handle the emergency. This is particularly true when a "Site Area Emergency" or "General Emergency" is imminent. Establishing EALs for such conditions must take estimated evacuation time into consideration to minimize the potential for the plume to pass while evacuation is underway.

Regardless of whether or not containment integrity is challenged, it is possible for significant radioactive inventory within containment to result in EPA PAG plume exposure levels being exceeded even assuming containment is within technical specification allowable leakage rates. With or without containment challenge, however, a major release of radioactivity requiring offsite protection actions from core damage is not possible unless a major failure of fuel cladding allows radioactive material to be released from the core into the reactor coolant. NUREG-1228, "Source Estimations During Incident Response to Severe Nuclear Power Plant Accidents," indicates that such conditions do not exist when the amount of clad damage is less than 20%.

3.9 Emergency Action Levels

With the emergency classes defined, the thresholds that must be met for each EAL to be placed under the emergency class can be determined. There are two basic approaches to determining these EALs. EALs and emergency class boundaries coincide for those continuously measurable, instrumented ICs, such as radioactivity, core temperature, coolant levels, etc. For these ICs, the EAL will be the threshold reading that most closely corresponds to the emergency class description using the best available information.

For discrete (discontinuous) events, the approach will have to be somewhat different. Typically, in this category are internal and external hazards such as FIRE or earthquake. The purpose for including hazards in EALs is to assure that station personnel and offsite emergency response organizations are prepared to deal with consequential damage these hazards may cause. If, indeed, hazards have caused damage to safety functions or fission product barriers, this should be confirmed by symptoms or by observation of such failures. Therefore, it may be appropriate to enter an Alert status for events approaching or exceeding design basis limits such as Operating Basis Earthquake, design basis wind loads, FIRE within VITAL AREAs, etc. This would give the operating staff additional support and improved ability to determine the extent of plant damage. if damage to barriers or challenges to Critical Safety Functions (CSFs) have occurred or are identified, then the additional support can be used to escalate or terminate the Emergency Class based on what has been found. Of course, security events must reflect potential for increasing security threat levels.

Plant emergency operating procedures (EOPs) are designed to maintain and/or restore a set of CSFs which are listed in the order of priority for restoration efforts during accident conditions. While the actual nomenclature of the CSFs may vary among plants, generally the PWR CSF set includes:

- Subcriticality
- Core cooling
- Heat sink
- Pressure-temperature-stress (RCS integrity)
- Containment
- RCS inventory

There are diverse and redundant plant systems to support each CSF. By monitoring the CSFs instead of the individual system component status, the impact of multiple events is inherently addressed, e.g., the number of operable components available to maintain the critical safety function.

The EOPs contain detailed instructions regarding the monitoring of these functions and provides a scheme for classifying the significance of the challenge to the functions. In providing EALs based on these schemes, the emergency classification can flow from the EOP assessment rather than being based on a separate EAL assessment. This is desirable as it reduces ambiguity and reduces the time necessary to classify the event.

As an example, consider that the Westinghouse Owner's Group (WOG) Emergency Response Guidelines (ERGs) classify challenges as YELLOW, ORANGE, and RED paths. If the core exit thermocouples exceed 1200 degrees F or 700 degrees F with low reactor vessel water level, a RED path condition exists. The ERG considers a RED path as "... an extreme challenge to a plant function necessary for the protection of the public ..." This is almost identical to the present NRC NUREG-0654 description of a site area emergency "... actual or likely failures of plant functions needed for the protection of the public ..." It reasonably follows that if any CSF enters a RED path, a site area emergency exists. A general emergency could be considered to exist if core cooling CSF is in a RED path and the EOP function restoration procedures have not been successful in restoring core cooling.

Although the majority of the EALs provide very specific thresholds, the Emergency Director must remain alert to events or conditions that lead to the conclusion that exceeding the EAL threshold is imminent. If, in the judgment of the Emergency Director, an imminent situation is at hand, the classification should be made as if the thresholds has been exceeded. While this is particularly prudent at the higher emergency classes (as the early classification may provide for more effective implementation of protective measures), it is nonetheless applicable to all emergency classes.

3.10 Treatment Of Multiple Events And Emergency Class Upgrading

The above discussion deals primarily with simpler emergencies and events that may not escalate rapidly. However, usable EAL guidance must also consider rapidly evolving and complex events. Hence, emergency class upgrading and consideration of multiple events must be addressed.

There are three approaches presently in use for covering multiple events and emergency class upgrading. These approaches are:

(U1) Multiple contemporaneous events are counted and are the basis for escalating to a higher emergency class. For example, two or more contemporaneous Alerts escalate to a Site Area Emergency.

(U2) The emergency class is based on the highest EAL reached. For example, two Alerts remain in the Alert category. Or, an Alert and a Site Area Emergency is a Site Area Emergency.

(U3) Emergency Director judgment. Although all emergency classifications require judgment, some utilities rely on Emergency Director judgment with little or no additional explicit guidance.

An additional approach for plants with PRAs is to make use of event tree analysis to define combinations of events which lead to equivalent risks. Such event sequences should have an equal emergency classification assigned. However, the chief drawback to this approach as well as (U1) above, is that multiple events may be masked when they actually occur. Further, for plants using symptom-based (and barrier-based) emergency procedures, direct perception of multiple events is unnecessary.

Emergency class upgrading for multi-unit stations with shared safety-related systems and functions must also consider the effects of a loss of a common system on more than one unit (e.g. potential for radioactive release from more than one core at the same site). For example, many two-unit stations have their control panels for both units in close proximity within the same room.

Thus, control room evacuation most likely would affect both units. There are a number of other systems and functions which may be shared at a given multi-unit station. This must be considered in the emergency class declaration and in the development of appropriate site-specific ICs and EALs based on the generic EAL guidance.

Although the majority of the EALs provide very specific thresholds, the Emergency Director must remain alert to events or conditions that lead to the conclusion that exceeding the EAL threshold is imminent. If, in the judgment of the Emergency Director, an imminent situation is at hand, the classification should be made as if the thresholds has been exceeded. While this is particularly prudent at the higher emergency classes (as the early classification may provide for more effective implementation of protective measures), it is nonetheless applicable to all emergency classes.

RECOMMENDATION:

> **The best approach is (U2) above with appropriate consideration for Emergency Director judgment EALs. Properly structured EALs on a fission product barrier basis and which include equivalent risk, will appropriately escalate multiple events to a higher emergency class. For example, common cause failures such as loss of ultimate heat sink or loss of all AC power, will result in multiple contemporaneous symptoms indicating safety system functional failures and increasing challenge to fission product barriers. It is the existence of these symptoms (barrier challenges) that escalate the emergency class, whether there are one or multiple causes.**

3.11 Emergency Class Downgrading

Another important aspect of usable EAL guidance is the consideration of what to do when the risk posed by an emergency is clearly decreasing. There are several approaches presently in use for emergency class downgrading. These approaches are:

(D1) Terminate the emergency class declaration.

(D2) Recovery from emergency class.

(D3) Combination of downgrading approaches. Many utilities reviewed include the option to downgrade to a lower emergency class. This is consistent with actions called for in NUREG-0654 Appendix 1. However, these utilities state that their experience more closely resembles (D1) and (D2) above as practical choices.

Another approach possible with risk-based EALs is a relatively simple approach for upgrading to a higher emergency class when the risk increases and downgrading when risk decreases. The boundaries for emergency categories are defined in terms of risk in this approach, and discrete events fall into these categories based on risk. This means that within each emergency class, there is uniformity to the relative levels of risk to human health and safety from radiological accidents. However, this option may not be practical when applied to actual emergencies, especially those involving General Emergencies.

RECOMMENDATION:

> **A combination approach involving recovery from General Emergencies and some Site Area Emergencies and termination from NOUEs, Alerts, and certain Site Area Emergencies causing no long-term plant damage appears to be the best choice. Downgrading to lower emergency classes adds notifications but may have merit under certain circumstances.**

3.12 Classifying Transient Events

For some events, the condition may be corrected before a declaration has been made. For example, an emergency classification is warranted when automatic and manual actions taken within the control room do not result in a required reactor scram. However, it is likely that actions taken outside of the control room will be successful, probably before the Emergency Director classifies the event. The key consideration in this situation is to determine whether or not further plant damage occurred while the corrective actions were being taken. In some situations, this can be readily determined, in other situations, further analyses (e.g., coolant radiochemistry sampling, may be necessary). There are several approaches presently in use for handling transient events. These approaches are:

(T1) Classify the event as indicated and terminate the emergency once assessment shows that there were no consequences from the event and other termination criteria are met.

(T2) No emergency declaration is made, but the event is reported and notifications are made.

RECOMMENDATION

Option (T1) is believed to be appropriate for events at higher emergency classifications. Option (T2) may be appropriate for events that might have been classified as NOUEs, but might not be sufficient for some events (e.g., ATWS). It is recommended that the program incorporate aspects of both options with examples of when each would be appropriate. Many of the generic event-based IC's and EAL's have discriminators based on time or magnitude. Generally, if the discriminator is exceeded, the event should be classified. In implementing the generic guidance into site-specific programs, care should be taken to ensure that the ICs and EALs minimize the need for these ad hoc decisions on transient events.

There may be cases in which a plant condition that exceeded an EAL threshold was not recognized at the time of occurrence, but is identified well after the condition has occurred (e.g., as a result of routine log or record review) and the condition no longer exists. In these cases, an emergency should not be declared.

Reporting requirements of 10 CFR 50.72 are applicable and the guidance of NUREG-1022, Rev. 1, Section 3 should be applied.

3.13 Interface Between Classification and Activation of Emergency Facilities

Existing regulations call for the activation of various emergency facilities at different levels of emergency classification. The intent of activating these facilities is to provide needed support to the on-shift complement. A question often arises, "If I utilize the TSC as a precautionary measure do I have to declare an Alert emergency?" There are two possible situations:

- The Emergency Director is faced with an event or series of events which individually may not constitute an Alert emergency, but in combination, is causing the Emergency Director with concern over his ability to contend with the situation using his on-shift resources. This should be clearly recognized as a case in which the Emergency Director judgment ICs apply, and the emergency classification is probably warranted.

- The site has received warning of severe weather. Site management deems it prudent to utilize the onsite emergency facilities to ensure the availability of personnel should the weather cause plant damage while personnel travel is hindered. This situation wouldn't warrant an Alert classification unless the severe weather warning was such that damage comparable to an Alert IC was expected.

RECOMMENDATION

The key consideration is not the fact that the facilities were utilized, but rather, the reason for that use. Facilities may be used for events that may not warrant classification of an emergency.

3.14 Cold Shutdown/Refueling IC/EALs

Generic Letter 88–17, Loss of Decay Heat Removal, SECY–91–283, Evaluation of Shutdown and Low Power Risk Issues, SECY–93–190, Regulatory Approach to Shutdown and Low–power Operation, NUREG–1449, Shutdown and Low–Power Operation at Commercial Nuclear Power Plants in the United States, and NUMARC 91–06, Guidelines for Industry Actions to Assess Shutdown Management, all address nuclear power plant safety issues that are applicable to periods when the plant is shutdown. These evaluations identify a number of variables which significantly affect the probability and consequences of losing decay heat removal capability during shutdown periods. In addition, NUREG–1449 discusses that the need to respond appropriately, including emergency classification and notification, still exists during cold–shutdown and refueling conditions. Both SECY–93–190 and NUREG–1449 have been reviewed and issues concerning shutdown effects on declaring emergencies have been addressed.

Given the variability of plant configurations (e.g., systems out–of–service for maintenance, containment open, reduced AC power redundancy, time since shutdown) during these periods, the consequences of any given initiating event can vary greatly. For example, a loss of decay heat removal capability that occurs at the end of an extended outage has less significance than a similar loss occurring during the first week after shutdown. Compounding these events is the likelihood that instrumentation necessary for assessment may also be inoperable. The NESP shutdown EALs are based on performance capability to the extent possible with consideration given to RCS integrity, containment closure, and fuel clad integrity for the applicable modes.

The initiating conditions and example emergency actions levels associated directly with Cold Shutdown or Refueling safety function are presented in Recognition Category C, Cold Shutdown/Refueling. The example EALs for both PWR and BWR are consistent with the public risk associated with the other events represented in the Fission Product Barrier Matrix and in other sections of this document.

Boiling water reactors and pressurized water reactors differ significantly with regard to plant response to events that occur during shutdowns. There is generally a larger water inventory in a BWR than in a PWR. Containment isolation capability is generally better in PWRs than in earlier design BWRs. Where differences exist, separate BWR/PWR EALs have been prepared to reflect the differences in plant vulnerabilities or mitigation features.

The guidance which addresses cold shutdown/refueling IC/EALs in NEI 99-01 is intended to address both NUMARC/NESP-007 and NUREG-0654 users. For NUREG-0654 users, the scope of the cold shutdown/refueling initiative is limited to the "new" IC/EALs (CU2, CU4, CA1, CA2, and CG1), CA4 (compare with NUREG-054 Example Alert 10), and CS1 and CS2 (partially related to NUREG-0654 Example Site Area 10).

3.15 Permanently Defueled Station IC/EALs

A Permanently Defueled Station is basically a spent fuel storage facility. The spent fuel is stored in a pool of water that serves as both the cooling medium for decay heat and shielding from direct radiation. The primary functions of this pool configuration become the emphasis of emergency classification methodology.

When in the permanently defueled condition, the licensee receives approval for specific emergency planning requirements negotiated with the State and local governmental agencies and the NRC. The source term and relative risks associated with pool storage are the basis for maintaining only an onsite emergency plan. Calculations are provided in the licensing process that quantify radioactive releases associated with plausible accidents.

The guidance which addresses permanently defueled station IC/EALs in NEI 99-01 is intended to address both NUMARC/NESP-007 and NUREG-0654 users.

3.16 ISFSI IC/EALs

An Independent spent fuel storage installation (ISFSI) is a complex that is designed and constructed for the interim storage of spent nuclear fuel and other radioactive materials associated with spent fuel storage. The Final Rule governing Emergency Planning Licensing Requirements for Independent Spent Fuel Storage Facilities (Federal Register Volume 60, Number 120 June 22, 1995, Pages 32430-32442) indicated that a significant amount of the radioactive material contained within a cask must escape its packaging and enter the biosphere for there to be a significant environmental impact resulting from an accident involving the dry storage of spent nuclear fuel. Formal offsite planning is not required because the postulated worst-case accident involving an ISFSI has insignificant consequences to the public health and safety.

The guidance which addresses ISFSI IC/EALs in NEI 99-01 is intended to address both NUMARC/NESP-007 and NUREG-0654 users. Licensees may choose to present site-specific ISFSI IC/EALs separate from other ICs/EALs as presented herein, or integrate them into Recognition Category A, H, and S IC/EALs.

3.17 Operating Mode Applicability

Emergency action levels have typically been written without regard to the operating mode to which they apply. While the applicable operating modes are obvious for some initiating conditions (e.g., failure of the reactor protection system), the situation is not as clear for others.

The plant operating mode that existed at the time that the event occurred, prior to any protective system or operator action initiated in response to the condition, is compared to the mode applicability of the EALs. If an event occurs, and a lower or higher plant operating mode is reached before the emergency classification can be made, the declaration shall be based on the mode that existed at the time the event occurred.

Note that in Revision 4 the system malfunction matrices have been completely separated such that the system ICs that apply to the Hot Shutdown mode and above are located in Category S and the system ICs that apply to the Cold Shutdown mode and below are located in Category C.

For events that occur in Cold Shutdown or Refueling, escalation is via EALs that have Cold Shutdown or Refueling for mode applicability, even if Hot Shutdown (or a higher mode) is entered during any subsequent heat–up. In particular, the Fission Product Barrier Matrix EALs are applicable only to events that initiate in Hot Shutdown or higher.

3.17.1 Mode Applicability Matrix

Recognition Category C completely replaces Recognition Category S when in Cold Shutdown and Refueling modes. It should be noted that Recognition Category A and H IC/EALs still apply when in Cold Shutdown and Refueling modes. Recognition Category F is not applicable to Cold Shutdown and Refueling modes.

MODE APPLICABILITY MATRIX

	Recognition Category						
Mode	A	C	D	E	F	H	S
Operating	X				X	X	X
Startup	X				X	X	X
Hot Standby	X				X	X	X
Hot Shutdown	X				X	X	X
Cold Shutdown	X	X				X	
Refueling	X	X				X	
Defueled	X	X				X	
None			X	X			

The modes identified in the IC/EALs were based on the standard technical specifications for BWRs and Westinghouse PWRs. To aid in interpreting these modes for PWRs from other NSSSs and for plant with non–standard technical specifications, the modes are described below.

3.17.2 BWR Operating Modes

Power Operations (1): Mode Switch in Run

Startup (2): Mode Switch in Startup/Hot Standby or Refuel (with all vessel head bolts fully tensioned)

Hot Shutdown (3): Mode Switch in Shutdown, Average Reactor Coolant Temperature >200 °F

Cold Shutdown (4): Mode Switch in Shutdown, Average Reactor Coolant Temperature ≤ 200 °F

Refueling (5): Mode Switch in Shutdown or Refuel, and one or more vessel head bolts less than fully tensioned.

Defueled (None) All reactor fuel removed from reactor pressure vessel (Full core off load during refueling or extended outage).

3.17.3 PWR Operating Modes

Power Operations (1):	Reactor Power > 5%, Keff ≥ 0.99
Startup (2):	Reactor Power ≤ 5%, Keff ≥ 0.99
Hot Standby (3):	RCS ≥ 350 °F, Keff < 0.99
Hot Shutdown (4):	200 °F < RCS < 350 °F, Keff < 0.99
Cold Shutdown (5):	RCS < 200 °F, Keff < 0.99
Refueling (6):	One or more vessel head closure bolts less than fully tensioned
Defueled (None)	All reactor fuel removed from reactor pressure vessel. (Full core off load during refueling or extended outage)

4.0 HUMAN FACTORS CONSIDERATIONS

Some factors that should be considered in determining the method of presentation of EALs:

- Who is the audience (user) for this information? A senior utility executive would likely want information presented differently than a licensed operator. Offsite agencies and the NRC may have entirely different information needs.

- The conditions under which the information must be read, understood, and acted upon. Since the subject matter here is *emergency* actions, it is highly likely that the user of the EALs will be under high stress during the conditions where they are required to be used, particularly under conditions corresponding to Site Area Emergency and General Emergency.

- What is the user's perception as to the importance of the EALs compared to other actions and decisions that may be needed at the same time? To allow a licensed operator to discharge his responsibilities for dealing with the situation and also provide prompt notification to outside agencies, the emergency classification and notification process must be rapid and concise.

- Is the EAL consistent with the user's knowledge of what constitutes an *emergency* situation?

- How much help does the user receive in deciding which EAL and/emergency class is involved? An Emergency Director with a staffed TSC and EOF has many more resources immediately at his disposal than the licensed operator (typically, the Shift Supervisor) who has to make the initial decisions and take first actions.

Based on review of a number of plants' EALs and associated information, interviews with utility personnel, and a review of drill experience some recommendations follow.

4.1 Level Of Integration Of EALs With Plant Procedures

A rigorous integration of EALs and emergency class determinations into the plant procedure set, although having some benefits, is probably unnecessary. Such a rigorous integration could well make it more difficult to keep documentation up-to-date. However, keeping EALs totally separated from plant procedures and relying on licensed operator or other utility Emergency Director memory during infrequent, high stress periods is insufficient.

RECOMMENDATION:

Visual cues in the plant procedures that it is appropriate to consult the EALs is a method currently used by several utilities. This method can be effective when it is tied to appropriate training. Notes in the appropriate plant procedures to consult the EALs can also be used. It should be noted that this discussion is not restricted to only the emergency procedures; alarm recognition procedures, abnormal operating procedures, and normal operating procedures that apply to cold shutdown and refueling modes should also be included. In addition, EALs can be based on entry into particular procedures or existence of particular Critical Safety Function conditions.

4.2 Method Of Presentation

A variety of presentation methods are presently in use. Methods range from directly copying NUREG-0654 Appendix 1 language, adding plant-specific indications to clarify NUREG-0654, use of procedure language including specific tag numbers for instrument readings and alarms, deliberate omission of instrument tag numbers, flow charts, critical safety function status trees, checklists, and combinations of the above.

What is clear, however, is that the licensed operator (typically the Shift Supervisor) is the first user of this information, has the least amount of help in interpreting the EALs, and also has other significant responsibilities to fulfill while dealing with the EALs. Emergency Directors outside the control room to whom responsibilities are turned over have other resources and advisors available to them that a licensed operator may not have when first faced with an emergency situation. In addition, as an emergency situation evolves, the operating staff and the health physics staff are the personnel who must first deal with information that is germane to changing the emergency classification (up, down, or out of the emergency class).

RECOMMENDATION:

The method of presentation should be one with which the operations and health physics staff are comfortable. As is the case for emergency procedures, bases for steps should be in a separate (or separable) document suitable for training and for reference by emergency response personnel and offsite agencies. Each nuclear plant should already have presentation and human factors standards as part of its procedure writing guidance. EALs that are consistent with those procedure writing standards (in particular, emergency operating procedures which most closely correspond to the conditions under which EALs must be used) should be the norm for each utility.

4.3 Symptom-based, Event-based, Or Barrier-based EALs

A review of the emergency class descriptions provided elsewhere in this document shows that NOUEs and Alerts deal primarily with sequences that are precursors to more serious emergencies or that may have taken a plant outside of its intended operating envelope, but currently pose no danger to the public. Observable indications in these classes can be events (e.g. natural phenomena), symptoms (e.g., high temperature, low water level), or barrier-related (e.g., challenge to fission product barrier). As one escalates to Site Area Emergency and General Emergency, potential radiological impact to people (both onsite and offsite) increases. However, at this point the root cause event(s) leading to the emergency class escalation matter far less than the increased (potential for) radiological releases. Thus, EALs for these emergency classes should be primarily symptom- and barrier-based. It should be noted again, as stated in Section 3.4, that barrier monitoring is a subset of symptom monitoring, i.e., what readings (symptoms) indicate a challenge to a fission product barrier.

RECOMMENDATION:

A combination approach that ranges from primarily event-based for NOUEs to primarily symptom- or barrier-based for General Emergencies is recommended. This is to better assure that timely recognition and notification occurs, that events occurring during refueling and cold shutdown are appropriately covered, and that multiple events can be effectively treated in the EALs.

5.0 GENERIC EAL GUIDANCE

This section provides generic EAL guidance based on the information gathered and reviewed by the Task Force. Because of the wide variety of presentation methods used at different utilities, this document specifies guidance as to what each IC and EAL should address, and including sufficient basis information for each will best assure uniformity of approach. This approach is analogous to reactor vendors' owners groups developing generic emergency procedure guidelines which are converted by each utility into plant-specific emergency operating procedures. Each utility is reminded, however, to review the "Human Factors Considerations" section of this document as part of implementation of the attached Generic EAL Guidance.

5.1 Generic Arrangement

The information is presented by Recognition Categories:

- A - Abnormal Rad Levels / Radiological Effluent
- C - Cold Shutdown./ Refueling System Malfunction
- D – Permanently Defueled Station Malfunction
- E - Events Related to Independent Spent Fuel Storage Installations
- F - Fission Product Barrier Degradation
- H - Hazards and Other Conditions Affecting Plant Safety
- S - System Malfunction

The Initiating Conditions for each of the above Recognition Categories A, C, D, E, H, and S are in the order of NOUE, Alert, Site Area Emergency, and General Emergency. For all Recognition Categories, an Initiating Condition matrix versus Emergency Class is first shown. For Recognition Category F, the barrier-based EALs are presented in Tables F-1 and F-2 for BWRs and PWRs respectively. For all other Recognition Categories separate BWR and PWR Initiating Condition matrices are not required. The purpose of the IC matrices is to provide the reader with an overview of how the ICs are logically related under each Emergency Class.

Each of the EAL guides in Recognition Categories A, C, D, E, H, and S is structured in the following way:

- **Recognition Category** - As described above.
- **Emergency Class** - NOUE, Alert, Site Area Emergency or General Emergency.
- **Initiating Condition** - Symptom- or Event-Based, Generic Identification and Title.
- **Operating Mode Applicability** - refers to the operating mode (PWRs) or operating condition (BWRs) during which the IC/EAL is applicable - Power Operation (includes Startup Mode in PWRs), Hot Standby (includes Hot Standby / Startup Condition in BWRs), Hot Shutdown, Cold Shutdown, Refueling, Defueled, All, or None. These modes are defined in each licensee's technical specifications. The mode classifications and terminology appropriate to the specific facility should be used. See also Section 3.15. Note that Permanently Defueled and ISFSI IC/EALs have no mode applicability.

If an IC or EAL includes an explicit reference to a technical specification, and the technical specification is not applicable because of operating mode, then that particular IC or EAL is also not applicable.

- **Example Emergency Action Level(s)** – these EALs are examples of conditions and indications that were considered to meet the criteria of the IC. These examples were not intended to be all encompassing, and some may not apply to a particular facility. Utilities should generally address each example EAL that applies to their site. If an example EAL does not apply because of its wording, e.g., specifies instrumentation not available at the site, the utility should identify other available means for entry into the IC. Ideally, the example EALs used will be unambiguous, expressed in site-specific nomenclature, and be readily discernible from control room instrumentation.

- **Basis** – provides information that explains the IC and example EALs. The bases are written to assist the personnel implementing the generic guidance into site-specific procedures. Site-specific deviations from the IC/EALs should be compared to the Basis for that IC to ensure that the fundamental intent of each IC/EAL is met. Some bases provide information intended to assist with establishing site-specific instrumentation values. Appendix A, C, D, and E provide detailed guidance on implementing their corresponding Recognition Category.

For Recognition Category F, basis information is presented in a format consistent with Tables 3 and 4. The presentation method shown for Fission Product Barrier Function Matrix was chosen to clearly show the synergism among the EALs and to support more accurate dynamic assessments. Other acceptable methods of achieving these goals which are currently in use include flow charts, block diagrams, and checklist tables. Utilities selecting these alternative need to ensure that all possible EAL combinations in the Fission Product Barrier Function Matrix are addressed in their presentation method.

5.2 Generic Bases

The generic guidance has the primary threshold for NOUEs as operation outside the safety envelope for the plant as defined by plant technical specifications, including LCOs and Action Statement Times. In addition, certain precursors of more serious events such as loss of offsite AC power and earthquakes are included in NOUE IC/EALs. This provides a clear demarcation between the lowest emergency class and "non-emergency" notifications specified by 10 CFR 50.72.

For a number of Alerts, IC/EALs are chosen based on hazards which may cause damage to plant safety functions (i.e., tornadoes, hurricanes, FIRE in plant VITAL AREAs) or require additional help directly (control room evacuation) and thus increased monitoring of the plant is warranted. The symptom-based and barrier-based IC/EALs are sufficiently anticipatory to address the results of multiple failures, regardless of whether there is or is not a common cause. Declaration of the Alert will already result in the manning of the TSC for assistance and additional monitoring. Thus, direct escalation to the Site Area Emergency is unnecessary. Other Alerts, that have been specified, correspond to conditions which are consistent with the emergency class description.

The basis for declaring a Site Area Emergency and General Emergency is primarily the extent and severity of fission product barrier challenges, based on plant conditions as presently known or as can be reasonably projected.

With regard to the Hazards Recognition Category, the existence of a hazard that represents a potential degradation in the level of safety of the plant is the basis of NOUE classification. If the hazard results in VISIBLE DAMAGE to plant structures or equipment associated with safety systems or if system performance is affected, the event may be escalated to an Alert. The reference to "duration" or to "damage" to safety systems is intended only to size the event. Consequential damage from such hazards, if observed, would be the basis for escalation to Site Area Emergency or General Emergency, by entry to System Malfunction or Fission Product Barrier IC/EALs.

5.3 Site Specific Implementation

The guidance presented here is not intended to be applied to plants as-is. The generic guidance is intended to give the logic for developing site-specific IC/EALs using site-specific IC/EAL presentation methods. Each utility will need to revise the IC/EALs to meet site-specific needs with regard to instrumentation, nomenclature, plant arrangement, and method of presentation, etc. Such revision is expected and encouraged provided that the intent of the generic guidance is retained. Deviations from the intent may be acceptable, but will need to be justified during regulatory review. Items associated with presentation, e.g., format, sequencing of IC/EALs, IC numbering, recognition categories are at the option of the utility.

The generic guidance includes both ICs and example EALs. It is the intent of this guidance that both be included in the site-specific implementation. Each serves a specific purpose. The IC is intended to be the fundamental criteria for the declaration, whereas, the EALs are intended to represent unambiguous examples of conditions that may meet the IC. There may be unforeseen events, or combinations of events, for which the EALs may not be exceeded, but in the judgment of the Emergency Director, the intent of the IC may be met. While the generic guidance does include Emergency Director judgment ICs, the additional detail in the individual ICs will facilitate classifications over the broad guidance of the ED judgment ICs.

For sites involving more than one reactor unit, consideration needs to be given to how events involving shared safety functions may affect more than one unit, and whether or not this may be a factor in escalating the event.

State and local requirements have not been reflected in the generic guidance and should be considered on a case-by-case basis with appropriate state and local emergency response organizations.

Although not a requirement, utilities should consider either preparing a basis document or including basis information with the IC/EALs. The bases provided for each IC/EAL will provide a starting point for developing these site-specific bases. This information may assist the Emergency Director in making classifications, particularly those involving judgment or multiple events. The basis information may be useful in training, for explaining event classifications to offsite officials, and would facilitate regulatory review and approval of the classification scheme.

5.4 Definitions

In the IC/EALs, selected words have been set in all capital letters. These words are defined terms having specific meanings as they relate to this procedure. Definitions of these terms are provided below.

AFFECTING SAFE SHUTDOWN: Event in progress has adversely affected functions that are necessary to bring the plant to and maintain it in the applicable HOT or COLD SHUTDOWN condition. Plant condition applicability is determined by Technical Specification LCOs in effect.

Example 1: Event causes damage that results in entry into an LCO that requires the plant to be placed in HOT SHUTDOWN. HOT SHUTDOWN is achievable, but COLD SHUTDOWN is not. This event **is not** "AFFECTING SAFE SHUTDOWN."
Example 2: Event causes damage that results in entry into an LCO that requires the plant to be placed in COLD SHUTDOWN. HOT SHUTDOWN is achievable, but COLD SHUTDOWN is not. This event **is** "AFFECTING SAFE SHUTDOWN."

BOMB: refers to an explosive device suspected of having sufficient force to damage plant systems or structures.

CIVIL DISTURBANCE: is a group of (site-specific #) or more persons violently protesting station operations or activities at the site.

CONFINEMENT BOUNDARY: is the barrier(s) between areas containing radioactive substances and the environment.

CONTAINMENT CLOSURE: (PWR) is defined by site-specific procedure. (BWR) is considered to be Secondary Containment as required by Technical Specifications.

EXPLOSION: is a rapid, violent, unconfined combustion, or catastrophic failure of pressurized equipment that imparts energy of sufficient force to potentially damage permanent structures, systems, or components.

EXTORTION: is an attempt to cause an action at the station by threat of force.

FAULTED: (PWRs) in a steam generator, the existence of secondary side leakage that results in an uncontrolled decrease in steam generator pressure or the steam generator being completely depressurized.

FIRE: is combustion characterized by heat and light. Sources of smoke such as slipping drive belts or overheated electrical equipment do not constitute FIREs. Observation of flame is preferred but is NOT required if large quantities of smoke and heat are observed.

HOSTAGE: is a person(s) held as leverage against the station to ensure that demands will be met by the station.

HOSTILE FORCE: one or more individuals who are engaged in a determined assault, overtly or by stealth and deception, equipped with suitable weapons capable of killing, maiming, or causing destruction.

IMMEDIATELY DANGEROUS TO LIFE AND HEALTH (IDLH): A condition that either poses an immediate threat to life and health or an immediate threat of severe exposure to contaminants which are likely to have adverse delayed effects on health.

INTRUSION / INTRUDER: is a person(s) present in a specified area without authorization. Discovery of a BOMB in a specified area is indication of INTRUSION into that area by a HOSTILE FORCE.

LOWER FLAMMABILITY LIMIT (LFL): The minimum concentration of a combustible substance that is capable of propagating a flame through a homogenous mixture of the combustible and a gaseous oxidizer.

Table 5-A-1

Recognition Category A

Abnormal Rad Levels / Radiological Effluent

INITIATING CONDITION MATRIX

NOUE		ALERT		SITE AREA EMERGENCY		GENERAL EMERGENCY	
AU1	**Any UNPLANNED Release of Gaseous or Liquid Radio-activity to the Environment that Exceeds Two Times the Radio-logical Effluent Technical Specifications for 60 Minutes or Longer.** *Op. Modes: All*	AA1	**Any UNPLANNED Release of Gaseous or Liquid Radioactivity to the Environment that Exceeds 200 Times the Radiological Effluent Technical Specifications for 15 Minutes or Longer.** *Op. Modes: All*	AS1	**Offsite Dose Resulting from an Actual or Imminent Release of Gaseous Radioactivity Exceeds 100 mR TEDE or 500 mR Thyroid CDE for the Actual or Projected Duration of the Release.** *Op. Modes: All*	AG1	**Offsite Dose Resulting from an Actual or Imminent Release of Gaseous Radioactivity Exceeds 1000 mR TEDE or 5000 mR Thyroid CDE for the Actual or Projected Duration of the Release Using Actual Meteorology.** *Op. Modes: All*
AU2	**Unexpected Increase in Plant Radiation.** *Op. Modes: All*	AA3	**Release of Radioactive Material or Increases in Radiation Levels Within the Facility That Impedes Operation of Systems Required to Maintain Safe Operations or to Establish or Maintain Cold Shutdown** *Op. Modes: All*				
		AA2	**Damage to Irradiated Fuel or Loss of Water Level that Has or Will Result in the Uncovering of Irradiated Fuel Outside the Reactor Vessel.** *Op. Modes: All*				

AU1

Initiating Condition – NOTIFICATION OF UNUSUAL EVENT

Any UNPLANNED Release of Gaseous or Liquid Radioactivity to the Environment that Exceeds Two Times the Radiological Effluent Technical Specifications for 60 Minutes or Longer.

Operating Mode Applicability: All

Example Emergency Action Levels: (1 or 2 or 3 or 4 or 5)

1. VALID reading on any effluent monitor that exceeds two times the alarm setpoint established by a current radioactivity discharge permit for 60 minutes or longer.

2. VALID reading on one or more of the following radiation monitors that exceeds the reading shown for 60 minutes or longer:

   (site-specific list)

3. Confirmed sample analyses for gaseous or liquid releases indicates concentrations or release rates, with a release duration of 60 minutes or longer, in excess of two times (site-specific technical specifications).

4. VALID reading on perimeter radiation monitoring system greater than 0.10 mR/hr above normal background sustained for 60 minutes or longer [for sites having telemetered perimeter monitors].

5. VALID indication on automatic real-time dose assessment capability greater than (site-specific value) for 60 minutes or longer [for sites having such capability].

Basis:

Refer to Appendix A for a detailed basis of the radiological effluent IC/EALs.

This IC addresses a potential or actual decrease in the level of safety of the plant as indicated by a radiological release that exceeds regulatory commitments for an extended period of time. Nuclear power plants incorporate features intended to control the release of radioactive effluents to the environment. Further, there are administrative controls established to prevent unintentional releases, or control and monitor intentional releases. These controls are located in the Offsite Dose Calculation Manual (ODCM), and for plants that have not implemented Generic Letter 89-01, in the Radiological Effluent Technical Specifications (RETS). The occurrence of extended, uncontrolled radioactive releases to the environment is indicative of a degradation in these features and/or controls. Some sites may find it advantageous to address gaseous and liquid releases with separate initiating conditions and EALs.

The RETS multiples are specified in ICs AU1 and AA1 only to distinguish between non-emergency conditions, and from each other. While these multiples obviously correspond to an offsite dose or dose rate, the emphasis in classifying these events is the degradation in the level of safety of the plant, NOT the magnitude of the associated dose or dose rate. Releases should not be prorated or averaged. For example, a release exceeding 4x RETS for 30 minutes does not meet the threshold for this IC.

UNPLANNED, as used in this context, includes any release for which a radioactivity discharge permit was not prepared, or a release that exceeds the conditions (e.g., minimum dilution flow, maximum discharge flow, alarm setpoints, etc.) on the applicable permit. The Emergency Director should not wait until 60 minutes has elapsed, but should declare the event as soon as it is determined that the release duration has or will likely exceed 60 minutes. Also, if an ongoing release is detected and the starting time for that release is unknown, the Emergency Director should, in the absence of data to the contrary, assume that the release has exceeded 60 minutes.

EAL #1 addresses radioactivity releases, that for whatever reason, cause effluent radiation monitor readings to exceed two times the Technical Specification limit and releases are not terminated within 60 minutes. This alarm setpoint may be associated with a planned batch release, or a continuous release path. In either case, the setpoint is established by the ODCM to warn of a release that is not in compliance with the RETS. Indexing the EAL threshold to the ODCM setpoints in this manner insures that the EAL threshold will never be less than the setpoint established by a specific discharge permit.

EAL #2 is intended for licensees that have established effluent monitoring on non-routine release pathways for which a discharge permit would not normally be prepared. The ODCM establishes a methodology for determining effluent radiation monitor setpoints. The ODCM specifies default source terms and, for gaseous releases, prescribes the use of pre-determined annual average meteorology in the most limiting downwind sector for showing compliance with the regulatory commitments. These monitor reading EALs should be determined using this methodology.

EAL #3 addresses uncontrolled releases that are detected by sample analyses, particularly on unmonitored pathways, e.g., spills of radioactive liquids into storm drains, heat exchanger leakage in river water systems, etc.

The 0.10 mR/hr value in EAL #4 is based on a release rate not exceeding 500 mrem per year, as provided in the ODCM / RETS, prorated over 8766 hours, multiplied by two, and rounded. ($500 \div 8766 \times 2 = 0.114$). This is also the basis of the site specific value in EAL #5.

EALs #1 and #2 directly correlate with the IC since annual average meteorology is required to be used in showing compliance with the RETS and is used in calculating the alarm setpoints. EALs #4 and #5 are a function of actual meteorology, which will likely be different from the limiting annual average value. Thus, there will likely be a numerical inconsistency. However, the fundamental basis of this IC is NOT a dose or dose rate, but rather the degradation in the level of safety of the plant implied by the uncontrolled release. Exceeding EAL #4 or EAL #5 is an indication of an uncontrolled release meeting the fundamental basis for this IC.

AU2

Initiating Condition – NOTIFICATION OF UNUSUAL EVENT

Unexpected Increase in Plant Radiation.

Operating Mode Applicability: All

Example Emergency Action Levels: (1 or 2)

1. a. VALID (site-specific) indication of uncontrolled water level decrease in the reactor refueling cavity, spent fuel pool, or fuel transfer canal with all irradiated fuel assemblies remaining covered by water.

   AND

   b. Unplanned VALID (site-specific) Direct Area Radiation Monitor reading increases

2. Unplanned VALID Direct Area Radiation Monitor readings increases by a factor of 1000 over normal* levels.

   *Normal levels can be considered as the highest reading in the past twenty-four hours excluding the current peak value.

Basis:

This IC addresses increased radiation levels as a result of water level decreases above the RPV flange or events that have resulted, or may result, in unexpected increases in radiation dose rates within plant buildings. These radiation increases represent a loss of control over radioactive material and may represent a potential degradation in the level of safety of the plant.

In light of Reactor Cavity Seal failure incidents at two different PWRs and loss of water in the Spent Fuel Pit/Fuel Transfer Canal at a BWR, explicit coverage of these types of events via EAL #1 is appropriate given their potential for increased doses to plant staff. Classification as a NOUE is warranted as a precursor to a more serious event. Site-specific indications may include instrumentation such as water level and local area radiation monitors, and personnel (e.g., refueling crew) reports. If available, security video cameras may allow remote observation. Depending on available level instrumentation, the declaration threshold may need to be based on indications of water makeup rate or decrease in refueling water storage tank level.

While a radiation monitor could detect an increase in dose rate due to a drop in the water level, it might not be a reliable indication of whether or not the fuel is covered. For example, the reading on an area radiation monitor located on the refueling bridge may increase due to planned evolutions such as head lift, or even a fuel assembly being raised in the manipulator mast. Generally, increased radiation monitor indications will need to combined with another indicator (or personnel report) of water loss. For refueling events where the water level drops below the RPV flange classification would be via CU2. This event escalates to an Alert per IC AA2 if irradiated fuel outside the reactor vessel is uncovered. For events involving irradiated fuel in the reactor vessel, escalation would be via the Fission Product Barrier Matrix for events in operating modes 1-4.

EAL #2 addresses UNPLANNED increases in in-plant radiation levels that represent a degradation in the control of radioactive material, and represent a potential degradation in the level of safety of the plant. This event escalates to an Alert per IC AA3 if the increase in dose rates impedes personnel access necessary for safe operation.

ABNORMAL RAD LEVELS/RADIOLOGICAL EFFLUENT

AA1

Initiating Condition – ALERT

Any UNPLANNED Release of Gaseous or Liquid Radioactivity to the Environment that Exceeds 200 Times the Radiological Effluent Technical Specifications for 15 Minutes or Longer.

Operating Mode Applicability: All

Example Emergency Action Levels: (1 or 2 or 3 or 4 or 5)

1. VALID reading on any effluent monitor that exceeds 200 times the alarm setpoint established by a current radioactivity discharge permit for 15 minutes or longer.

2. VALID reading on one or more of the following radiation monitors that exceeds the reading shown for 15 minutes or longer:

   (site-specific list)

3. Confirmed sample analyses for gaseous or liquid releases indicates concentrations or release rates, with a release duration of 15 minutes or longer, in excess of 200 times (site-specific technical specifications).

4. VALID reading on perimeter radiation monitoring system greater than 10.0 mR/hr above normal background sustained for 15 minutes or longer [for sites having telemetered perimeter monitors].

5. VALID indication on automatic real-time dose assessment capability greater than (site-specific value) for 15 minutes or longer [for sites having such capability].

Basis:

Refer to Appendix A for a detailed basis of the radiological effluent IC/EALs.

This IC addresses a potential or actual decrease in the level of safety of the plant as indicated by a radiological release that exceeds regulatory commitments for an extended period of time. Nuclear power plants incorporate features intended to control the release of radioactive effluents to the environment. Further, there are administrative controls established to prevent unintentional releases, or control and monitor intentional releases. These controls are located in the Offsite Dose Calculation Manual (ODCM), and for plants that have not implemented Generic Letter 89-01, in the Radiological Effluent Technical Specifications (RETS). The occurrence of extended, uncontrolled radioactive releases to the environment is indicative of a degradation in these features and/or controls. Some sites may find it advantageous to address gaseous and liquid releases with separate initiating conditions and EALs.

The RETS multiples are specified in ICs AU1 and AA1 only to distinguish between non-emergency conditions, and from each other. While these multiples obviously correspond to an offsite dose or dose rate, the emphasis in classifying these events is the degradation in the level of safety of the plant, NOT the magnitude of the associated dose or dose rate. Releases should not be prorated or averaged.

UNPLANNED, as used in this context, includes any release for which a radioactivity discharge permit was not prepared, or a release that exceeds the conditions (e.g., minimum dilution flow, maximum discharge flow, alarm setpoints, etc.) on the applicable permit. The Emergency Director should not wait until 15 minutes has elapsed, but should declare the event as soon as it is determined that the release duration has or will likely exceed 15 minutes. Also, if an ongoing release is detected and the starting time for that release is unknown, the Emergency Director should, in the absence of data to the contrary, assume that the release has exceeded 15 minutes.

EAL #1 addresses radioactivity releases that for whatever reason cause effluent radiation monitor readings that exceed two hundred times the alarm setpoint established by the radioactivity discharge permit. This alarm setpoint may be associated with a planned batch release, or a continuous release path. In either case, the setpoint is established by the ODCM to warn of a release that is not in compliance with the RETS. Indexing the EAL threshold to the ODCM setpoints in this manner insures that the EAL threshold will never be less than the setpoint established by a specific discharge permit.

EAL #2 is similar to EAL #1, but is intended to address effluent or accident radiation monitors on non-routine release pathways (i.e., for which a discharge permit would not normally be prepared). The ODCM establishes a methodology for determining effluent radiation monitor setpoints. The ODCM specifies default source terms and, for gaseous releases, prescribes the use of pre-determined annual average meteorology in the most limiting downwind sector for showing compliance with the regulatory commitments. These monitor reading EALs should be determined using this methodology.

EAL #3 addresses uncontrolled releases that are detected by sample analyses, particularly on unmonitored pathways, e.g., spills of radioactive liquids into storm drains, heat exchanger leakage in river water systems, etc.

The 10.0 mR/hr value in EAL #4 is based on a release rate not exceeding 500 mrem per year, as provided in the ODCM / RETS, prorated over 8766 hours, multiplied by 200, and rounded. ($500 \div 8766 \times 200 = 11.4$). This is also the basis of the site specific value in EAL #5.

EALs #1 and #2 directly correlate with the IC since annual average meteorology is required to be used in showing compliance with the RETS and is used in calculating the alarm setpoints. EALs #4 and #5 are a function of actual meteorology, which will likely be different from the limiting annual average value. Thus, there will likely be a numerical inconsistency. However, the fundamental basis of this IC is NOT a dose or dose rate, but rather the degradation in the level of safety of the plant implied by the uncontrolled release. Exceeding EAL #4 or EAL #5 is an indication of an uncontrolled release meeting the fundamental basis for this IC.

Due to the uncertainty associated with meteorology, emergency implementing procedures should call for the timely performance of dose assessments using actual (real-time) meteorology in the event of a gaseous radioactivity release of this magnitude. The results of these assessments should be compared to the ICs AS1 and AG1 to determine if the event classification should be escalated. Contrary to the practices specified in revision 2 of this document, classification should not be delayed pending the results of these dose assessments.

AA2

Initiating Condition -- ALERT

Damage to Irradiated Fuel or Loss of Water Level that Has or Will Result in the Uncovering of Irradiated Fuel Outside the Reactor Vessel.

Operating Mode Applicability: All

Example Emergency Action Levels: (1 or 2)

1. A VALID (site-specific) alarm or reading on one or more of the following radiation monitors: (site-specific monitors)

   Refuel Floor Area Radiation Monitor
   Fuel Handling Building Ventilation Monitor
   Refueling Bridge Area Radiation Monitor

2. Water level less than (site-specific) feet for the reactor refueling cavity, spent fuel pool and fuel transfer canal that will result in irradiated fuel uncovering.

Basis:

This IC addresses specific events that have resulted, or may result, in unexpected increases in radiation dose rates within plant buildings, and may be a precursor to a radioactivity release to the environment. These events represent a loss of control over radioactive material and represent a degradation in the level of safety of the plant. These events escalate from IC AU2 in that fuel activity has been released, or is anticipated due to fuel heatup. This IC applies to spent fuel requiring water coverage and is not intended to address spent fuel which is licensed for dry storage, which is discussed in IC E-AU1.

EAL #1 addresses radiation monitor indications of fuel uncovery and/or fuel damage. Increased readings on ventilation monitors may be indication of a radioactivity release from the fuel, confirming that damage has occurred. Increased background at the monitor due to water level decrease may mask increased ventilation exhaust airborne activity and needs to be considered. While a radiation monitor could detect an increase in dose rate due to a drop in the water level, it might not be a reliable indication of whether or not the fuel is covered. For example, the monitor could in fact be properly responding to a known event involving transfer or relocation of a source, stored in or near the fuel pool or responding to a planned evolution such as removal of the reactor head. Application of these Initiating Conditions requires understanding of the actual radiological conditions present in the vicinity of the monitor. Information Notice No. 90-08, *"KR-85 Hazards from Decayed Fuel"* should be considered in establishing radiation monitor EAL thresholds.

In EAL #2, site-specific indications may include instrumentation such as water level and local area radiation monitors, and personnel (e.g., refueling crew) reports. If available, security video cameras may allow remote observation. Depending on available level indication, the declaration threshold may need to be based on indications of water makeup rate or decrease in refueling water storage tank level.

Escalation, if appropriate, would occur via IC AS1 or AG1 or Emergency Director judgment.

AA3

Initiating Condition – ALERT

Release of Radioactive Material or Increases in Radiation Levels Within the Facility That Impedes Operation of Systems Required to Maintain Safe Operations or to Establish or Maintain Cold Shutdown

Operating Mode Applicability: All

Example Emergency Action Levels: (1 or 2)

1. VALID (site-specific) radiation monitor readings GREATER THAN 15 mR/hr in areas requiring continuous occupancy to maintain plant safety functions:

   (Site-specific) list

2. VALID (site-specific) radiation monitor readings GREATER THAN <site specific> values in areas requiring infrequent access to maintain plant safety functions.

   (Site-specific) list

Basis:

This IC addresses increased radiation levels that impede necessary access to operating stations, or other areas containing equipment that must be operated manually or that requires local monitoring, in order to maintain safe operation or perform a safe shutdown. It is this impaired ability to operate the plant that results in the actual or potential substantial degradation of the level of safety of the plant. The cause and/or magnitude of the increase in radiation levels is not a concern of this IC. The Emergency Director must consider the source or cause of the increased radiation levels and determine if any other IC may be involved. For example, a dose rate of 15 mR/hr in the control room may be a problem in itself. However, the increase may also be indicative of high dose rates in the containment due to a LOCA. In this latter case, an SAE or GE may be indicated by the fission product barrier matrix ICs.

At multiple-unit sites, the example EALs could result in declaration of an Alert at one unit due to a radioactivity release or radiation shine resulting from a major accident at the other unit. This is appropriate if the increase impairs operations at the operating unit.

This IC is not meant to apply to increases in the containment dome radiation monitors as these are events which are addressed in the fission product barrier matrix ICs. Nor is it intended to apply to anticipated temporary increases due to planned events (e.g., incore detector movement, radwaste container movement, depleted resin transfers, etc.)

Areas requiring continuous occupancy includes the control room and, as appropriate to the site, any other control stations that are manned continuously, such as a radwaste control room or a central security alarm station. The value of 15mR/hr is derived from the GDC 19 value of 5 rem in 30 days with adjustment for expected occupancy times. Although Section III.D.3 of NUREG-0737, *"Clarification of TMI Action Plan Requirements"*, provides that the 15 mR/hr value can be averaged over the 30 days, the value is used here without averaging, as a 30 day duration implies an event potentially more significant than an Alert.

For areas requiring infrequent access, the site-specific value(s) should be based on radiation levels which result in exposure control measures intended to maintain doses within normal occupational exposure guidelines and limits (i.e., 10 CFR 20), and in doing so, will impede necessary access. As used here, *impede,* includes hindering or interfering provided that the interference or delay is sufficient to significantly threaten the safe operation of the plant.

Emergency planners developing the site-specific lists may refer to the site's abnormal operating procedures, emergency operating procedures, the 10 CFR 50 Appendix R analysis, and/or, the analyses performed in response to Section 2.1.6b of NUREG-0578, *"TMI-2 Lessons Learned Task Force Status Report and Short-term Recommendations"*, when identifying areas containing safe shutdown equipment. Do not use the dose rates postulated in the NUREG-0578 analyses as a basis for the radiation monitor readings for this IC, as the design envelope for the NUREG-0578 analyses correspond to general emergency conditions.

AS1

Initiating Condition -- SITE AREA EMERGENCY

Offsite Dose Resulting from an Actual or Imminent Release of Gaseous Radioactivity Exceeds 100 mR TEDE or 500 mR Thyroid CDE for the Actual or Projected Duration of the Release.

Operating Mode Applicability: All

Example Emergency Action Levels: (1 or 2 or 3 or 4)

Note: *If dose assessment results are available at the time of declaration, the classification should be based on EAL #2 instead of EAL #1.While necessary declarations should not be delayed awaiting results, the dose assessment should be initiated / completed in order to determine if the classification should be subsequently escalated.*

1. VALID reading on one or more of the following radiation monitors that exceeds or is expected to exceed the reading shown for 15 minutes or longer:

   (site-specific list)

2. Dose assessment using actual meteorology indicates doses greater than 100 mR TEDE or 500 mR thyroid CDE at or beyond the site boundary.

3. A VALID reading sustained for 15 minutes or longer on perimeter radiation monitoring system greater than 100 mR/hr. [for sites having telemetered perimeter monitors]

4. Field survey results indicate closed window dose rates exceeding 100 mR/hr expected to continue for more than one hour; or analyses of field survey samples indicate thyroid CDE of 500 mR for one hour of inhalation, at or beyond the site boundary.

Basis:

Refer to Appendix A for a detailed basis of the radiological effluent IC/EALs.

This IC addresses radioactivity releases that result in doses at or beyond the site boundary that exceed a small fraction of the EPA Protective Action Guides (PAGs). Releases of this magnitude are associated with the failure of plant systems needed for the protection of the public. While these failures are addressed by other ICs, this IC provides appropriate diversity and addresses events which may not be able to be classified on the basis of plant status alone, e.g., fuel handling accident in spent fuel building.

The TEDE dose is set at 10% of the EPA PAG, while the 500 mR thyroid CDE was established in consideration of the 1:5 ratio of the EPA PAG for TEDE and thyroid CDE.

The Emergency Director should not wait until 15 minutes has elapsed, but should declare the event as soon as it is determined that the release duration has or will likely exceed 15 minutes.

The (site specific) monitor list in EAL #1 should include monitors on all potential release pathways.

The EPA PAGs are expressed in terms of the sum of the effective *dose equivalent (EDE)* and the *committed effective dose equivalent (CEDE)*, or as the thyroid *committed dose equivalent (CDE)*. For the purpose of these IC/EALs, the dose quantity *total effective dose equivalent (TEDE)*, as defined in 10 CFR 20, is used in lieu of *"...sum of EDE and CEDE...."* The EPA PAG guidance provides for the use adult thyroid dose conversion factors. However, some states have decided to calculate child thyroid CDE. Utility IC/EALs need to be consistent with those of the states involved in the facility's emergency planning zone.

The monitor reading EALs should be determined using a dose assessment method that back calculates from the dose values specified in the IC. The meteorology and source term (noble gases, particulates, and halogens) used should be the same as those used for determining the monitor reading EALs in ICs AU1 and AA1. This protocol will maintain intervals between the EALs for the four classifications. Since doses are generally not monitored in real-time, it is suggested that a release duration of one hour be assumed, and that the EALs be based on a site boundary (or beyond) dose of 100 mR/hour whole body or 500 mR/hour thyroid, whichever is more limiting (as was done for EALs #3 and #4). If individual site analyses indicate a longer or shorter duration for the period in which the substantial portion of the activity is released, the longer duration should be used.

Since dose assessment is based on actual meteorology, whereas the monitor reading EALs are not, the results from these assessments may indicate that the classification is not warranted, or may indicate that a higher classification is warranted. For this reason, emergency implementing procedures should call for the timely performance of dose assessments using actual meteorology and release information. If the results of these dose assessments are available when the classification is made (e.g., initiated at a lower classification level), the dose assessment results override the monitor reading EALs. Contrary to the practices specified in revision 2 of this document, classification should not be delayed pending the results of these dose assessments.

AG1

Initiating Condition – GENERAL EMERGENCY

Offsite Dose Resulting from an Actual or Imminent Release of Gaseous Radioactivity Exceeds 1000 mR TEDE or 5000 mR Thyroid CDE for the Actual or Projected Duration of the Release Using Actual Meteorology.

Operating Mode Applicability: All

Example Emergency Action Levels: (1 or 2 or 3 or 4)

Note: *If dose assessment results are available at the time of declaration, the classification should be based on EAL #2 instead of EAL #1.While necessary declarations should not be delayed awaiting results, the dose assessment should be initiated / completed in order to determine if the classification should be subsequently escalated.*

1. VALID reading on one or more of the following radiation monitors that exceeds or expected to exceed the reading shown for 15 minutes or longer:

   (site-specific list)

2. Dose assessment using actual meteorology indicates doses greater than 1000 mR TEDE or 5000 mR thyroid CDE at or beyond the site boundary.

3. A VALID reading sustained for 15 minutes or longer on perimeter radiation monitoring system greater than 1000 mR/hr. [for sites having telemetered perimeter monitors]

4. Field survey results indicate closed window dose rates exceeding 1000 mR/hr expected to continue for more than one hour; or analyses of field survey samples indicate thyroid CDE of 5000 mR for one hour of inhalation, at or beyond site boundary.

Basis:

Refer to Appendix A for a detailed basis of the radiological effluent IC/EALs.

This IC addresses radioactivity releases that result in doses at or beyond the site boundary that exceed the EPA Protective Action Guides (PAGs). Public protective actions will be necessary. Releases of this magnitude are associated with the failure of plant systems needed for the protection of the public and likely involve fuel damage. While these failures are addressed by other ICs, this IC provides appropriate diversity and addresses events which may not be able to be classified on the basis of plant status alone. It is important to note that, for the more severe accidents, the release may be unmonitored or there may be large uncertainties associated with the source term and/or meteorology.

The Emergency Director should not wait until 15 minutes has elapsed, but should declare the event as soon as it is determined that the release duration has or will likely exceed 15 minutes.

The (site specific) monitor list in EAL #1 should include monitors on all potential release pathways.

The EPA PAGs are expressed in terms of the sum of the effective *dose equivalent (EDE)* and the *committed effective dose equivalent (CEDE)*, or as the thyroid *committed dose equivalent (CDE)*. For the purpose of these IC/EALs, the dose quantity *total effective dose equivalent (TEDE),* as defined in 10 CFR 20, is used in lieu of *"...sum of EDE and CEDE...."* The EPA PAG guidance provides for the use adult thyroid dose conversion factors. However, some states have decided to calculate child thyroid CDE. Utility IC/EALs need to be consistent with those of the states involved in the facilities emergency planning zone.

The monitor reading EALs should be determined using a dose assessment method that backcalculates from the dose values specified in the IC. The meteorology and source term (noble gases, particulates, and halogens) used should be the same as those used for determining the monitor reading EALs in ICs AU1 and AA1. This protocol will maintain intervals between the EALs for the four classifications. Since doses are generally not monitored in real-time, it is suggested that a release duration of one hour be assumed, and that the EALs be based on a site boundary (or beyond) dose of 1000 mR/hour whole body or 5000 mR/hour thyroid, whichever is more limiting (as was done for EALs #3 and #4). If individual site analyses indicate a longer or shorter duration for the period in which the substantial portion of the activity is released, the longer duration should be used.

Since dose assessment is based on actual meteorology, whereas the monitor reading EALs are not, the results from these assessments may indicate that the classification is not warranted, or may indicate that a higher classification is warranted. For this reason, emergency implementing procedures should call for the timely performance of dose assessments using actual meteorology and release information. If the results of these dose assessments are available when the classification is made (e.g., initiated at a lower classification level), the dose assessment results override the monitor reading EALs. Contrary to the practices specified in revision 2 of this document, classification should not be delayed pending the results of these dose assessments.

Recognition Category C
Cold Shutdown/Refueling System Malfunction
INITIATING CONDITION MATRIX

NOUE	ALERT	SITE AREA EMERGENCY	GENERAL EMERGENCY
CU1 RCS Leakage. *Op. Mode: Cold Shutdown*	**CA1** Loss of RCS Inventory. *Op. Modes: Cold Shutdown*	**CS1** Loss of RPV Inventory Affecting Core Decay Heat Removal Capability. *Op. Modes: Cold Shutdown*	**CG1** Loss of RPV Inventory Affecting Fuel Clad Integrity with Containment Challenged with Irradiated Fuel in the RPV. Op. Modes: Cold Shutdown, Refueling
CU2 UNPLANNED Loss of RCS Inventory with Irradiated Fuel in the RPV *Op. Mode: Refueling*	**CA2** Loss of RPV Inventory with Irradiated Fuel in the RPV. *Op. Modes: Refueling*	**CS2** Loss of RPV Inventory Affecting Core Decay Heat Removal Capability with Irradiated Fuel in the RPV. Op. Modes: Refueling	
CU3 Loss of All Offsite Power to Essential Busses for Greater Than 15 Minutes. *Op. Modes: Cold Shutdown, Refueling*	**CA3** Loss of All Offsite Power and Loss of All Onsite AC Power to Essential Busses. *Op. Modes: Cold Shutdown, Refueling, Defueled*		
CU4 UNPLANNED Loss of Decay Heat Removal Capability with Irradiated Fuel in the RPV. *OP. Modes: Cold Shutdown, Refueling*	**CA4** Inability to Maintain Plant in Cold Shutdown with Irradiated Fuel in the RPV. *Op. Modes: Cold Shutdown, Refueling*		
CU5 Fuel Clad Degradation. *Op. Modes: Cold Shutdown, Refueling*			
CU6 UNPLANNED Loss of All Onsite or Offsite Communications Capabilities. *Op. Modes: Cold Shutdown, Refueling*			
CU7 UNPLANNED Loss of Required DC Power for Greater than 15 Minutes. *Op. Modes: Cold Shutdown, Refueling*			
CU8 Inadvertent Criticality. *Op Modes:, Cold Shutdown, Refueling*			

CU1

Initiating Condition – NOTIFICATION OF UNUSUAL EVENT

RCS Leakage.

Operating Mode Applicability: Cold Shutdown

Example Emergency Action Levels: (1 or 2)

1. Unidentified or pressure boundary leakage greater than 10 gpm.

2. Identified leakage greater than 25 gpm.

Basis:

This IC is included as a NOUE because it is considered to be a potential degradation of the level of safety of the plant. The 10 gpm value for the unidentified and pressure boundary leakage was selected as it is sufficiently large to be observable via normally installed instrumentation (e.g., Pressurizer level, RCS loop level instrumentation, etc...) or reduced inventory instrumentation such as level hose indication. Lesser values must generally be determined through time-consuming surveillance tests (e.g., mass balances). The EAL for identified leakage is set at a higher value due to the lesser significance of identified leakage in comparison to unidentified or pressure boundary leakage. Prolonged loss of RCS Inventory may result in escalation to the Alert level via either IC CA1 (Loss of RCS Inventory with Irradiated Fuel in the RPV) or CA4 (Inability to Maintain Plant in Cold Shutdown with Irradiated Fuel in the RPV).

The difference between CU1 and CU2 deals with the RCS conditions that exist between cold shutdown and refueling mode applicability. In cold shutdown the RCS will normally be intact and RCS inventory and level monitoring means such as Pressurizer level indication and makeup volume control tank levels are normally available. In the refueling mode the RCS is not intact and RPV level and inventory are monitored by different means.

Expanded basis for these assumptions is provided in Appendix C.

Initiating Condition -- NOTIFICATION OF UNUSUAL EVENT

UNPLANNED Loss of RCS Inventory with Irradiated Fuel in the RPV.

Operating Mode Applicability: Refueling

Example Emergency Action Levels: (1 or 2)

1. UNPLANNED RCS level decrease below the RPV flange for ≥15 minutes

2. a. Loss of RPV inventory as indicated by unexplained {site-specific} sump and tank level increase

AND

b. RPV level cannot be monitored

Basis:

This IC is included as a NOUE because it may be a precursor of more serious conditions and, as result, is considered to be a potential degradation of the level of safety of the plant. Refueling evolutions that decrease RCS water level below the RPV flange are carefully planned and procedurally controlled. An UNPLANNED event that results in water level decreasing below the RPV flange warrants declaration of a NOUE due to the reduced RCS inventory that is available to keep the core covered. The allowance of 15 minutes was chosen because it is reasonable to assume that level can be restored within this time frame using one or more of the redundant means of refill that should be available. If level cannot be restored in this time frame then it may indicate a more serious condition exists. Continued loss of RCS Inventory will result in escalation to the Alert level via either IC CA2 (Loss of RPV Inventory with Irradiated Fuel in the RPV) or CA4 (Inability to Maintain Plant in Cold Shutdown with Irradiated Fuel in the RPV).

The difference between CU1 and CU2 deals with the RCS conditions that exist between cold shutdown and refueling modes. In cold shutdown the RCS will normally be intact and standard RCS inventory and level monitoring means are available. In the refueling mode the RCS is not intact and RPV level and inventory are monitored by different means.

In the refueling mode, normal means of core temperature indication and RCS level indication may not be available. Redundant means of RPV level indication will normally be installed (including the ability to monitor level visually) to assure that the ability to monitor level will not be interrupted. However, if all level indication were to be lost during a loss of RCS inventory event, the operators would need to determine that RPV inventory loss was occurring by observing sump and tank level changes. Sump and tank level increases must be evaluated against other potential sources of leakage such as cooling water sources inside the containment to ensure they are indicative of RCS leakage. Escalation to Alert would be via either CA2 or RCS heatup via CA4.

EAL 1 involves a decrease in RCS level below the top of the RPV flange that continues for 15 minutes due to an UNPLANNED event. This EAL is not applicable to decreases in flooded reactor cavity level (covered by AU2 EAL1) until such time as the level decreases to the level of the vessel flange. For BWRs, if RPV level continues to decrease and reaches the Low-Low ECCS Actuation Setpoint then escalation to CA2 would be appropriate. For PWRs, if RPV level continues to decrease and reaches the Bottom ID of the RCS Loop then escalation to CA2 would be appropriate. Note that the Bottom ID of the RCS Loop Setpoint should be the level equal to the bottom of the RPV loop penetration (not the low point of the loop).

Expanded basis for these assumptions is provided in Appendix C.

CU3

Initiating Condition – NOTIFICATION OF UNUSUAL EVENT

Loss of All Offsite Power to Essential Busses for Greater Than 15 Minutes.

Operating Mode Applicability: Cold Shutdown
Refueling

Example Emergency Action Level:

1. a. Loss of power to (site-specific) transformers for greater than 15 minutes.

AND

b. At least (site-specific) emergency generators are supplying power to emergency busses.

Basis:

Prolonged loss of AC power reduces required redundancy and potentially degrades the level of safety of the plant by rendering the plant more vulnerable to a complete Loss of AC Power (e.g., Station Blackout). Fifteen minutes was selected as a threshold to exclude transient or momentary power losses.

Plants that have the capability to cross-tie AC power from a companion unit may take credit for the redundant power source in the associated EAL for this IC. Inability to effect the cross-tie within 15 minutes warrants declaring a NOUE.

SYSTEM MALFUNCTION

CU4

Initiating Condition -- NOTIFICATION OF UNUSUAL EVENT

UNPLANNED Loss of Decay Heat Removal Capability with Irradiated Fuel in the RPV.

Operating Mode Applicability: Cold Shutdown
Refueling

Example Emergency Action Levels: (1 or 2)

1. An UNPLANNED event results in RCS temperature exceeding the Technical Specification cold shutdown temperature limit

2. Loss of all RCS temperature and RPV level indication for > 15 minutes.

Basis:

This IC is included as a NOUE because it may be a precursor of more serious conditions and, as a result, is considered to be a potential degradation of the level of safety of the plant. In cold shutdown the ability to remove decay heat relies primarily on forced cooling flow. Operation of the systems that provide this forced cooling may be jeopardized due to the unlikely loss of electrical power or RCS inventory. Since the RCS usually remains intact in the cold shutdown mode a large inventory of water is available to keep the core covered. In cold shutdown the decay heat available to raise RCS temperature during a loss of inventory or heat removal event may be significantly greater than in the refueling mode. Entry into cold shutdown conditions may be attained within hours of operating at power. Entry into the refueling mode procedurally may not occur for typically 100 hours {site-specific} or longer after the reactor has been shutdown. Thus the heatup threat and therefore the threat to damaging the fuel clad may be lower for events that occur in the refueling mode with irradiated fuel in the RPV (note that the heatup threat could be lower for cold shutdown conditions if the entry into cold shutdown was following a refueling). In addition, the operators should be able to monitor RCS temperature and RPV level so that escalation to the alert level via CA4 or CA1 will occur if required.

During refueling the level in the RPV will normally be maintained above the RPV flange. Refueling evolutions that decrease water level below the RPV flange are carefully planned and procedurally controlled. Loss of forced decay heat removal at reduced inventory may result in more rapid increases in RCS/RPV temperatures depending on the time since shutdown. Escalation to the Alert level via CA4 is provided should an UNPLANNED event result in RCS temperature exceeding the Technical Specification cold shutdown temperature limit for greater than 30 minutes with CONTAINMENT CLOSURE not established.

Unlike the cold shutdown mode, normal means of core temperature indication and RCS level indication may not be available in the refueling mode. Redundant means of RPV level indication are therefore procedurally installed to assure that the ability to monitor level will not be interrupted. However, if all level and temperature indication were to be lost in either the cold shutdown of refueling modes, EAL 2 would result in declaration of a NOUE if either temperature or level indication cannot be restored within 15 minutes from the loss of both means of indication.

Escalation to Alert would be via CA2 based on an inventory loss or CA4 based on exceeding its temperature criteria.

The Emergency Director must remain attentive to events or conditions that lead to the conclusion that exceeding the EAL threshold is imminent. If, in the judgment of the Emergency Director, an imminent situation is at hand, the classification should be made as if the threshold has been exceeded.

Expanded basis for these assumptions is provided in Appendix C.

CU5

Initiating Condition -- NOTIFICATION OF UNUSUAL EVENT

Fuel Clad Degradation.

Operating Mode Applicability: Cold Shutdown
Refueling

Example Emergency Action Levels: (1 or 2)

1. (Site-specific) radiation monitor readings indicating fuel clad degradation greater than Technical Specification allowable limits.

2. (Site-specific) coolant sample activity value indicating fuel clad degradation greater than Technical Specification allowable limits.

Basis:

This IC is included as a NOUE because it is considered to be a potential degradation in the level of safety of the plant and a potential precursor of more serious problems. EAL #1 addresses site-specific radiation monitor readings that provide indication of fuel clad integrity. EAL #2 addresses coolant samples exceeding coolant technical specifications for iodine spike.

CU6

Initiating Condition -- NOTIFICATION OF UNUSUAL EVENT

UNPLANNED Loss of All Onsite or Offsite Communications Capabilities.

Operating Mode Applicability: Cold Shutdown
Refueling

Example Emergency Action Levels: (1 or 2)

1. Loss of all (site-specific list) onsite communications capability affecting the ability to perform routine operations.

2. Loss of all (site-specific list) offsite communications capability.

Basis:

The purpose of this IC and its associated EALs is to recognize a loss of communications capability that either defeats the plant operations staff ability to perform routine tasks necessary for plant operations or the ability to communicate problems with offsite authorities. The loss of offsite communications ability is expected to be significantly more comprehensive than the condition addressed by 10 CFR 50.72.

The availability of one method of ordinary offsite communications is sufficient to inform state and local authorities of plant problems. This EAL is intended to be used only when extraordinary means (e.g., relaying of information from radio transmissions, individuals being sent to offsite locations, etc.) are being utilized to make communications possible.

Site-specific list for onsite communications loss must encompass the loss of all means of routine communications (e.g., commercial telephones, sound powered phone systems, page party system and radios / walkie talkies).

Site-specific list for offsite communications loss must encompass the loss of all means of communications with offsite authorities. This should include the ENS, commercial telephone lines, telecopy transmissions, and dedicated phone systems.

CU7

Initiating Condition – NOTIFICATION OF UNUSUAL EVENT

UNPLANNED Loss of Required DC Power for Greater than 15 Minutes.

Operating Mode Applicability: Cold Shutdown
Refueling

Example Emergency Action Level:

1. a. UNPLANNED Loss of Vital DC power to required DC busses based on (site-specific) bus voltage indications.

AND

b. Failure to restore power to at least one required DC bus within 15 minutes from the time of loss.

Basis:

The purpose of this IC and its associated EALs is to recognize a loss of DC power compromising the ability to monitor and control the removal of decay heat during Cold Shutdown or Refueling operations. This EAL is intended to be anticipatory in as much as the operating crew may not have necessary indication and control of equipment needed to respond to the loss.

UNPLANNED is included in this IC and EAL to preclude the declaration of an emergency as a result of planned maintenance activities. Routinely plants will perform maintenance on a Train related basis during shutdown periods. It is intended that the loss of the operating (operable) train is to be considered. If this loss results in the inability to maintain cold shutdown, the escalation to an Alert will be per CA4 "Inability to Maintain Plant in Cold Shutdown with Irradiated Fuel in the RPV."

(Site-specific) bus voltage should be based on the minimum bus voltage necessary for the operation of safety related equipment. This voltage value should incorporate a margin of at least 15 minutes of operation before the onset of inability to operate those loads. This voltage is usually near the minimum voltage selected when battery sizing is performed. Typically the value for the entire battery set is approximately 105 VDC. For a 60 cell string of batteries the cell voltage 1.75 Volts per cell. For a 58 string battery set the minimum voltage is typically 1.81 Volts per cell.

CU8

Initiating Condition -- NOTIFICATION OF UNUSUAL EVENT

Inadvertent Criticality.

Operating Mode Applicability: Cold Shutdown
Refueling

Example Emergency Action Levels: (1 or 2)

1. An UNPLANNED extended positive period observed on nuclear instrumentation.
2. An UNPLANNED sustained positive startup rate observed on nuclear instrumentation.

Basis:

This IC addresses criticality events that occur in Cold Shutdown or Refueling modes (NUREG 1449, Shutdown and Low-Power Operation at Commercial Nuclear Power Plants in the United States) such as fuel mis-loading events and inadvertent dilution events. This IC indicates a potential degradation of the level of safety of the plant, warranting a NOUE classification. This IC excludes inadvertent criticalities that occur during planned reactivity changes associated with reactor startups (e.g., criticality earlier than estimated) which are addressed in the companion IC SU8.

This condition can be identified using period monitors/startup rate monitor. The terms "extended" and "sustained" are used in order to allow exclusion of expected short term positive periods/startup rates from planned fuel bundle or control rod movements during core alteration for PWRs and BWRs. These short term positive periods/startup rates are the result of the increase in neutron population due to subcritical multiplication.

Escalation would be by Emergency Director Judgment.

SYSTEM MALFUNCTION

CA1

Initiating Condition -- ALERT

Loss of RCS Inventory.

Operating Mode Applicability: Cold Shutdown

Example Emergency Action Levels: (1 or 2)

1. Loss of RCS inventory as indicated by RPV level less than {site-specific level}.
   (low-low ECCS actuation setpoint) (BWR)
   (bottom ID of the RCS loop) (PWR)

2. a. Loss of RCS inventory as indicated by unexplained {site-specific} sump and tank level increase

   AND

   b. RCS level cannot be monitored for > 15 minutes

Basis:

These example EALs serve as precursors to a loss of ability to adequately cool the fuel. The magnitude of this loss of water indicates that makeup systems have not been effective and may not be capable of preventing further RPV level decrease and potential core uncovery. This condition will result in a minimum classification of Alert. The BWR Low-Low ECCS Actuation Setpoint was chosen because it is a standard setpoint at which all available injection systems automatically start. The PWR Bottom ID of the RCS Loop Setpoint was chosen because at this level remote RCS level indication may be lost and loss of suction to decay heat removal systems has occured. The Bottom ID of the RCS Loop Setpoint should be the level equal to the bottom of the RPV loop penetration (not the low point of the loop). The inability to restore and maintain level after reaching this setpoint would therefore be indicative of a failure of the RCS barrier.

In cold shutdown the decay heat available to raise RCS temperature during a loss of inventory or heat removal event may be significantly greater than in the refueling mode. Entry into cold shutdown conditions may be attained within hours of operating at power or hours after refueling is completed. Entry into the refueling mode procedurally may not occur for typically 100 hours {site-specific} or longer after the reactor has been shutdown. Thus the heatup threat and therefore the threat to damaging the fuel clad may be lower for events that occur in the refueling mode with irradiated fuel in the RPV (note that the heatup threat could be lower for cold shutdown conditions if the entry into cold shutdown was following a refueling). The above forms the basis for needing both a cold shutdown specific IC (CA1) and a refueling specific IC (CA2).

In the cold shutdown mode, normal RCS level and RPV level instrumentation systems will normally be available. However, if all level indication were to be lost during a loss of RCS inventory event, the operators would need to determine that RPV inventory loss was occurring by observing sump and tank level changes. Sump and tank level increases must be evaluated against other potential sources of leakage such as cooling water sources inside the containment to ensure they are indicative of RCS leakage. The 15-minute duration for the loss of level indication was chosen because it is half of the CS1 Site Area Emergency EAL duration. The 15-minute duration allows CA1 to be an effective precursor to CS1. Significant fuel damage is not expected to occur until the core has been uncovered for greater than 1 hour per the analysis referenced in the CS1 basis. Therefore this EAL meets the definition for an Alert emergency.

The difference between CA1 and CA2 deals with the RCS conditions that exist between cold shutdown and refueling mode applicability. In cold shutdown the RCS will normally be intact and standard RCS inventory and level monitoring means are available. In the refueling mode the RCS is not intact and RPV level and inventory are monitored by different means.

If RPV level continues to decrease then escalation to Site Area will be via CS1 (Loss of Inventory Affecting Core Decay Heat Removal Capability with Irradiated Fuel in the RPV).

Expanded basis for these assumptions is provided in Appendix C.

SYSTEM MALFUNCTION

CA2

Initiating Condition -- ALERT

Loss of RPV Inventory with Irradiated Fuel in the RPV.

Operating Mode Applicability: Refueling

Example Emergency Action Levels: (1 or 2)

1. Loss of RPV inventory as indicated by RPV level less than {site-specific level}.
   (low-low ECCS actuation setpoint) (BWR)
   (bottom ID of the RCS loop) (PWR)

2. a. Loss of RPV inventory as indicated by unexplained {site-specific} sump and tank level increase

   AND

   b. RPV level cannot be monitored for > 15 minutes

Basis:

These example EALs serve as precursors to a loss of heat removal. The magnitude of this loss of water indicates that makeup systems have not been effective and may not be capable of preventing further RPV level decrease and potential core uncovery. This condition will result in a minimum classification of Alert. The BWR Low-Low ECCS Actuation Setpoint was chosen because it is a standard setpoint at which all available injection systems automatically start. The Bottom ID of the RCS Loop Setpoint was chosen because at this level remote RCS level indication may be lost and loss of suction to decay heat removal systems may occur. . The Bottom ID of the RCS Loop Setpoint should be the level equal to the bottom of the RPV loop penetration (not the low point of the loop). The inability to restore and maintain level after reaching this setpoint would therefore be indicative of a failure of the RCS barrier.

In cold shutdown the decay heat available to raise RCS temperature during a loss of inventory or heat removal event may be significantly greater than in the refueling mode. Entry into cold shutdown conditions may be attained within hours of operating at power or hours after refueling is completed. Entry into the refueling mode procedurally may not occur for typically 100 hours {site-specific} or longer after the reactor has been shutdown. Thus the heatup threat and therefore the threat to damaging the fuel clad may be lower for events that occur in the refueling mode with irradiated fuel in the RPV (note that the heatup threat could be lower for cold shutdown conditions if the entry into cold shutdown was following a refueling). The above forms the basis for needing both a cold shutdown specific IC (CA1) and a refueling specific IC (CA2).

In the refueling mode, normal means of RPV level indication may not be available. Redundant means of RPV level indication will be normally installed (including the ability to monitor level visually) to assure that the ability to monitor level will not be interrupted. However, if all level indication were to be lost during a loss of RCS inventory event, the operators would need to determine that RPV inventory loss was occurring by observing sump and tank level changes. Sump and tank level increases must be evaluated against other potential sources of leakage such as cooling water sources inside the containment to ensure they are indicative of RCS leakage. The 15-minute duration for the loss of level indication was chosen because it is half of the CS2 Site Area Emergency EAL duration. The 15-minute duration allows CA2 to be an effective precursor to CS2. Significant fuel damage is not expected to occur until the core has been uncovered for greater than 1 hour per the analysis referenced in the CS2 basis. Therefore this EAL meets the definition for an Alert.

The difference between CA1 and CA2 deals with the RCS conditions that exist between cold shutdown and refueling mode applicability. In cold shutdown the RCS will normally be intact and standard RCS inventory and level monitoring means are available. In the refueling mode the RCS is not intact and RPV level and inventory are monitored by different means.

If RPV level continues to decrease then escalation to Site Area will be via CS1 (Loss of Inventory Affecting Core Decay Heat Removal Capability with Irradiated Fuel in the RPV).

Expanded basis for these assumptions is provided in Appendix C.

CA3

Initiating Condition -- ALERT

Loss of All Offsite Power and Loss of All Onsite AC Power to Essential Busses.

Operating Mode Applicability: Cold Shutdown
Refueling
Defueled

Example Emergency Action Level:

1. a. Loss of power to (site-specific) transformers.

AND

b. Failure of (site-specific) emergency generators to supply power to emergency busses.

AND

c. Failure to restore power to at least one emergency bus within 15 minutes from the time of loss of both offsite and onsite AC power.

Basis:

Loss of all AC power compromises all plant safety systems requiring electric power including RHR, ECCS, Containment Heat Removal, Spent Fuel Heat Removal and the Ultimate Heat Sink. When in cold shutdown, refueling, or defueled mode the event can be classified as an Alert, because of the significantly reduced decay heat, lower temperature and pressure, increasing the time to restore one of the emergency busses, relative to that specified for the Site Area Emergency EAL. Escalating to Site Area Emergency, if appropriate, is by Abnormal Rad Levels / Radiological Effluent, or Emergency Director Judgment ICs. Fifteen minutes was selected as a threshold to exclude transient or momentary power losses.

Consideration should be given to operable loads necessary to remove decay heat or provide Reactor Vessel makeup capability when evaluating loss of AC power to essential busses. Even though an essential bus may be energized, if necessary loads (i.e., loads that if lost would inhibit decay heat removal capability or Reactor Vessel makeup capability) are not operable on the energized bus then the bus should not be considered operable.

CA4

Initiating Condition -- ALERT

Inability to Maintain Plant in Cold Shutdown with Irradiated Fuel in the RPV.

Operating Mode Applicability: Cold Shutdown
Refueling

Example Emergency Action Levels: (EAL 1 or 2 or 3)

1. With CONTAINMENT CLOSURE and RCS integrity not established an UNPLANNED event results in RCS temperature exceeding the Technical Specification cold shutdown temperature limit.

2. With CONTAINMENT CLOSURE established and RCS integrity not established or RCS inventory reduced an UNPLANNED event results in RCS temperature exceeding the Technical Specification cold shutdown temperature limit for greater than 20 minutes[1].

3. An UNPLANNED event results in RCS temperature exceeding the Technical Specification cold shutdown temperature limit for greater than 60 minutes[1] or results in an RCS pressure increase of greater than {site specific} psig.

Basis:

EAL 1 addresses complete loss of functions required for core cooling during refueling and cold shutdown modes when neither CONTAINMENT CLOSURE nor RCS integrity are established. RCS integrity is in place when the RCS pressure boundary is in its normal condition for the cold shutdown mode of operation (e.g., no freeze seals or nozzle dams). No delay time is allowed for EAL1 because the evaporated reactor coolant that may be released into the Containment during this heatup condition could also be directly released to the environment.

EAL 2 addresses the complete loss of functions required for core cooling for > 20 minutes during refueling and cold shutdown modes when CONTAINMENT CLOSURE is established but RCS integrity is not established or RCS inventory is reduced (e.g., mid loop operation in PWRs). As in EAL 1, RCS integrity should be assumed to be in place when the RCS pressure boundary is in its normal condition for the cold shutdown mode of operation (e.g., no freeze seals or nozzle dams). The allowed 20 minute time frame was included to allow operator action to restore the heat removal function, if possible. The allowed time frame is consistent with the guidance provided by Generic Letter 88-17, "Loss of Decay Heat Removal" (discussed later in this basis) and is believed to be conservative given that a low pressure Containment barrier to fission product release is established. Note 1 indicates that EAL 2 is not applicable if actions are successful in restoring an RCS heat removal system to operation and RCS temperature is being reduced within the 20 minute time frame.

EAL 3 addresses complete loss of functions required for core cooling for > 60 minutes during refueling and cold shutdown modes when RCS integrity is established. As in EAL 1 and 2, RCS integrity should be considered to be in place when the RCS pressure boundary is in its normal

[1]Note: if an RCS heat removal system is in operation within this time frame and RCS temperature is being reduced then this EAL is not applicable.

condition for the cold shutdown mode of operation (e.g., no freeze seals or nozzle dams). The status of CONTAINMENT CLOSURE in this EAL is immaterial given that the RCS is providing a high pressure barrier to fission product release to the environment. The 60 minute time frame should allow sufficient time to restore cooling without there being a substantial degradation in plant safety. The {site specific} pressure increase covers situations where, due to high decay heat loads, the time provided to restore temperature control, should be less than 60 minutes. The RCS pressure setpoint chosen should be 10 psig or the lowest pressure that the site can read on installed Control Board instrumentation that is equal to or greater than 10 psig. Note 1 indicates that EAL 3 is not applicable if actions are successful in restoring an RCS heat removal system to operation and RCS temperature is being reduced within the 60 minute time frame assuming that the RCS pressure increase has remained less than the site specific pressure value.

Escalation to Site Area would be via CS1 or CS2 should boiling result in significant RPV level loss leading to core uncovery.

For PWRs, this IC and its associated EALs are based on concerns raised by Generic Letter 88-17, "Loss of Decay Heat Removal." A number of phenomena such as pressurization, vortexing, steam generator U-tube draining, RCS level differences when operating at a mid-loop condition, decay heat removal system design, and level instrumentation problems can lead to conditions where decay heat removal is lost and core uncovery can occur. NRC analyses show that sequences that can cause core uncovery in 15 to 20 minutes and severe core damage within an hour after decay heat removal is lost.

A loss of Technical Specification components alone is not intended to constitute an Alert. The same is true of a momentary UNPLANNED excursion above 200_F when the heat removal function is available.

The Emergency Director must remain alert to events or conditions that lead to the conclusion that exceeding the EAL threshold is imminent. If, in the judgment of the Emergency Director, an imminent situation is at hand, the classification should be made as if the threshold has been exceeded.

Expanded basis for these assumptions is provided in Appendix C.

Initiating Condition – SITE AREA EMERGENCY

Loss of RPV Inventory Affecting Core Decay Heat Removal Capability.

Operating Mode Applicability: Cold Shutdown

Example Emergency Action Levels: (1 or 2)

1. With CONTAINMENT CLOSURE not established:

   a. RPV inventory as indicated by RPV level less than {site-specific level}
      (6" below the low-low ECCS actuation setpoint) (BWR)
      (6" below the bottom ID of the RCS loop) (PWR)

   OR

   b. RPV level cannot be monitored for > 30 minutes with a loss of RPV inventory as indicated by unexplained {site-specific} sump and tank level increase

2. With CONTAINMENT CLOSURE established

   a. RPV inventory as indicated by RPV level less than TOAF

   OR

   b. RPV level cannot be monitored for > 30 minutes with a loss of RPV inventory as indicated by either:
      - Unexplained {site-specific} sump and tank level increase
      - Erratic Source Range Monitor Indication

Basis:

Under the conditions specified by this IC, continued decrease in RPV level is indicative of a loss of inventory control. Inventory loss may be due to an RPV breach, pressure boundary leakage, or continued boiling in the RPV.

In cold shutdown the decay heat available to raise RCS temperature during a loss of inventory or heat removal event may be significantly greater than in the refueling mode. Entry into cold shutdown conditions may be attained within hours of operating at power or hours after refueling is completed. Entry into the refueling mode procedurally may not occur for typically 100 hours {site-specific} or longer after the reactor has been shutdown. Thus the heatup threat and therefore the threat to damaging the fuel clad may be lower for events that occur in the refueling mode with irradiated fuel in the RPV (note that the heatup threat could be lower for cold shutdown conditions if the entry into cold shutdown was following a refueling). The above forms the basis for needing both a cold shutdown specific IC (CS1) and a refueling specific IC (CS2).

In the cold shutdown mode, normal RCS level and reactor vessel level indication systems (RVLIS) will normally be available. However, if all level indication were to be lost during a loss of RCS inventory event, the operators would need to determine that RPV inventory loss was occurring by observing sump and tank level changes. Sump and tank level increases must be evaluated against other potential sources of leakage such as cooling water sources inside the containment to ensure they are indicative of RCS leakage.

These example EALs are based on concerns raised by Generic Letter 88-17, *Loss of Decay Heat Removal,* SECY 91-283, *Evaluation of Shutdown and Low Power Risk Issues,* NUREG-1449, *Shutdown and Low-Power Operation at Commercial Nuclear Power Plants in the United States,* and, NUMARC 91-06, *Guidelines for Industry Actions to Assess Shutdown Management.* A number of variables, (BWRs - e.g., such as initial vessel level, or shutdown heat removal system design) (PWRs - e.g., mid-loop, reduced level/flange level, head in place, or cavity flooded, RCS venting strategy, decay heat removal system design, vortexing pre-disposition, steam generator U-tube draining) can have a significant impact on heat removal capability challenging the fuel clad barrier. Analysis in the above references indicates that core damage may occur within an hour following continued core uncovery therefore, conservatively, 30-minutes was chosen.

If a PWRs RVLIS is unable to distinguish 6" below the bottom ID of the RCS loop penetration, then the first observable point below the bottom ID of the loop should be chosen as the setpoint. If a RVLIS is not available such that the PWR EAL setpoint cannot be determined, then EAL 1.b should be used to determine if the IC has been met.

The 30-minute duration allowed when CONTAINMENT CLOSURE is established allows sufficient time for actions to be performed to recover needed cooling equipment and is considered to be conservative given that level is being monitored via CS1 and CS2. For PWRs the effluent release is not expected with closure established. For BWRs releases would be monitored and escalation would be via Category A ICs if required.

Thus, for both PWR and BWR declaration of a Site Area Emergency is warranted under the conditions specified by the IC. Escalation to a General Emergency is via CG1 (Loss of RPV Inventory Affecting Fuel Clad Integrity with Containment Challenged with Irradiated Fuel in the RPV) or radiological effluent IC AG1 (Offsite Dose Resulting from an Actual or Imminent Release of Gaseous Radioactivity Exceeds 1000 mR TEDE or 5000 mR Thyroid CDE for the Actual or Projected Duration of the Release Using Actual Meteorology).

Expanded basis for these assumptions is provided in Appendix C.

SYSTEM MALFUNCTION

CS2

Initiating Condition – SITE AREA EMERGENCY

Loss of RPV Inventory Affecting Core Decay Heat Removal Capability with Irradiated Fuel in the RPV.

Operating Mode Applicability: Refueling

Example Emergency Action Levels: (1 or 2)

1. With CONTAINMENT CLOSURE not established:

   a. RPV inventory as indicated by RPV level less than {site-specific level}
      (6" below the low-low ECCS actuation setpoint) (BWR)
      (6" below the bottom ID of the RCS loop) (PWR)

   OR

   b. RPV level cannot be monitored with Indication of core uncovery as evidenced by one or more of the following:
      - Containment High Range Radiation Monitor reading > {site-specific} setpoint
      - Erratic Source Range Monitor Indication
      - Other {site-specific} indications

2. With CONTAINMENT CLOSURE established

   a. RPV inventory as indicated by RPV level less than TOAF

   OR

   b. RPV level cannot be monitored with Indication of core uncovery as evidenced by one or more of the following:
      - Containment High Range Radiation Monitor reading > {site-specific} setpoint
      - Erratic Source Range Monitor Indication
      - Other {site-specific} indications

Basis:

Under the conditions specified by this IC, continued decrease in RPV level is indicative of a loss of inventory control. Inventory loss may be due to an RPV breach or continued boiling in the RPV. Since BWRs have RCS penetrations below the setpoint, continued level decrease may be indicative of pressure boundary leakage.

In cold shutdown the decay heat available to raise RCS temperature during a loss of inventory or heat removal event may be significantly greater than in the refueling mode Entry into cold shutdown conditions may be attained within hours of operating at power or hours after refueling is completed. Entry into the refueling mode procedurally may not occur for typically 100 hours {site-specific} or longer after the reactor has been shutdown. Thus the heatup threat and therefore the threat to damaging the fuel clad may be lower for events that occur in the refueling mode with irradiated fuel in the RPV (note that the heatup threat could be lower for cold shutdown conditions if the entry into cold shutdown was following a refueling). The above forms the basis for needing both a cold shutdown specific IC (CS1) and a refueling specific IC (CS2).

These example EALs are based on concerns raised by Generic Letter 88-17, *Loss of Decay Heat Removal*, SECY 91-283, *Evaluation of Shutdown and Low Power Risk Issues*, NUREG-1449, *Shutdown and Low-Power Operation at Commercial Nuclear Power Plants in the United States*, and, NUMARC 91-06, *Guidelines for Industry Actions to Assess Shutdown Management.* A number of variables, (BWRs - e.g., such as initial vessel level, or shutdown heat removal system design) (PWRs - e.g., mid-loop, reduced level/flange level, head in place, or cavity flooded, RCS venting strategy, decay heat removal system design, vortexing pre-disposition, steam generator U-tube draining) can have a significant impact on heat removal capability challenging the fuel clad barrier. Analysis in the above references indicates that core damage may occur within an hour following continued core uncovery therefore, conservatively, 30 minutes was chosen.

If a PWRs RVLIS is unable to distinguish 6" below the bottom ID of the RCS loop penetration, then the first observable point below the bottom ID of the loop should be chosen as the setpoint. If a RVLIS is not available such that the PWR EAL setpoint cannot be determined, then EAL 1.b should be used to determine if the IC has been met.

As water level in the RPV lowers, the dose rate above the core will increase. The dose rate due to this core shine should result in up-scaled Containment High Range Monitor indication and possible alarm. EAL 1.b and EAL 2.b calculations should be performed to conservatively estimate a site-specific dose rate setpoint indicative of core uncovery (ie., level at TOAF). Additionally, post-TMI studies indicated that the installed nuclear instrumentation will operate erratically when the core is uncovered and that this should be used as a tool for making such determinations.

For EAL 2 in the refueling mode, normal means of RPV level indication may not be available. Redundant means of RPV level indication will be normally installed (including the ability to monitor level visually) to assure that the ability to monitor level will not be interrupted.

For PWRs the effluent release is not expected with closure established. For BWRs releases would be monitored and escalation would be via Category A ICs if required.

Thus, for both PWR and BWR declaration of a Site Area Emergency is warranted under the conditions specified by the IC. Escalation to a General Emergency is via CG1 (Loss of RPV Inventory Affecting Fuel Clad Integrity with Containment Challenged with Irradiated Fuel in the RPV) or radiological effluent IC AG1 (Offsite Dose Resulting from an Actual or Imminent Release of Gaseous Radioactivity Exceeds 1000 mR TEDE or 5000 mR Thyroid CDE for the Actual or Projected Duration of the Release Using Actual Meteorology).

Expanded basis for these assumptions is provided in Appendix C.

Initiating Condition – GENERAL EMERGENCY

Loss of RPV Inventory Affecting Fuel Clad Integrity with Containment Challenged with Irradiated Fuel in the RPV.

Operating Mode Applicability: Cold Shutdown
Refueling

Example Emergency Action Level: (1 and 2 and 3)

1. Loss of RPV inventory as indicated by unexplained {site-specific} sump and tank level increase

2. RPV Level:
   a. less than TOAF for > 30 minutes

   OR

   b. cannot be monitored with Indication of core uncovery for > 30 minutes as evidenced by one or more of the following:
      - Containment High Range Radiation Monitor reading > {site-specific} setpoint
      - Erratic Source Range Monitor Indication
      - Other {site-specific} indications

3. {Site specific} indication of CONTAINMENT challenged as indicated by one or more of the following:
   - Explosive mixture inside containment
   - Pressure above {site specific} value
   - CONTAINMENT CLOSURE not established
   - Secondary Containment radiation monitors above {site specific} value (BWR only)

Basis:

For EAL 1 in the cold shutdown mode, normal RCS level and RPV level instrumentation systems will normally be available. However, if all level indication were to be lost during a loss of RCS inventory event, the operators would need to determine that RPV inventory loss was occurring by observing sump and tank level changes. Sump and tank level increases must be evaluated against other potential sources of leakage such as cooling water sources inside the containment to ensure they are indicative of RCS leakage.

For EAL 1 in the refueling mode, normal means of RPV level indication may not be available. Redundant means of RPV level indication will be normally installed (including the ability to monitor level visually) to assure that the ability to monitor level will not be interrupted. However, if all level indication were to be lost during a loss of RCS inventory event, the operators would need to determine that RPV inventory loss was occurring by observing sump and tank level changes.

For both cold shutdown and refueling modes sump and tank level increases must be evaluated against other potential sources of leakage such as cooling water sources inside the containment to ensure they are indicative of RCS leakage.

EAL 2 represents the inability to restore and maintain RPV level to above the top of active fuel. Fuel damage is probable if RPV level cannot be restored, as available decay heat will cause boiling, further reducing the RPV level.

These example EALs are based on concerns raised by Generic Letter 88-17, *Loss of Decay Heat Removal*, SECY 91-283, *Evaluation of Shutdown and Low Power Risk Issues*, NUREG-1449, *Shutdown and Low-Power Operation at Commercial Nuclear Power Plants in the United States*, and, NUMARC 91-06, *Guidelines for Industry Actions to Assess Shutdown Management.* A number of variables, (BWRs - e.g., such as initial vessel level, or shutdown heat removal system design) (PWRs - e.g., mid-loop, reduced level/flange level, head in place, or cavity flooded, RCS venting strategy, decay heat removal system design, vortexing pre-disposition, steam generator U-tube draining) can have a significant impact on heat removal capability challenging the fuel clad barrier. Analysis in the above references indicates that core damage may occur within an hour following continued core uncovery therefore, conservatively, 30 minutes was chosen.

As water level in the RPV lowers, the dose rate above the core will increase. For most designs the dose rate due to this core shine should result in up-scaled Containment High Range Monitor indication and possible alarm. Calculations should be performed to conservatively estimate a site-specific dose rate setpoint indicative of core uncovery (ie...level at TOAF). Additionally, post-TMI studies indicated that the installed nuclear instrumentation will operate erratically when the core is uncovered and that this should be used as a tool for making such determinations.

The GE is declared on the occurrence of the loss or imminent loss of function of <u>all three</u> barriers. Based on the above discussion, RCS barrier failure resulting in core uncovery for 30 minutes or more may cause fuel clad failure. With the CONTAINMENT breached or challenged then the potential for unmonitored fission product release to the environment is high. This represents a direct path for radioactive inventory to be released to the environment. This is consistent with the definition of a GE.

In the context of EAL 3, CONTAINMENT CLOSURE is the action taken to secure containment and its associated structures, systems, and components as a functional barrier to fission product release under existing plant conditions. CONTAINMENT CLOSURE should not be confused with refueling containment integrity as defined in technical specifications. Site shutdown contingency plans typically provide for re-establishing CONTAINMENT CLOSURE following a loss of heat removal or RCS inventory functions. If the closure is re-established prior to exceeding the temperature or level thresholds of the RCS Barrier and Fuel Clad Barrier EALs, escalation to GE would not occur.

The site-specific pressure at which CONTAINMENT is considered challenged may change based on the condition of the CONTAINMENT. If the Unit is in the cold shutdown mode and the CONTAINMENT is fully intact then the site-specific setpoint should be equivalent to the CONTAINMENT design pressure. This is consistent with typical owner's groups Emergency Response Procedures. If CONTAINMENT CLOSURE is established intentionally by the plant staff in preparations for inspection, maintenance, or refueling then the site-specific setpoint should be based on the site-specific pressure assumed for CONTAINMENT CLOSURE.

For BWRs, the use of secondary containment radiation monitors should provide indication of increased release that may be indicative of a challenge to secondary containment. The site-specific radiation monitor values should be based on the EOP "maximum safe values" because these values are easily recognizable and have an emergency basis.

In the early stages of a core uncovery event, it is unlikely that hydrogen buildup due to a core uncovery could result in an explosive mixture of dissolved gasses in CONTAINMENT. However, CONTAINMENT monitoring and/or sampling should be performed to verify this assumption and a General Emergency declared if it is determined that an explosive mixture exists.

Expanded basis for these assumptions is provided in Appendix C.

Recognition Category D

Permanently Defueled Station Malfunction

INITIATING CONDITION MATRIX

NOUE		ALERT	
D-AU1	UNPLANNED release of gaseous or liquid radioactivity to the environment ≥ 2 times the Technical Specification Release Limit for ≥ 60 Minutes. *Op. Mode: Not Applicable*	**D-AA1**	UNPLANNED release of gaseous or liquid radioactivity to the environment ≥ 200 times the Technical Specification Release Limit for ≥ 15 Minutes. *Op. Mode: Not Applicable*
D-AU2	UNCONTROLLED increase in plant radiation levels. *Op. Mode: Not Applicable*	**D-AA2**	UNCONTROLLED increase in plant radiation levels that impede operations *Op. Mode: Not Applicable*
D-SU1	Decrease in Spent Fuel Pool level OR temperature increase that is not the result of a planned evolution. *Op. Mode: Not Applicable*		
D-HU1	Confirmed security event with potential loss of level of safety of the plant. *Op. Mode: Not Applicable*	**D-HA1**	Confirmed security event in the Fuel Building or Control Room *Op. Mode: Not Applicable*
D-HU2	Other conditions judged warranting declaration of an UNUSUAL EVENT. *Op. Mode: Not Applicable*	**D-HA2**	Other conditions judged warranting declaration of ALERT. *Op. Mode: Not Applicable*
D-HU3	Natural OR destructive phenomena inside the Protected Area affecting the ability to maintain spent fuel integrity. *Op. Mode: Not Applicable*		

D-AU1

Initiating Condition -- NOTIFICATION OF UNUSUAL EVENT

UNPLANNED release of gaseous or liquid radioactivity to the environment $\geq$ 2 times the Technical Specification Release Limit for $\geq$ 60 Minutes.

Operating Mode Applicability: Not Applicable

Example Emergency Action Levels: (1 or 2)

1. UNPLANNED VALID reading on any effluent monitor that exceeds two times the Technical Specification Release Limit for > 60 Minutes.

2. Grab sample results indicate UNPLANNED gaseous release rates or liquid concentrations $\geq$ 2 times the Technical Specification Release Limit for $\geq$ 60 Minutes.

Basis:

An UNPLANNED release that cannot be terminated in 60 minutes represents an uncontrolled situation that is a potential degradation of the level of safety of the plant. The degradation in plant control implied by the fact that the release can not be terminated in 60 minutes is the primary concern. The Emergency Director should not wait until 60 minutes has elapsed, but should declare an UNUSUAL EVENT as soon as the release is determined to be uncontrolled or projected to be unisolable within 60 minutes.

The EAL 1 limit ensures compliance with 10CFR20.1301 dose limits to the public. This limit also ensures the concentration of liquid effluents released is < 2 times the value specified in 10CFR20, Appendix B.

The EAL 2 grab samples are used to determine gaseous release rates or liquid concentrations to confirm monitor readings or when the effluent monitors are not in service.

D-AU2

Initiating Condition – NOTIFICATION OF UNUSUAL EVENT

UNCONTROLLED increase in plant radiation levels.

Operating Mode Applicability: Not Applicable

Example Emergency Action Level:

1. Area Radiation Monitor readings or survey results indicate an uncontrolled increase in radiation level by 25 mR/hr that is not the result of a planned evolution.

Basis:

UNCONTROLLED means an increase in < 12 hours of monitored radiation level that is not the result of a planned evolution and the source of the increased is not immediately recognized and controlled.

Classification of an UNUSUAL EVENT is warranted as a precursor to more serious events. The concern of this EAL is the loss of control of radioactive material representing a potential degradation of the level of safety of the plant.

D-SU1

Initiating Condition – NOTIFICATION OF UNUSUAL EVENT

Decrease in Spent Fuel Pool Level OR temperature increase that is not the result of a planned evolution.

Operating Mode Applicability: Not Applicable

Example Emergency Action Levels: (1 or 2)

1. a. VALID (site-specific) indication of uncontrolled water level decrease in spent fuel pool with all irradiated fuel assemblies remaining covered by water.

   AND

   b. UNPLANNED VALID (site-specific) Direct Area Radiation Monitor reading increases

2. Spent Fuel Pool temperature increase to > [site-specific] ^{0}F that is not the result of a planned evolution.

Basis:

Classification of an NOUE for the EAL threshold value is warranted as a precursor to more serious events and a potential degradation in the level of safety of the plant. Since loss of level or continued pool boiling would result in increased radiation levels exceeding the criteria of D-AA2, continued system related loss of level type events are bounded by D-AA2.

The EAL1 site-specific value for level should be based on a calculated level that will result in prohibitive radiation levels in the Fuel Building. The site-specific radiation monitors should be chosen so that indication of decreasing pool levels is provided.

The EAL2 site-specific temperature should be chosen based on the initial temperature starting point for fuel damage calculations (typically 125 to 150°F) in the Safety Analysis Report (SAR).

D-HU1

Initiating Condition – NOTIFICATION OF UNUSUAL EVENT

Confirmed Security Event with potential loss of level of safety of the plant.

Operating Mode Applicability: Not Applicable

Example Emergency Action Levels:

1. Security Event as determined from (site-specific) Safeguards Contingency Plan and reported by the (site-specific) security shift supervision.

Basis:

This EAL is based on (site-specific) Site Security Plans. Security events which do not represent a potential degradation in the level of safety of the plant, are reported under 10 CFR 73.71 or in some cases under 10 CFR 50.72.

INTRUSION into the Fuel Building or Control Room by a HOSTILE FORCE would result in EAL escalation to an ALERT.

Reference is made to (site-specific) security shift supervision because these individuals are the designated personnel on-site qualified and trained to confirm that a security event is occurring or has occurred. Training on security event classification confirmation is closely controlled due to the strict secrecy controls placed on the plant Security Plan.

D-HU2

Initiating Condition -- NOTIFICATION OF UNUSUAL EVENT

Other conditions judged warranting declaration of an UNUSUAL EVENT

Operating Mode Applicability: Not Applicable

Example Emergency Action Levels:

1. Other conditions exist which in the judgment of the Shift Supervisor /Emergency Director indicate a potential degradation in the level of safety of the plant.

Basis:

Any condition not explicitly detailed as an EAL threshold value, which, in the judgment of the Emergency Director, is a potential degradation in the level of safety of the plant. Emergency Director judgment is to be based on known conditions and the expected response to mitigating activities within a short time period.

D-HU3

Initiating Condition – NOTIFICATION OF UNUSUAL EVENT

Natural or destructive phenomena inside the PROTECTED AREA affecting the ability to maintain spent fuel integrity

Operating Mode Applicability: Not Applicable

Example Emergency Action Levels: (1 or 2 or 3 or 4 or 5 or 6 or 7 or 8)

1. (Site-Specific) method indicates felt earthquake.

2. Report by plant personnel of tornado or high winds greater than (site-specific) mph striking within the PROTECTED AREA that has the potential to affect equipment needed to maintain spent fuel integrity.

3. Vehicle crash into plant structures or systems within PROTECTED AREA boundary that has the potential to affect equipment needed to maintain spent fuel integrity.

4. Report by plant personnel of an unanticipated EXPLOSION within PROTECTED AREA boundary resulting in VISIBLE DAMAGE that has the potential to affect equipment needed to maintain spent fuel integrity.

5. Uncontrolled flooding in (site-specific) areas of the plant that has the potential to affect equipment needed to maintain spent fuel integrity.

6. FIRE in the following (Site-Specific) buildings or areas not extinguished within 15 minutes of Control Room notification or verification of a control room alarm that has the potential to affect equipment needed to maintain spent fuel integrity.

7. Toxic or flammable gas within the PROTECTED AREA that has the potential to affect the operation of equipment needed to maintain spent fuel integrity.

8. (Site-Specific) occurrences affecting the PROTECTED AREA that has the potential to affect equipment needed to maintain spent fuel integrity.

Basis:

NOUE in this IC are categorized on the basis of the occurrence of an event of sufficient magnitude to be of concern to plant operators. Areas identified in the EALs define the location of the event based on the potential for damage to equipment contained therein.

EAL #1 should be developed on site-specific basis. Damage may be caused to some portions of the site, but should not affect ability to operate spent fuel pool equipment. Method of detection can be based on instrumentation, validated by a reliable source, or operator assessment. As defined in the EPRI-sponsored "Guidelines for Nuclear Plant Response to an Earthquake", dated October 1989, a "felt earthquake" is:

An earthquake of sufficient intensity such that: (a) the vibratory ground motion is felt at the nuclear plant site and recognized as an earthquake based on a consensus of control room operators on duty at the time, and (b) for plants with operable seismic instrumentation, the seismic switches of the plant are activated. For most plants with seismic instrumentation, the seismic switches are set at an acceleration of about 0.01g.

EAL #2 is based on the assumption that a tornado striking (touching down) or high winds within the protected area may have potentially damaged plant structures containing functions or systems required to maintain spent fuel integrity. The high wind site specific value in EAL#2 should be based on site-specific FSAR design basis.

EAL #3 is intended to address crashes of vehicles that cause significant damage to plant structures containing functions and systems necessary to maintain spent fuel integrity.

EAL #4 addresses only those EXPLOSIONs of sufficient force to damage equipment needed to maintain spent fuel integrity. No attempt is made in this EAL to assess the actual magnitude of the damage. The occurrence of the EXPLOSION with reports of evidence of damage is sufficient for declaration. The Emergency Director also needs to consider any security aspects of the EXPLOSION, if applicable.

EAL #5 addresses the effect of flooding caused by internal events such as component failures or equipment misalignment that has the potential to affect equipment needed to maintain spent fuel integrity. The site-specific areas include those areas that contain systems required to maintain fuel integrity, that are not designed to be wetted or submerged.

EAL #6 addresses FIREs that may have the potential to affect the ability to maintain spent fuel integrity. As used here, *Detection* is visual observation and report by plant personnel or sensor alarm indication. The 15 minute time period begins within a credible notification that a FIRE is occurring, or indication of a VALID fire detection system alarm. Verification of a fire detection system alarm includes actions that can be taken with the control room or other nearby site-specific location to ensure that the alarm is not spurious. A verified alarm is assumed to be an indication of a FIRE unless it is disproved within the 15 minute period by personnel dispatched to the scene. In other words, a personnel report from the scene may be used to disprove a sensor alarm if received within 15 minutes of the alarm, but shall not be required to verify the alarm.

The intent of this 15 minute duration is to size the FIRE and to discriminate against small FIREs that are readily extinguished (e.g., smoldering waste paper basket). The site-specific list should be limited and applies to buildings and areas containing equipment important to maintaining spent fuel integrity. This excludes FIREs within administration buildings, waste-basket FIREs, and other small FIREs of no safety consequence.

EAL #7 addresses toxic or flammable gas in the protected area that has the potential to affect the ability to maintain spent fuel integrity due to the potential damage to equipment or the evacuation of personnel preventing operation or maintenance of spent fuel pool equipment.

EAL #8 covers other site-specific phenomena such as hurricane, flood, or seiche that have the potential to result loss of spent fuel integrity.

Escalation to the ALERT level will be via D-AA2 if any of the above events has caused damage that results in radiation levels increasing by 100 mr/hr and impedes operation of systems needed to maintain spent fuel integrity.

D-AA1

Initiating Condition – ALERT

UNPLANNED release of gaseous or liquid radioactivity to the environment > 200 times the Technical Specification Release Limit for > 15 Minutes.

Operating Mode Applicability: Not Applicable

Example Emergency Action Levels: (1 or 2 or 3)

1. UNPLANNED VALID reading on any effluent monitor that exceeds 200 times the Technical Specification Release Limit for > 15 Minutes.

2. Confirmed sample analyses for gaseous or liquid releases indicates concentrations or release rates, with a duration of 15 minutes or longer, in excess of 200 times (site –specific Technical Specifications.

Basis:

An UNPLANNED release of this magnitude that cannot be terminated in 15 minutes represents an uncontrolled situation that is an actual or potential substantial degradation of the level of safety of the plant. The degradation in plant control implied by the fact that the release can not be terminated in 15 minutes is the primary concern. The Emergency Director should not wait until 15 minutes has elapsed, but should declare an ALERT as soon as the release is determined to be uncontrolled or projected to be unisolable within 15 minutes.

The EAL1 release rate limit ensures compliance with 10CFR20.1301 dose limits to the public. This limit also ensures the concentration of liquid effluents is < 200 times the value specified in 10CFR20, Appendix B.

The EAL2 grab samples are used to determine gaseous release rates or liquid concentrations to confirm monitor readings or when the effluent monitors are not in service.

PERMANENTLY DEFUELED STATION MALFUNCTION

D-AA2

Initiating Condition -- ALERT

UNCONTROLLED increase in plant radiation levels that impede operations

Operating Mode Applicability: Not Applicable

Example Emergency Action Levels: (1 or 2)

1. Area Radiation Monitor readings or survey results indicate an UNCONTROLLED increase in radiation level by 100 mR/hr that is not the result of a planned evolution and impedes access to areas needed to maintain control of radioactive material or operation of systems needed to maintain spent fuel integrity.

   (Site-specific) list

2. VALID (site-specific) radiation monitor readings GREATER THAN 15 mR/hr in areas requiring continuous occupancy:

   (Site-specific) list

Basis:

The site specific list for EAL1 will include available Fuel Handling building radiation monitors.

An increase in radiation levels that is not the result of a planned evolution that impedes operations necessary to allow maintenance of spent fuel integrity warrants the classification of an ALERT.

Damage to spent fuel represents a substantial degradation in the level of safety of the plant and therefore warrants an ALERT classification.

The value of 15mR/hr is derived from the GDC 19 value of 5 rem in 30 days with adjustment for expected occupancy times. Although Section III.D.3 of NUREG-0737, *"Clarification of TMI Action Plan Requirements"*, provides that the 15 mR/hr value can be averaged over the 30 days, the value is used here without averaging, as a 30 day duration implies an event potentially more significant than an Alert.

D-HA1

Initiating Condition -- ALERT

Confirmed Security Event in the Fuel Building or Control Room.

Operating Mode Applicability: Not Applicable

Example Emergency Action Levels:

1. INTRUSION into the Fuel Building or Control Room by a HOSTILE FORCE.

Basis:

This class of security events represents an escalated threat to plant safety above that contained in the NOUE. A confirmed INTRUSION report is satisfied if physical evidence indicates the presence of a HOSTILE FORCE within the Fuel Handling Building or Control Room.

D-HA2

Initiating Condition -- ALERT

Other conditions judged warranting declaration of ALERT.

Operating Mode Applicability: Not Applicable

Example Emergency Action Levels:

1. Other conditions exist which in the judgment of the Emergency Director indicate that plant systems may be substantially degraded and that increased monitoring of plant functions is warranted. Any releases are expected to be limited to small fractions of the EPA Protective Action Guideline exposure levels.

Basis:

A condition exists which, in the judgement of the Emergency Director, presents an actual or potential substantial degradation in the level of safety of the plant. Emergency Director judgement is to be based on known conditions and the expected response to mitigating activities.

Recognition Category E

Events Related to ISFSI Malfunction

INITIATING CONDITION MATRIX

NOUE

E-AU1	Unexpected Increase in ISFSI Radiation. *Op. Mode: Not Applicable*
E-HU1	Damage to a loaded cask CONFINEMENT BOUNDARY. *Op. Mode: Not Applicable*
E-HU2	Confirmed security event with potential loss of level of safety of the ISFSI *Op. Mode: Not Applicable*

E-AU1

Initiating Condition – NOTIFICATION OF UNUSUAL EVENT

Unexpected Increase in ISFSI Radiation.

Operating Mode Applicability: NOT APPLICABLE

Example Emergency Action Levels:

1. VALID (site-specific) radiation reading for irradiated spent fuel in dry storage $\geq$ 2 times the ISFSI Technical Specification limits.

Basis:

This EAL addresses the degradation of irradiated spent fuel stored onsite in dry storage modules or casks. These modules are designed to standards identified in 10 CFR Part 72. The dry storage modules are routinely monitored by site Radiation Protection/Health Physics personnel, such that any degradation would be detected. Increases in radiation levels may indicate a potential criticality event. Readings of (site specific dose rate) are indicative of degradation of the irradiated spent fuel or storage cask/module.

E-HU1

Initiating Condition – NOTIFICATION OF UNUSUAL EVENT

Damage to a loaded cask CONFINEMENT BOUNDARY.

Operating Mode Applicability: Not applicable

Example Emergency Action Level: (1 or 2 or 3)

1. Natural phenomena events affecting a loaded cask CONFINEMENT BOUNDARY.

   (site-specific list)

2. Accident conditions affecting a loaded cask CONFINEMENT BOUNDARY.

   (site-specific list)

3. Any condition in the opinion of the Emergency Director that indicates loss of loaded fuel storage cask CONFINEMENT BOUNDARY.

Basis:

A NOUE in this IC is categorized on the basis of the occurrence of an event of sufficient magnitude that a loaded cask CONFINEMENT BOUNDARY is damaged or violated. This includes classification based on a loaded fuel storage cask CONFINEMENT BOUNDARY loss leading to the degradation of the fuel during storage or posing an operational safety problem with respect to its removal from storage.

For EAL #1 and EAL #2, the results of the ISFSI Safety Analysis Report (SAR) per NUREG 1536 should be used to develop the site-specific list of natural phenomena events and accident conditions. These EALs would address responses to a dropped cask, a tipped over cask, explosion, missile damage, fire damage or natural phenomena affecting a cask (e.g., seismic event, tornado, etc.).

For EAL #3, any condition not explicitly detailed as an EAL threshold value, which, in the judgment of the Emergency Director, is a potential degradation in the level of safety of the ISFSI. Emergency Director judgment is to be based on known conditions and the expected response to mitigating activities within a short time period.

ISFSI Technical Specifications allow time to complete required actions if cask seal integrity is not maintained; therefore, classification should not be made based on a loss of seal integrity by itself. However, loss of seal integrity coincident with an accident condition or natural phenomena affecting a cask would justify classification.

E-HU2

Initiating Condition – NOTIFICATION OF UNUSUAL EVENT

Confirmed Security Event with potential loss of level of safety of the ISFSI.

Operating Mode Applicability: Not applicable

Example Emergency Action Levels:

1. Security Event as determined from (site-specific) Security Plan and reported by the (site-specific) security shift supervision.

Basis:

This EAL is based on (site-specific) Security Plans. Security events which do not represent a potential degradation in the level of safety of the ISFSI, are reported under 10 CFR 73.71 or in some cases under 10 CFR 50.72.

Reference is made to (site-specific) security shift supervision because these individuals are the designated personnel qualified and trained to confirm that a security event is occurring or has occurred. Training on security event classification confirmation is closely controlled due to the strict secrecy controls placed on the Security Plan.

Table 5-F-1

Recognition Category F

Fission Product Barrier Degradation

INITIATING CONDITION MATRIX

See Table 3 for BWR Example EALs
See Table 4 for PWR Example EALs

NOUE		ALERT		SITE AREA EMERGENCY		GENERAL EMERGENCY	
FU1	ANY Loss or ANY Potential Loss of Containment *Op. Modes: Power Operation, Hot Standby, Startup, Hot Shutdown*	**FA1**	ANY Loss or ANY Potential Loss of EITHER Fuel Clad OR RCS *Op. Modes: Power Operation, Hot Standby, Startup, Hot Shutdown*	**FS1**	Loss or Potential Loss of ANY Two Barriers *Op. Modes: Power Operation, Hot Standby, Startup, Hot Shutdown*	**FG1**	Loss of ANY Two Barriers AND Potential Loss of Third Barrier *Op. Modes: Power Operation, Hot Standby, Startup, Hot Shutdown*

NOTES

1. The logic used for these initiating conditions reflects the following considerations:

   - The Fuel Clad Barrier and the RCS Barrier are weighted more heavily than the Containment Barrier (See Sections 3.4 and 3.8). NOUE ICs associated with RCS and Fuel Clad Barriers are addressed under System Malfunction ICs.

   - At the Site Area Emergency level, there must be some ability to dynamically assess how far present conditions are from the threshold for a General Emergency. For example, if Fuel Clad and RCS Barrier "Loss" EALs existed, that, in addition to offsite dose assessments, would require continual assessments of radioactive inventory and containment integrity. Alternatively, if both Fuel Clad and RCS Barrier "Potential Loss" EALs existed, the Emergency Director would have more assurance that there was no immediate need to escalate to a General Emergency.

   - The ability to escalate to higher emergency classes as an event deteriorates must be maintained. For example, RCS leakage steadily increasing would represent an increasing risk to public health and safety.

2. Fission Product Barrier ICs must be capable of addressing event dynamics. Thus, the EAL Reference Table 3 and 4 state that imminent (i.e., within 2 hours) Loss or Potential Loss should result in a classification as if the affected threshold(s) are already exceeded, particularly for the higher emergency classes.

TABLE 5-F-2

BWR Emergency Action Level

Fission Product Barrier Reference Table

Thresholds For LOSS or POTENTIAL LOSS of Barriers*

*Determine which combination of the three barriers are lost or have a potential loss and use the following key to classify the event. Also, multiple events could occur which result in the conclusion that exceeding the loss or Potential loss thresholds is imminent (i.e., within 1 to 2 hours). In this imminent loss situation use judgment and classify as if the thresholds are exceeded.

UNUSUAL EVENT	**ALERT**	**SITE AREA EMERGENCY**	**GENERAL EMERGENCY**
ANY loss or ANY Potential Loss of Containment	ANY loss or ANY Potential Loss of EITHER Fuel Clad or RCS	Loss or Potential Loss of ANY two Barriers	Loss of ANY two Barriers AND Potential Loss of Third Barrier

Fuel Clad Barrier Example EALS		**RCS Barrier Example EALS**		**Containment Barrier Example EALS**	
LOSS	**POTENTIAL LOSS**	**LOSS**	**POTENTIAL LOSS**	**LOSS**	**POTENTIAL LOSS**
1. Primary Coolant Activity Level		**1. Drywell Pressure**		**1. Drywell Pressure**	
Coolant Activity GREATER THAN (site-specific) Value	Not Applicable	Pressure GREATER THAN (site-specific) PSIG	Not Applicable	Rapid unexplained decrease following initial increase **OR** Drywell pressure response not consistent with LOCA conditions	(Site-specific) PSIG and increasing **OR** Explosive mixture exists
OR		**OR**		**OR**	
2. Reactor Vessel Water Level		**2. Reactor Vessel Water Level**		**2. Reactor Vessel Water Level**	
Level LESS THAN (site-specific value)	Level LESS THAN (site-specific value)	Level LESS THAN (site-specific value)	Not Applicable	Not Applicable	Primary containment flooding required
		OR		**OR**	
		3. RCS Leak Rate		**3. CNMT Isolation Failure or Bypass**	
		(Site-specific) Indication of an unisolable Main Steamline Break	RCS leakage GREATER THAN 50 gpm inside the drywell **OR** Unisolable primary system leakage outside drywell as indicated by area temperature or area radiation alarm	Failure of both valves in any one line to close AND downstream pathway to the environment exists **OR** Intentional venting per EOPs **OR** Unisolable primary system leakage outside drywell as indicated by area temperature or area radiation alarm	Not applicable
OR		**OR**		**OR**	

TABLE 5-F-2
BWR Emergency Action Level
Fission Product Barrier Reference Table
Thresholds For LOSS or POTENTIAL LOSS of Barriers*

*Determine which combination of the three barriers are lost or have a potential loss and use the following key to classify the event. Also, multiple events could occur which result in the conclusion that exceeding the loss or Potential loss thresholds is imminent (i.e., within 1 to 2 hours). In this imminent loss situation use judgment and classify as if the thresholds are exceeded.

UNUSUAL EVENT	ALERT	SITE AREA EMERGENCY	GENERAL EMERGENCY
ANY loss or ANY Potential Loss of Containment	ANY loss or ANY Potential Loss of EITHER Fuel Clad or RCS	Loss or Potential Loss of ANY two Barriers	Loss of ANY two Barriers AND Potential Loss of Third Barrier

Fuel Clad Barrier Example EALS		RCS Barrier Example EALS		Containment Barrier Example EALS	
LOSS	**POTENTIAL LOSS**	**LOSS**	**POTENTIAL LOSS**	**LOSS**	**POTENTIAL LOSS**
3. Drywell Radiation Monitoring		**4. Drywell Radiation Monitoring**		**4. Significant Radioactive Inventory in Containment**	
Drywell Radiation monitor reading GREATER THAN (site-specific) R/hr	Not Applicable	Drywell Radiation monitor reading GREATER THAN (site-specific) R/hr	Not Applicable	Not applicable	Drywell Radiation monitor reading GREATER THAN (site-specific) R/hr
OR		**OR**		**OR**	
4. Other (Site-Specific) Indications		**5. Other (Site-Specific) Indications**		**5. Other (site-specific) Indications**	
(Site specific) as applicable	(Site specific) as applicable	(Site-specific) as applicable	(Site-specific) as applicable	(Site specific) as applicable	(Site specific) as applicable
OR		**OR**		**OR**	
5. Emergency Director Judgment		**6. Emergency Director Judgment**		**6. Emergency Director Judgment**	
Any condition in the opinion of the Emergency Director that indicates Loss or Potential Loss of the Fuel Clad Barrier		Any condition in the opinion of the Emergency Director that indicates Loss or Potential Loss of the RCS Barrier		Any condition in the opinion of the Emergency Director that indicates Loss or Potential Loss of the Containment barrier	

Basis Information For Table 5-F-2
BWR Emergency Action Level
Fission Product Barrier Reference Table

FUEL CLAD BARRIER EXAMPLE EALs: (1 or 2 or 3 or 4 or 5)

The Fuel Clad barrier is the zircalloy or stainless steel tubes that contain the fuel pellets.

1. Primary Coolant Activity Level

This (site-specific) value corresponds to 300 μCi/gm I_{131} equivalent. Assessment by the NUMARC EAL Task Force indicates that this amount of coolant activity is well above that expected for iodine spikes and corresponds to less than 5% fuel clad damage. This amount of radioactivity indicates significant clad damage and thus the Fuel Clad Barrier is considered lost. The value expressed can be either in mR/hr observed on the sample or as uCi/gm results from analysis.

There is no equivalent "Potential Loss" EAL for this item.

2. Reactor Vessel Water Level

The "Loss" EAL (site-specific) value corresponds to the level which is used in EOPs to indicate challenge of core cooling. Depending on the plant this may be top of active fuel or 2/3 coverage of active fuel. This is the minimum value to assure core cooling without further degradation of the clad. The "Potential Loss" EAL is the same as the RCS barrier "Loss" EAL #2 below and corresponds to the (site-specific) water level at the top of the active fuel. Thus, this EAL indicates a "Loss" of RCS barrier and a "Potential Loss" of the Fuel Clad Barrier. This EAL appropriately escalates the emergency class to a Site Area Emergency. If the "Loss" value is also the Top of Active Fuel, the "Potential Loss" value must be a value indicating a higher level also corresponding to a higher level indicated in the RCS barrier "Loss" EAL #2.

3. Drywell Radiation Monitoring

The (site-specific) reading is a value which indicates the release of reactor coolant, with elevated activity indicative of fuel damage, into the drywell. The reading should be calculated assuming the instantaneous release and dispersal of the reactor coolant noble gas and iodine inventory associated with a concentration of 300 μCi/gm dose equivalent I-131 or the calculated concentration equivalent to the clad damage used in EAL #1 into the drywell atmosphere. Reactor coolant concentrations of this magnitude are several times larger than the maximum concentrations (including iodine spiking) allowed within technical specifications and are therefore indicative of fuel damage. This value is higher than that specified for RCS barrier Loss EAL #4. Thus, this EAL indicates a loss of both Fuel Clad barrier and RCS barrier.

Caution: *it is important to recognize that in the event the radiation monitor is sensitive to shine from the reactor vessel or piping, spurious readings will be present and another indicator of fuel clad damage is necessary or compensated for in the threshold value.*

There is no "Potential Loss" EAL associated with this item.

4. Other (Site-Specific) Indications

This EAL is to cover other (site-specific) indications that may indicate loss or potential loss of the Fuel Clad barrier, including indications from containment air monitors or any other (site-specific) instrumentation.

5. Emergency Director Judgment

This EAL addresses any other factors that are to be used by the Emergency Director in determining whether the Fuel Clad barrier is lost or potentially lost. In addition, the inability to monitor the barrier should also be incorporated in this EAL as a factor in Emergency Director judgment that the barrier may be considered lost or potentially lost. (See also IC SG1, "Prolonged Loss of All Offsite Power and Prolonged Loss of All Onsite AC Power", for additional information.)

RCS BARRIER EXAMPLE EALs: (1 or 2 or 3 or 4 or 5 or 6)

The RCS Barrier is the reactor coolant system pressure boundary and includes the reactor vessel and all reactor coolant system piping up to the isolation valves.

1. Drywell Pressure

The (site-specific) drywell pressure is based on the drywell high pressure set point which indicates a LOCA by automatically initiating the ECCS or equivalent makeup system.

There is no "Potential Loss" EAL corresponding to this item.

2. Reactor Vessel Water Level

This "Loss" EAL is the same as "Potential Loss" Fuel Clad Barrier EAL #2. The (site-specific) water level corresponds to the level which is used in EOPs to indicate challenge of core cooling. Depending on the plant this may be top of active fuel or 2/3 coverage of active fuel. This EAL appropriately escalates the emergency class to a Site Area Emergency. Thus, this EAL indicates a loss of the RCS barrier and a Potential Loss of the Fuel Clad Barrier.

There is no "Potential Loss" EAL corresponding to this item.

3. RCS Leak Rate

An unisolable MSL break is a breach of the RCS barrier. Thus, this EAL is included for consistency with the Alert emergency classification. The potential loss of RCS based on leakage is set at a level indicative of a small breach of the RCS but which is well within the makeup capability of normal and emergency high pressure systems. Core uncovery is not a significant concern for a 50 gpm leak, however, break propagation leading to significantly larger loss of inventory is possible. Many BWRs may be unable to measure an RCS leak of this size because the leak would likely increase drywell pressure above the drywell isolation set point. The system normally used to monitor leakage is typically isolated as part of the drywell isolation and is therefore unavailable. If primary system leak rate information is unavailable, other indicators of RCS leakage should be used.

Potential loss of RCS based on primary system leakage outside the drywell is determined from site-specific temperature or area radiation alarms low setpoint in the areas of the main steam line tunnel, main turbine generator, RCIC, HPCI, etc., which indicate a direct path from the RCS to areas outside primary containment. The indicators should be confirmed to be caused by RCS leakage. The area temperature or radiation low alarm setpoints are indicated for this example to enable an Alert classification. An unisolable leak which is indicated by a high alarm setpoint escalates to a Site Area Emergency when combined with Containment Barrier EAL 3 (after a containment isolation) and a General Emergency when the Fuel Clad Barrier criteria is also exceeded.

4. Drywell Radiation Monitoring

The (site-specific) reading is a value which indicates the release of reactor coolant to the drywell. The reading should be calculated assuming the instantaneous release and dispersal of the reactor coolant noble gas and iodine inventory associated with normal operating concentrations (i.e., within T/S) into the drywell atmosphere. This reading will be less than that specified for Fuel Clad Barrier EAL #3. Thus, this EAL would be indicative of a RCS leak only. If the radiation monitor reading increased to that value specified by Fuel Clad Barrier EAL #3, fuel damage would also be indicated.

However, if the site specific physical location of the drywell radiation monitor is such that radiation from a cloud of released RCS gases could not be distinguished from radiation from adjacent piping and components containing elevated reactor coolant activity, this EAL should be omitted and other site specific indications of RCS leakage substituted.

There is no "Potential Loss" EAL associated with this item.

5. Other (Site-Specific) Indications

This EAL is to cover other (site-specific) indications that may indicate loss or potential loss of the RCS barrier.

6. Emergency Director Judgment

This EAL addresses any other factors that are to be used by the Emergency Director in determining whether the RCS barrier is lost or potentially lost. In addition, the inability to monitor the barrier should also be incorporated in this EAL as a factor in Emergency Director judgment that the barrier may be considered lost or potentially lost. (See also IC SG1, "Prolonged Loss of Offsite Power and Prolonged Loss of All Onsite AC Power", for additional information.)

PRIMARY CONTAINMENT BARRIER EXAMPLE EALs: (1 or 2 or 3 or 4 or 5 or 6)

The Primary Containment Barrier includes the drywell, the wetwell, their respective interconnecting paths, and other connections up to and including the outermost containment isolation valves. Containment Barrier EALs are used primarily as discriminators for escalation from an Alert to a Site Area Emergency or a General Emergency.

1. Drywell Pressure

Rapid unexplained loss of pressure (i.e., not attributable to drywell spray or condensation effects) following an initial pressure increase indicates a loss of containment integrity. Drywell pressure should increase as a result of mass and energy release into containment from a LOCA. Thus, drywell pressure not increasing under these conditions indicates a loss of containment integrity. This indicator relies on the operators recognition of an unexpected response for the condition and therefore does not have a specific value associated. The unexpected response is important because it is the indicator for a containment bypass condition. The (site-specific) PSIG for potential loss of containment is based on the containment drywell design pressure. Existence of an explosive mixture means a hydrogen and oxygen concentration of at least the lower deflagration limit curve exists. This applies to BWRs with Mark III containments, as well as Mark I and II containment designs when they are de-inerted.

2. Reactor Vessel Water Level

The entry into the Primary Containment Flooding emergency procedure indicates reactor vessel water level can not be restored and that a core melt sequence is in progress. EOPs direct the operators to enter Containment Flooding when Reactor Vessel Level cannot be restored to greater than a Site Specific value (generally 2/3 core height) or is unknown. Entry into Containment Flooding procedures is a logical escalation in response to the inability to maintain reactor vessel level.

The conditions in this potential loss EAL represent imminent core melt sequences which, if not corrected, could lead to vessel failure and increased potential for containment failure. In conjunction with and an escalation of the level EALs in the Fuel and RCS barrier columns, this EAL will result in the declaration of a General Emergency -- loss of two barriers and the potential loss of a third. If the emergency operating procedures have been ineffective in restoring reactor vessel level above the RCS and Fuel Clad Barrier Threshold Values, there is not a "success" path and a core melt sequence is in progress. Entry into Containment flooding procedures is a logical escalation in response to the inability to maintain reactor vessel level.

Severe accident analysis (e.g., NUREG-1150) have concluded that function restoration procedures can arrest core degradation with the reactor vessel in a significant fraction of the core damage scenarios, and the likelihood of containment failure is very small in these events. Given this, it is appropriate to provide a reasonable period to allow emergency operating procedures to arrest the core melt sequence. Whether or not the procedures will be effective should be apparent within the time provided. The Emergency Director should make the declaration as soon as it is determined that the procedures have been, or will be, ineffective. There is no "loss" EAL associated with this item.

3. Containment Isolation Failure or Bypass

This EAL is intended to cover the inability to isolate the containment when containment isolation is required. In addition, the presence of area radiation or temperature alarms high setpoint indicating unisolable primary system leakage outside the drywell are covered after a containment isolation. The indicators should be confirmed to be caused by RCS leakage. Also, an intentional venting of primary containment for pressure control per EOPs to the secondary containment and/or the environment is considered a loss of containment. Containment venting for temperature or pressure when not in an accident situation should not be considered.

There is no "Potential Loss" EAL associated with this item.

4. Significant Radioactive Inventory in Containment

The (site-specific) reading is a value which indicates significant fuel damage well in excess of that required for loss of RCS and Fuel Clad. As stated in Section 3.8, a major release of radioactivity requiring offsite protective actions from core damage is not possible unless a major failure of fuel cladding allows radioactive material to be released from the core into the reactor coolant. Regardless of whether containment is challenged, this amount of activity in containment, if released, could have such severe consequences that it is prudent to treat this as a potential loss of containment, such that a General Emergency declaration is warranted. NUREG-1228, "Source Estimations During Incident Response to Severe Nuclear Power Plant Accidents," indicates that such conditions do not exist when the amount of clad damage is less than 20%. Unless there is a (site-specific) analysis justifying a higher value, it is recommended that a radiation monitor reading corresponding to 20% fuel clad damage be specified here.

There is no "Loss" EAL associated with this item.

5. Other (Site-Specific) Indications

This EAL is to cover other (site-specific) indications that may indicate loss or potential loss of the containment barrier.

6. Emergency Director Judgment

This EAL addresses any other factors that are to be used by the Emergency Director in determining whether the Containment barrier is lost or potentially lost. In addition, the inability to monitor the barrier should also be incorporated in this EAL as a factor in Emergency Director judgment that the barrier may be considered lost or potentially lost. (See also IC SG1, "Prolonged Loss of All Offsite Power and Prolonged Loss of All Onsite AC Power", for additional information.)

TABLE 5-F-4

PWR Emergency Action Level

Fission Product Barrier Reference Table

Thresholds For LOSS or POTENTIAL LOSS of Barriers*

*Determine which combination of the three barriers are lost or have a potential loss and use the following key to classify the event. Also an event for multiple events could occur which result in the conclusion that exceeding the loss or potential loss thresholds is imminent (i.e., within 1 to 2 hours). In this imminent loss situation use judgment and classify as if the thresholds are exceeded.

UNUSUAL EVENT	**ALERT**	**SITE AREA EMERGENCY**	**GENERAL EMERGENCY**
ANY loss or ANY Potential Loss of Containment	ANY loss or ANY Potential Loss of EITHER Fuel Clad or RCS	Loss or Potential Loss of ANY two Barriers	Loss of ANY two Barriers AND Potential Loss of Third Barrier

Fuel Clad Barrier Example EALS		**RCS Barrier Example EALS**		**Containment Barrier Example EALS**	
LOSS	**POTENTIAL LOSS**	**LOSS**	**POTENTIAL LOSS**	**LOSS**	**POTENTIAL LOSS**
1. Critical Safety Function Status		**1. Critical Safety Function Status**		**1. Critical Safety Function Status**	
Core-Cooling Red	Core Cooling-Orange OR Heat Sink-Red	Not Applicable	RCS Integrity-Red OR Heat Sink-Red	Not Applicable	Containment-Red
OR		**OR**		**OR**	
2. Primary Coolant Activity Level		**2. RCS Leak Rate**		**2. Containment Pressure**	
Coolant Activity GREATER THAN (site-specific) Value	Not Applicable	GREATER THAN available makeup capacity as indicated by a loss of RCS subcooling	Unisolable leak exceeding the capacity of one charging pump in the normal charging mode	Rapid unexplained decrease following initial increase OR Containment pressure or sump level response not consistent with LOCA conditions	(Site-specific) PSIG and increasing OR Explosive mixture exists **OR** Pressure greater than containment depressurizat-ion actuation setpoint with less than one full train of depressurization equipment operating
OR				**OR**	
3. Core Exit Thermocouple Readings				**3. Core Exit Themocouple Reading**	
GREATER THAN (site-specific) degree F	GREATER THAN (site-specific) degree F			Not applicable	Core exit thermocouples in excess of 1200 degrees and restoration procedures not effective within 15 minutes; or, core exit thermocouples in excess of 700 degrees with reactor vessel level below top of active fuel and restoration procedures not effective within 15 minutes

TABLE 5-F-4

PWR Emergency Action Level

Fission Product Barrier Reference Table

Thresholds For LOSS or POTENTIAL LOSS of Barriers*

*Determine which combination of the three barriers are lost or have a potential loss and use the following key to classify the event. Also an event for multiple events could occur which result in the conclusion that exceeding the loss or potential loss thresholds is imminent (i.e., within 1 to 2 hours). In this imminent loss situation use judgment and classify as if the thresholds are exceeded.

UNUSUAL EVENT	ALERT	SITE AREA EMERGENCY	GENERAL EMERGENCY
ANY loss or ANY Potential Loss of Containment	ANY loss or ANY Potential Loss of EITHER Fuel Clad or RCS	Loss or Potential Loss of ANY two Barriers	Loss of ANY two Barriers AND Potential Loss of Third Barrier

Fuel Clad Barrier Example EALS		RCS Barrier Example EALS		Containment Barrier Example EALS	
LOSS	**POTENTIAL LOSS**	**LOSS**	**POTENTIAL LOSS**	**LOSS**	**POTENTIAL LOSS**
OR		**OR**		**OR**	
4. Reactor Vessel Water Level		**3. SG Tube Rupture**		**4. SG Secondary Side Release with P-to-S Leakage**	
Not Applicable	Level LESS than (site-specific) value	SGTR that results in an ECCS (SI) Actuation	Not Applicable	RUPTURED S/G is also FAULTED outside of containment OR Primary-to-Secondary leakrate greater than 10 gpm with nonisolable steam release from affected S/G to the environment	Not applicable
				OR	
				5. CNMT Isolation Valves Status After CNMT Isolation	
				Valve(s) not closed AND downstream pathway to the environment exists	Not Applicable
OR		**OR**		**OR**	
5. Containment Radiation Monitoring		**4. Containment Radiation Monitoring**		**6. Significant Radioactive Inventory in Containment**	
Containment rad monitor reading GREATER THAN (site-specific) R/hr	Not Applicable	Containment rad monitor reading GREATER THAN (site-specific) R/hr	Not Applicable	Not Applicable	Containment rad monitor reading GREATER THAN (site-specific) R/hr

TABLE 5-F-4

PWR Emergency Action Level

Fission Product Barrier Reference Table

Thresholds For LOSS or POTENTIAL LOSS of Barriers*

*Determine which combination of the three barriers are lost or have a potential loss and use the following key to classify the event. Also an event for multiple events could occur which result in the conclusion that exceeding the loss or potential loss thresholds is imminent (i.e., within 1 to 2 hours). In this imminent loss situation use judgment and classify as if the thresholds are exceeded.

UNUSUAL EVENT	ALERT	SITE AREA EMERGENCY	GENERAL EMERGENCY
ANY loss or ANY Potential Loss of Containment	ANY loss or ANY Potential Loss of EITHER Fuel Clad or RCS	Loss or Potential Loss of ANY two Barriers	Loss of ANY two Barriers AND Potential Loss of Third Barrier

Fuel Clad Barrier Example EALS		RCS Barrier Example EALS		Containment Barrier Example EALS	
LOSS	**POTENTIAL LOSS**	**LOSS**	**POTENTIAL LOSS**	**LOSS**	**POTENTIAL LOSS**
OR		**OR**		**OR**	
6. Other (Site-Specific) Indications		**5. Other (Site-Specific) Indications**		**7. Other (site-specific) Indications**	
(Site specific) as applicable	(Site specific) as applicable	(Site-specific) as applicable	(Site-specific) as applicable	(Site specific) as applicable	(Site specific) as applicable
OR		**OR**		**OR**	
7. Emergency Director Judgment		**6. Emergency Director Judgment**		**8. Emergency Director Judgment**	
Any condition in the opinion of the Emergency Director that indicates Loss or Potential Loss of the Fuel Clad Barrier		Any condition in the opinion of the Emergency Director that indicate Loss or Potential Loss of the RCS Barrier		Any condition in the opinion of the Emergency Director that indicates Loss or Potential Loss of the Containment barrier	

Basis Information For Table 5-F-4
PWR Emergency Action Level
Fission Product Barrier Reference Table

FUEL CLAD BARRIER EXAMPLE EALs: (1 or 2 or 3 or 4 or 5 or 6)

The Fuel Clad Barrier is the zircalloy or stainless steel tubes that contain the fuel pellets.

1. Critical Safety Function Status

This EAL is for PWRs using Critical Safety Function Status Tree (CSFST) monitoring and functional restoration procedures. For more information, please refer to Section 3.9 of this report. RED path indicates an extreme challenge to the safety function. ORANGE path indicates a severe challenge to the safety function.

Core Cooling - ORANGE indicates subcooling has been lost and that some clad damage may occur. Heat Sink - RED indicates the ultimate heat sink function is under extreme challenge and thus these two items indicate potential loss of the Fuel Clad Barrier.

Core Cooling - RED indicates significant superheating and core uncovery and is considered to indicate loss of the Fuel Clad Barrier.

2. Primary Coolant Activity Level

This (site-specific) value corresponds to 300 μCi/gm I_{131} equivalent. Assessment by the NUMARC EAL Task Force indicates that this amount of coolant activity is well above that expected for iodine spikes and corresponds to less than 5% fuel clad damage. This amount of radioactivity indicates significant clad damage and thus the Fuel Clad Barrier is considered lost. The value expressed can be either in mR/hr observed on the sample or as μCi/gm results from analysis.

There is no equivalent "Potential Loss" EAL for this item.

3. Core Exit Thermocouple Readings

Core Exit Thermocouple Readings are included in addition to the Critical Safety Functions to include conditions when the CSFs may not be in use (initiation after SI is blocked) or plants which do not have a CSF scheme.

The "Loss" EAL (site-specific) reading should correspond to significant superheating of the coolant. This value typically corresponds to the temperature reading that indicates core cooling - RED in Fuel Clad Barrier EAL #1 which is usually about 1200 degrees F.

The "Potential Loss" EAL (site-specific) reading should correspond to loss of subcooling. This value typically corresponds to the temperature reading that indicates core cooling - ORANGE in Fuel Clad Barrier EAL #1 which is usually about 700 to 900 degrees F.

4. Reactor Vessel Water Level

There is no "Loss" EAL corresponding to this item because it is better covered by the other Fuel Clad Barrier "Loss" EALs.

The (site-specific) value for the "Potential Loss" EAL corresponds to the top of the active fuel. For sites using CSFSTs, the "Potential Loss" EAL is defined by the Core Cooling - ORANGE path. The (site-specific) value in this EAL should be consistent with the CSFST value.

5. Containment Radiation Monitoring

The (site-specific) reading is a value which indicates the release of reactor coolant, with elevated activity indicative of fuel damage, into the containment. The reading should be calculated assuming the instantaneous release and dispersal of the reactor coolant noble gas and iodine inventory associated with a concentration of 300 μCi/gm dose equivalent I-131 into the containment atmosphere. Reactor coolant concentrations of this magnitude are several times larger than the maximum concentrations (including iodine spiking) allowed within technical specifications and are therefore indicative of fuel damage. This value is higher than that specified for RCS barrier Loss EAL #4. Thus, this EAL indicates a loss of both the fuel clad barrier and a loss of RCS barrier.

There is no "Potential Loss" EAL associated with this item.

6. Other (Site-Specific) Indications

This EAL is to cover other (site-specific) indications that may indicate loss or potential loss of the Fuel Clad barrier, including indications from containment air monitors or any other (site-specific) instrumentation.

7. Emergency Director Judgment

This EAL addresses any other factors that are to be used by the Emergency Director in determining whether the Fuel Clad barrier is lost or potentially lost. In addition, the inability to monitor the barrier should also be incorporated in this EAL as a factor in Emergency Director judgment that the barrier may be considered lost or potentially lost. (See also IC SG1, "Prolonged Loss or All Offsite Power and Prolonged Loss of All Onsite AC Power", for additional information.)

RCS BARRIER EXAMPLE EALs: (1 or 2 or 3 or 4 or 5 or 6)

The RCS Barrier includes the RCS primary side and its connections up to and including the pressurizer safety and relief valves, and other connections up to and including the primary isolation valves.

1. Critical Safety Function Status

This EAL is for PWRs using Critical Safety Function Status Tree (CSFST) monitoring and functional restoration procedures. For more information, please refer to Section 3.9 of this report. RED path indicates an extreme challenge to the safety function derived from appropriate instrument readings, and these CSFs indicate a potential loss of RCS barrier.

There is no "Loss" EAL associated with this item.

2. RCS Leak Rate

The "Loss" EAL addresses conditions where leakage from the RCS is greater than available inventory control capacity such that a loss of subcooling has occurred. The loss of subcooling is the fundamental indication that the inventory control systems are inadequate in maintaining RCS pressure and inventory against the mass loss through the leak.

The "Potential Loss" EAL is based on the inability to maintain normal liquid inventory within the Reactor Coolant System (RCS) by normal operation of the Chemical and Volume Control System which is considered as one centrifugal charging pump discharging to the charging header. A second charging pump being required is indicative of a substantial RCS leak. For plants with low capacity charging pumps, a 50 gpm leak rate value may be used to indicate the Potential Loss.

3. SG Tube Rupture

This EAL is intended to address the full spectrum of Steam Generator (SG) tube rupture events in conjunction with Containment Barrier "Loss" EAL #4 and Fuel Clad Barrier EALs. The "Loss" EAL addresses RUPTURED SG(s) for which the leakage is large enough to cause actuation of ECCS (SI). This is consistent to the RCS Barrier "Potential Loss" EAL #2. For plants that have implemented W.O.G. emergency response guides, this condition is described by "entry into E-3 required by EOPs". By itself, this EAL will result in the declaration of an Alert. However, if the SG is also FAULTED (i.e., two barriers failed), the declaration escalates to a Site Area Emergency per Containment Barrier "Loss" EAL #4.

There is no "Potential Loss" EAL.

4. Containment Radiation Monitoring

The (site-specific) reading is a value which indicates the release of reactor coolant to the containment. The reading should be calculated assuming the instantaneous release and dispersal of the reactor coolant noble gas and iodine inventory associated with normal operating concentrations (i.e., within T/S) into the containment atmosphere. This reading will be less than that specified for Fuel Clad Barrier EAL #5. Thus, this EAL would be indicative of a RCS leak only. If the radiation monitor reading increased to that specified by Fuel Clad Barrier EAL #5, fuel damage would also be indicated.

However, if the site specific physical location of the containment radiation monitor is such that radiation from a cloud of released RCS gases could not be distinguished from radiation from nearby piping and components containing elevated reactor coolant activity, this EAL should be omitted and other site specific indications of RCS leakage substituted.

There is no "Potential Loss" EAL associated with this item.

5. Other (Site-Specific) Indications

This EAL is to cover other (site-specific) indications that may indicate loss or potential loss of the RCS barrier, including indications from containment air monitors or any other (site-specific) instrumentation.

6. Emergency Director Judgment

This EAL addresses any other factors that are to be used by the Emergency Director in determining whether the RCS barrier is lost or potentially lost. In addition, the inability to monitor the barrier should also be incorporated in this EAL as a factor in Emergency Director judgment that the barrier may be considered lost or potentially lost. (See also IC SG1, "Prolonged Loss of All Offsite Power and Prolonged Loss of All Onsite AC Power", for additional information.)

CONTAINMENT BARRIER EXAMPLE EALs: (1 or 2 or 3 or 4 or 5 or 6 or 7 or 8)

The Containment Barrier includes the containment building, its connections up to and including the outermost containment isolation valves. This barrier also includes the main steam, feedwater, and blowdown line extensions outside the containment building up to and including the outermost secondary side isolation valve.

1. Critical Safety Function Status

This EAL is for PWRs using Critical Safety Function Status Tree (CSFST) monitoring and functional restoration procedures. For more information, please refer to Section 3.9 of this report. RED path indicates an extreme challenge to the safety function derived from appropriate instrument readings and/or sampling results, and thus represents a potential loss of containment. Conditions leading to a containment RED path result from RCS barrier and/or Fuel Clad Barrier Loss. Thus, this EAL is primarily a discriminator between Site Area Emergency and General Emergency representing a potential loss of the third barrier.

There is no "Loss" EAL associated with this item.

2. Containment Pressure

Rapid unexplained loss of pressure (i.e., not attributable to containment spray or condensation effects) following an initial pressure increase indicates a loss of containment integrity. Containment pressure and sump levels should increase as a result of the mass and energy release into containment from a LOCA. Thus, sump level or pressure not increasing indicates containment bypass and a loss of containment integrity. The (site-specific) PSIG for potential loss of containment is based on the containment design pressure. Existence of an explosive mixture means a hydrogen and oxygen concentration of at least the lower deflagration limit curve exists. The indications of potential loss under this EAL corresponds to some of those leading to the RED path in EAL #1 above and may be declared by those sites using CSFSTs. As described above, this EAL is primarily a discriminator between Site Area Emergency and General Emergency representing a potential loss of the third barrier.

The second potential loss EAL represents a potential loss of containment in that the containment heat removal/depressurization system (e.g., containment sprays, ice condenser fans, etc., but not including containment venting strategies) are either lost or performing in a degraded manner, as indicated by containment pressure greater than the setpoint at which the equipment was supposed to have actuated.

3. Core Exit Thermocouples

In this EAL, the function restoration procedures are those emergency operating procedures that address the recovery of the core cooling critical safety functions. The procedure is considered effective if the temperature is decreasing or if the vessel water level is increasing. For units using the CSF status trees a direct correlation to those status trees can be made if the effectiveness of the restoration procedures is also evaluated as stated below.

Severe accident analyses (e.g., NUREG-1150) have concluded that function restoration procedures can arrest core degradation within the reactor vessel in a significant fraction of the core damage scenarios, and that the likelihood of containment failure is very small in these events. Given this, it is appropriate to provide a reasonable period to allow function restoration procedures to arrest the core melt sequence. Whether or not the procedures will be effective should be apparent within 15 minutes. The Emergency Director should make the declaration as soon as it is determined that the procedures have been, or will be ineffective. The reactor vessel level chosen should be consistent with the emergency response guides applicable to the facility.

The conditions in this potential loss EAL represent an imminent core melt sequence which, if not corrected, could lead to vessel failure and an increased potential for containment failure. In conjunction with the Core Cooling and Heat Sink criteria in the Fuel and RCS barrier columns, this EAL would result in the declaration of a General Emergency -- loss of two barriers and the potential loss of a third. If the function restoration procedures are ineffective, there is no "success" path.

There is no "Loss" EAL associated with this item.

4. SG Secondary Side Release With Primary To Secondary Leakage

This "loss" EAL recognizes that SG tube leakage can represent a bypass of the containment barrier as well as a loss of the RCS barrier. The first "loss" EAL addresses the condition in which a RUPTURED steam generator is also FAULTED. This condition represents a bypass of the RCS and containment barriers. In conjunction with RCS Barrier "loss" EAL #3, this would always result in the declaration of a Site Area Emergency.

The second "loss" EAL addresses SG tube leaks that exceed 10 gpm in conjunction with a nonisolable release path to the environment from the affected steam generator. The threshold for establishing the nonisolable secondary side release is intended to be a prolonged release of radioactivity from the RUPTURED steam generator directly to the environment. This could be expected to occur when the main condenser is unavailable to accept the contaminated steam (i.e., SGTR with concurrent loss of offsite power and the RUPTURED steam generator is required for plant cooldown or a stuck open relief valve). If the main condenser is available, there may be releases via air ejectors, gland seal exhausters, and other similar controlled, and often monitored, pathways. These pathways do not meet the intent of a nonisolable release path to the environment. These minor releases are assessed using Abnormal Rad Levels / Radiological Effluent ICs.

Users should realize that the two "loss" EALs described above could be considered redundant. This was recognized during the development process. The inclusion of an EAL that uses Emegency Procedure commonly used terms like "ruptured and faulted" adds to the ease of the classification process and has been included based on this human factor concern.

The leakage threshold for this EAL has been increased with Revision 3. In the earlier revision, the threshold was leakage greater than T/S allowable. Since the prior revision, many plants have implemented reduced steam generator T/S limits (e.g., 150 gpd) as a defense in depth associated with alternate steam generator plugging criteria. The 150 gpd threshold is deemed too low for use as an emergency threshold. A pressure boundary leakage of 10 gpm was used as the threshold in IC SU5, RCS Leakage, and is deemed appropriate for this EAL. For smaller breaks, not exceeding the normal charging capacity threshold in RCS Barrier "Potential Loss" EAL #2 (RCS Leak Rate) or not resulting in ECCS actuation in EAL #3 (SG Tube Rupture), this EAL results in a NOUE. For larger breaks, RCS barrier EALs #2 and #3 would result in an Alert. For SG tube ruptures which may involve multiple steam generators or unisolable secondary line breaks, this EAL would exist in conjunction with RCS barrier "Loss" EAL #3 and would result in a Site Area Emergency. Escalation to General Emergency would be based on "Potential Loss" of the Fuel Clad Barrier.

5. Containment Isolation Valve Status After Containment Isolation

This EAL is intended to address incomplete containment isolation that allows direct release to the environment. It represents a loss of the containment barrier.

The use of the modifier "direct" in defining the release path discriminates against release paths through interfacing liquid systems. The existence of an in-line charcoal filter does not make a release path indirect since the filter is not effective at removing fission noble gases. Typical filters have an efficiency of 95-99% removal of iodine. Given the magnitude of the core inventory of iodine, significant releases could still occur. In addition, since the fission product release would be driven by boiling in the reactor vessel, the high humidity in the release stream can be expected to render the filters ineffective in a short period.

There is no "Potential Loss" EAL associated with this item.

6. Significant Radioactive Inventory in Containment

The (site-specific) reading is a value which indicates significant fuel damage well in excess of the EALs associated with both loss of Fuel Clad and loss of RCS Barriers. As stated in Section 3.8, a major release of radioactivity requiring offsite protective actions from core damage is not possible unless a major failure of fuel cladding allows radioactive material to be released from the core into the reactor coolant.

Regardless of whether containment is challenged, this amount of activity in containment, if released, could have such severe consequences that it is prudent to treat this as a potential loss of containment, such that a General Emergency declaration is warranted. NUREG-1228, "Source Estimations During Incident Response to Severe Nuclear Power Plant Accidents," indicates that such conditions do not exist when the amount of clad damage is less than 20%. Unless there is a (site-specific) analysis justifying a higher value, it is recommended that a radiation monitor reading corresponding to 20% fuel clad damage be specified here.

There is no "Loss" EAL associated with this item.

7. Other (Site-Specific) Indications

This EAL should cover other (site-specific) indications that may unambiguously indicate loss or potential loss of the containment barrier, including indications from area or ventilation monitors in containment annulus or other contiguous buildings. If site emergency operating procedures provide for venting of the containment during an emergency as a means of preventing catastrophic failure, a Loss EAL should be included for the containment barrier. This EAL should be declared as soon as such venting is imminent. Containment venting as part of recovery actions is classified in accordance with the radiological effluent ICs.

8. Emergency Director Judgment

This EAL addresses any other factors that are to be used by the Emergency Director in determining whether the Containment barrier is lost or potentially lost. In addition, the inability to monitor the barrier should also be incorporated in this EAL as a factor in Emergency Director judgment that the barrier may be considered lost or potentially lost. (See also IC SG1, "Prolonged Loss of All Offsite Power and Prolonged Loss of All Onsite AC Power", for additional information.)

TABLE 5-H-1

Recognition Category H

Hazards and Other Conditions Affecting Plant Safety

INITIATING CONDITION MATRIX

NOUE	ALERT	SITE AREA EMERGENCY	GENERAL EMERGENCY
HU1 Natural and Destructive Phenomena Affecting the PROTECTED AREA. *Op. Modes: All*	**HA1** Natural and Destructive Phenomena Affecting the Plant VITAL AREA. *Op. Modes: All*		
HU2 FIRE Within PROTECTED AREA Boundary Not Extinguished Within 15 Minutes of Detection. *Op. Modes: All*	**HA2** FIRE or EXPLOSION Affecting the Operability of Plant Safety Systems Required to Establish or Maintain Safe Shutdown. *Op. Modes: All*		
HU3 Release of Toxic or Flammable Gases Deemed Detrimental to Safe Operation of the Plant. *Op. Modes: All*	**HA3** Release of Toxic or Flammable Gases Within or Contiguous to a VITAL AREA Which Jeopardizes Operation of Safety Systems Required to Establish or Maintain Safe Shutdown. *Op. Modes: All*		
HU4 Confirmed Security Event Which Indicates a Potential Degradation in the Level of Safety of the Plant. *Op. Modes: All*	**HA4** Confirmed Security Event in a Plant PROTECTED AREA. *Op. Modes: All*	**HS1** Confirmed Security Event in a Plant VITAL AREA. *Op. Modes: All*	**HG1** Security Event Resulting in Loss Of Physical Control of the Facility. *Op. Modes: All*
HU5 Other Conditions Existing Which in the Judgment of the Emergency Director Warrant Declaration of a NOUE. *Op. Modes: All*	**HA6** Other Conditions Existing Which in the Judgment of the Emergency Director Warrant Declaration of an Alert. *Op. Modes: All*	**HS3** Other Conditions Existing Which in the Judgment of the Emergency Director Warrant Declaration of Site Area Emergency. *Op. Modes: All*	**HG2** Other Conditions Existing Which in the Judgment of the Emergency Director Warrant Declaration of General Emergency. *Op. Modes: All*
	HA5 Control Room Evacuation Has Been Initiated. *Op. Modes: All*	**HS2** Control Room Evacuation Has Been Initiated and Plant Control Cannot Be Established. *Op. Modes: All*	

HU1

Initiating Condition – NOTIFICATION OF UNUSUAL EVENT

Natural and Destructive Phenomena Affecting the PROTECTED AREA.

Operating Mode Applicability: All

Example Emergency Action Level: (1 or 2 or 3 or 4 or 5 or 6 or 7)

1. (Site-Specific) method indicates felt earthquake.

2. Report by plant personnel of tornado or high winds greater than (site-specific) mph striking within PROTECTED AREA boundary.

3. Vehicle crash into plant structures or systems within PROTECTED AREA boundary.

4. Report by plant personnel of an unanticipated EXPLOSION within PROTECTED AREA boundary resulting in VISIBLE DAMAGE to permanent structure or equipment.

5. Report of turbine failure resulting in casing penetration or damage to turbine or generator seals.

6. Uncontrolled flooding in (site-specific) areas of the plant that has the potential to affect safety related equipment needed for the current operating mode.

7. (Site-Specific) occurrences affecting the PROTECTED AREA.

Basis:

NOUE in this IC are categorized on the basis of the occurrence of an event of sufficient magnitude to be of concern to plant operators. Areas identified in the EALs define the location of the event based on the potential for damage to equipment contained therein. Escalation of the event to an Alert occurs when the magnitude of the event is sufficient to result in damage to equipment contained in the specified location.

EAL #1 should be developed on site-specific basis. Damage may be caused to some portions of the site, but should not affect ability of safety functions to operate. Method of detection can be based on instrumentation, validated by a reliable source, or operator assessment. As defined in the EPRI-sponsored "Guidelines for Nuclear Plant Response to an Earthquake", dated October 1989, a *"felt earthquake"* is:

> An earthquake of sufficient intensity such that: (a) the vibratory ground motion is felt at the nuclear plant site and recognized as an earthquake based on a consensus of control room operators on duty at the time, and (b) for plants with operable seismic instrumentation, the seismic switches of the plant are activated. For most plants with seismic instrumentation, the seismic switches are set at an acceleration of about 0.01g.

EAL #2 is based on the assumption that a tornado striking (touching down) or high winds within the PROTECTED AREA may have potentially damaged plant structures containing functions or systems required for safe shutdown of the plant. The high wind site specific value in EAL#2 should be based on site-specific FSAR design basis. If such damage is confirmed visually or by other in-plant indications, the event may be escalated to Alert.

EAL #3 is intended to address crashes of vehicle types large enough to cause significant damage to plant structures containing functions and systems required for safe shutdown of the plant. If the crash is confirmed to affect a plant VITAL AREA, the event may be escalated to Alert.

For EAL #4 only those EXPLOSIONs of sufficient force to damage permanent structures or equipment within the PROTECTED AREA should be considered. No attempt is made in this EAL to assess the actual magnitude of the damage. The occurrence of the EXPLOSION with reports of evidence of damage is sufficient for declaration. The Emergency director also needs to consider any security aspects of the EXPLOSION, if applicable.

EAL #5 is intended to address main turbine rotating component failures of sufficient magnitude to cause observable damage to the turbine casing or to the seals of the turbine generator. Of major concern is the potential for leakage of combustible fluids (lubricating oils) and gases (hydrogen cooling) to the plant environs. Actual FIREs and flammable gas build up are appropriately classified via HU2 and HU3. Generator seal damage observed after generator purge does not meet the intent of this EAL because it did not impact normal operation of the plant. This EAL is consistent with the definition of a NOUE while maintaining the anticipatory nature desired and recognizing the risk to non-safety related equipment. Escalation of the emergency classification is based on potential damage done by missiles generated by the failure or by the radiological releases for a BWR, or in conjunction with a steam generator tube rupture, for a PWR. These latter events would be classified by the radiological ICs or Fission Product Barrier ICs.

EAL #6 addresses the effect of flooding caused by internal events such as component failures, equipment misalignment, or outage activity mishaps. The site-specific areas include those areas that contain systems required for safe shutdown of the plant, that are not designed to be wetted or submerged. Escalation of the emergency classification is based on the damage caused or by access restrictions that prevent necessary plant operations or systems monitoring. The plant's IPEEE may provide insight into areas to be considered when developing this EAL.

EAL #7 covers other site-specific phenomena such as hurricane, flood, or seiche. These EALs can also be precursors of more serious events. In particular, sites subject to severe weather as defined in the NUMARC station blackout initiatives, should include an EAL based on activation of the severe weather mitigation procedures (e.g., precautionary shutdowns, diesel testing, staff call-outs, etc.).

HAZARDS AND OTHER CONDITIONS AFFECTING PLANT SAFETY

HU2

Initiating Condition – NOTIFICATION OF UNUSUAL EVENT

FIRE Within PROTECTED AREA Boundary Not Extinguished Within 15 Minutes of Detection.

Operating Mode Applicability: All

Example Emergency Action Level:

1. FIRE in buildings or areas contiguous to any of the following (site-specific) areas not extinguished within 15 minutes of control room notification or verification of a control room alarm:

(Site-specific) list

Basis:

The purpose of this IC is to address the magnitude and extent of FIREs that may be potentially significant precursors to damage to safety systems. As used here, *Detection* is visual observation and report by plant personnel or sensor alarm indication. The 15 minute time period begins with a credible notification that a FIRE is occurring, or indication of a VALID fire detection system alarm. Verification of a fire detection system alarm includes actions that can be taken with the control room or other nearby site-specific location to ensure that the alarm is not spurious. A verified alarm is assumed to be an indication of a FIRE unless it is disproved within the 15 minute period by personnel dispatched to the scene. In other words, a personnel report from the scene may be used to disprove a sensor alarm if received within 15 minutes of the alarm, but shall not be required to verify the alarm.

The intent of this 15 minute duration is to size the FIRE and to discriminate against small FIREs that are readily extinguished (e.g., smoldering waste paper basket). The site-specific list should be limited and applies to buildings and areas contiguous (in actual contact with or immediately adjacent*)* to plant VITAL AREAs or other significant buildings or areas. The intent of this IC is not to include buildings (i.e., warehouses) or areas that are not contiguous (in actual contact with or immediately adjacent) to plant VITAL AREAs. This excludes FIREs within administration buildings, waste-basket FIREs, and other small FIREs of no safety consequence.

Escalation to a higher emergency class is by IC HA4, "FIRE Affecting the Operability of Plant Safety Systems Required for the Current Operating Mode".

HU3

Initiating Condition – NOTIFICATION OF UNUSUAL EVENT

Release of Toxic or Flammable Gases Deemed Detrimental to Normal Operation of the Plant.

Operating Mode Applicability: All

Example Emergency Action Levels: (1 or 2)

1. Report or detection of toxic or flammable gases that has or could enter the site area boundary in amounts that can affect NORMAL PLANT OPERATIONS.

2. Report by Local, County or State Officials for evacuation or sheltering of site personnel based on an offsite event.

Basis:

This IC is based on the existence of uncontrolled releases of toxic or flammable gas that may enter the site boundary and affect normal plant operations. It is intended that releases of toxic or flammable gases are of sufficient quantity, and the release point of such gases is such that normal plant operations would be affected. This would preclude small or incidental releases, or releases that do not impact structures needed for plant operation. The EALs are intended to not require significant assessment or quantification. The IC assumes an uncontrolled process that has the potential to affect plant operations, or personnel safety.

Escalation of this EAL is via HA3, which involves a quantified release of toxic or flammable gas affecting VITAL AREAs.

HU4

Initiating Condition – NOTIFICATION OF UNUSUAL EVENT

Confirmed Security Event Which Indicates a Potential Degradation in the Level of Safety of the Plant.

Operating Mode Applicability: All

Example Emergency Action Levels:

1. Security events as determined from (site-specific) Safeguards Contingency Plan and reported by the (site-specific) security shift supervision

Basis:

This EAL is based on (site-specific) Site Security Plans. Security events which do not represent a potential degradation in the level of safety of the plant, are reported under 10 CFR 73.71 or in some cases under 10 CFR 50.72. Examples of security events that indicate Potential Degradation in the Level of Safety of the Plant are provided below for consideration.

Consideration should be given to the following types of events when evaluating an event against the criteria of the site specific Security Contingency Plan: SABOTAGE, HOSTAGE / EXTORTION, CIVIL DISTURBANCE, and STRIKE ACTION.

INTRUSION into the plant PROTECTED AREA by a HOSTILE FORCE would result in EAL escalation to an ALERT.

Reference is made to (site-specific) security shift supervision because these individuals are the designated personnel on-site qualified and trained to confirm that a security event is occurring or has occurred. Training on security event classification confirmation is closely controlled due to the strict secrecy controls placed on the plant Security Plan.

HAZARDS AND OTHER CONDITIONS AFFECTING PLANT SAFETY

HU5

Initiating Condition – NOTIFICATION OF UNUSUAL EVENT

Other Conditions Existing Which in the Judgment of the Emergency Director Warrant Declaration of a NOUE.

Operating Mode Applicability: All

Example Emergency Action Level:

1. Other conditions exist which in the judgment of the Emergency Director indicate that events are in process or have occurred which indicate a potential degradation of the level of safety of the plant. No releases of radioactive material requiring offsite response or monitoring are expected unless further degradation of safety systems occurs.

Basis:

This EAL is intended to address unanticipated conditions not addressed explicitly elsewhere but that warrant declaration of an emergency because conditions exist which are believed by the Emergency Director to fall under the NOUE emergency class.

From a broad perspective, one area that may warrant Emergency Director judgment is related to likely or actual breakdown of site-specific event mitigating actions. Examples to consider include inadequate emergency response procedures, transient response either unexpected or not understood, failure or unavailability of emergency systems during an accident in excess of that assumed in accident analysis, or insufficient availability of equipment and/or support personnel.

HAZARDS AND OTHER CONDITIONS AFFECTING PLANT SAFETY

HA1

Initiating Condition -- ALERT

Natural and Destructive Phenomena Affecting the Plant VITAL AREA.

Operating Mode Applicability: All

Example Emergency Action Levels: (1 or 2 or 3 or 4 or 5 or 6)

1. (Site-Specific) method indicates Seismic Event greater than Operating Basis Earthquake (OBE).

2. Tornado or high winds greater than (site-specific) mph within PROTECTED AREA boundary and resulting in VISIBLE DAMAGE to any of the following plant structures / equipment or Control Room indication of degraded performance of those systems.

   - Reactor Building
   - Intake Building
   - Ultimate Heat Sink
   - Refueling Water Storage Tank
   - Diesel Generator Building
   - Turbine Building
   - Condensate Storage Tank
   - Control Room
   - Other (Site-Specific) Structures.

3. Vehicle crash within PROTECTED AREA boundary and resulting in VISIBLE DAMAGE to any of the following plant structures or equipment therein or control indication of degraded performance of those systems:

   - Reactor Building
   - Intake Building
   - Ultimate Heat Sink
   - Refueling Water Storage Tank
   - Diesel Generator Building
   - Turbine Building
   - Condensate Storage Tank
   - Control Room
   - Other (Site-Specific) Structures.

4. Turbine failure-generated missiles result in any VISIBLE DAMAGE to or penetration of any of the following plant areas: (site-specific) list.

5. Uncontrolled flooding in (site-specific) areas of the plant that results in degraded safety system performance as indicated in the control room or that creates industrial safety hazards (e.g., electric shock) that precludes access necessary to operate or monitor safety equipment.

6. (Site-Specific) occurrences within PROTECTED AREA boundary and resulting in VISIBLE DAMAGE to plant structures containing equipment necessary for safe shutdown, or has caused damage as evidenced by control room indication of degraded performance of those systems.

Basis:

The EALs in this IC escalate from the NOUE EALs in HU1 in that the occurrence of the event has resulted in VISIBLE DAMAGE to plant structures or areas containing equipment necessary for a safe shutdown, or has caused damage to the safety systems in those structures evidenced by control indications of degraded system response or performance. The occurrence of VISIBLE DAMAGE and/or degraded system response is intended to discriminate against lesser events. The initial "report" should not be interpreted as mandating a lengthy damage assessment prior to classification. No attempt is made in this EAL to assess the actual magnitude of the damage. The significance here is not that a particular system or structure was damaged, but rather, that the event was of sufficient magnitude to cause this degradation. Escalation to higher classifications occur on the basis of other ICs (e.g., System Malfunction).

EAL #1 should be based on site-specific FSAR design basis. Seismic events of this magnitude can result in a plant VITAL AREA being subjected to forces beyond design limits, and thus damage may be assumed to have occurred to plant safety systems. See EPRI-sponsored "Guidelines for Nuclear Plant Response to an Earthquake", dated October 1989, for information on seismic event categories.

EAL #2 should be based on site-specific FSAR design basis. Wind loads of this magnitude can cause damage to safety functions.

EAL #s 2, 3, 4, 5 should specify site-specific structures or areas containing systems and functions required for safe shutdown of the plant.

EAL #3 is intended to address crashes of vehicle types large enough to cause significant damage to plant structures containing functions and systems required for safe shutdown of the plant.

EAL #4 is intended to address the threat to safety related equipment imposed by missiles generated by main turbine rotating component failures. This site-specific list of areas should include all areas containing safety-related equipment, their controls, and their power supplies. This EAL is, therefore, consistent with the definition of an ALERT in that if missiles have damaged or penetrated areas containing safety-related equipment the potential exists for substantial degradation of the level of safety of the plant.

EAL #5 addresses the effect of internal flooding that has resulted in degraded performance of systems affected by the flooding, or has created industrial safety hazards (e.g., electrical shock) that preclude necessary access to operate or monitor safety equipment. The inability to operate or monitor safety equipment represents a potential for substantial degradation of the level of safety of the plant. This flooding may have been caused by internal events such as component failures, equipment misalignment, or outage activity mishaps. The site-specific areas includes those areas that contain systems required for safe shutdown of the plant, that are not designed to be wetted or submerged. The plant's IPEEE may provide insight into areas to be considered when developing this EAL.

EAL #6 covers other site-specific phenomena such as hurricane, flood, or seiche. These EALs can also be precursors of more serious events.

HAZARDS AND OTHER CONDITIONS AFFECTING PLANT SAFETY

HA2

Initiating Condition -- ALERT

FIRE or EXPLOSION Affecting the Operability of Plant Safety Systems Required to Establish or Maintain Safe Shutdown.

Operating Mode Applicability: All

Example Emergency Action Level:

1. FIRE or EXPLOSION in any of the following (site-specific) areas:

(Site-specific) list

AND

Affected system parameter indications show degraded performance or plant personnel report VISIBLE DAMAGE to permanent structures or equipment within the specified area.

Basis:

Site-specific areas containing functions and systems required for the safe shutdown of the plant should be specified. Site-Specific Safe Shutdown Analysis should be consulted for equipment and plant areas required to establish or maintain safe shutdown. This will make it easier to determine if the FIRE or EXPLOSION is potentially affecting one or more redundant trains of safety systems. Escalation to a higher emergency class, if appropriate, will be based on System Malfunction, Fission Product Barrier Degradation, Abnormal Rad Levels / Radiological Effluent, or Emergency Director Judgment ICs.

This EAL addresses a FIRE / EXPLOSION and not the degradation in performance of affected systems. System degradation is addressed in the System Malfunction EALs. The reference to damage of systems is used to identify the magnitude of the FIRE / EXPLOSION and to discriminate against minor FIREs / EXPLOSIONs. The reference to safety systems is included to discriminate against FIREs / EXPLOSIONs in areas having a low probability of affecting safe operation. The significance here is not that a safety system was degraded but the fact that the FIRE / EXPLOSION was large enough to cause damage to these systems. Thus, the designation of a single train was intentional and is appropriate when the FIRE / EXPLOSION is large enough to affect more than one component.

This situation is not the same as removing equipment for maintenance that is covered by a plant's Technical Specifications. Removal of equipment for maintenance is a planned activity controlled in accordance with procedures and, as such, does not constitute a substantial degradation in the level of safety of the plant. A FIRE / EXPLOSION is an UNPLANNED activity and, as such, does constitute a substantial degradation in the level of safety of the plant. In this situation, an Alert classification is warranted.

The inclusion of a "report of VISIBLE DAMAGE" should not be interpreted as mandating a lengthy damage assessment prior to classification. No attempt is made in this EAL to assess the actual magnitude of the damage. The occurrence of the EXPLOSION with reports of evidence of damage is sufficient for declaration. The declaration of an Alert and the activation of the Technical Support Center will provide the Emergency Director with the resources needed to perform these damage assessments. The Emergency Director also needs to consider any security aspects of the EXPLOSIONs, if applicable.

HAZARDS AND OTHER CONDITIONS AFFECTING PLANT SAFETY

HA3

Initiating Condition -- ALERT

Release of Toxic or Flammable Gases Within or Contiguous to a VITAL AREA Which Jeopardizes Operation of Systems Required to Establish or Maintain Safe Shutdown.

Operating Mode Applicability: All

Example Emergency Action Levels: (1 or 2)

1. Report or detection of toxic gases within or contiguous to a VITAL AREA in concentrations that may result in an atmosphere Immediately Dangerous to Life and Health (IDLH)

2. Report or detection of gases in concentration greater than the LOWER FLAMMABILITY LIMIT within or contiguous to a VITAL AREA .

Basis:

This IC is based on gases that affect the safe operation of the plant. This IC applies to buildings and areas contiguous to plant VITAL AREAs or other significant buildings or areas (i.e., service water pump house). The intent of this IC is not to include buildings (e.g., warehouses) or other areas that are not contiguous or immediately adjacent to plant VITAL AREAs. It is appropriate that increased monitoring be done to ascertain whether consequential damage has occurred. Escalation to a higher emergency class, if appropriate, will be based on System Malfunction, Fission Product Barrier Degradation, Abnormal Rad Levels / Radioactive Effluent, or Emergency Director Judgment ICs.

EAL #1 is met if measurement of toxic gas concentration results in an atmosphere that is IDLH within a VITAL AREA or any area or building contiguous to VITAL AREA. Exposure to an IDLH atmosphere will result in immediate harm to unprotected personnel, and would preclude access to any such affected areas.

EAL #2 is met when the flammable gas concentration in a VITAL AREA or any building or area contiguous to a VITAL AREA exceed the LOWER FLAMMABILITY LIMIT. Flammable gasses, such as hydrogen and acetylene, are routinely used to maintain plant systems (hydrogen) or to repair equipment/components (acetylene - used in welding). This EAL addresses concentrations at which gases can ignite/support combustion. An uncontrolled release of flammable gasses within a facility structure has the potential to affect safe operation of the plant by limiting either operator or equipment operations due to the potential for ignition and resulting equipment damage/personnel injury. Once it has been determined that an uncontrolled release is occurring, then sampling must be done to determine if the concentration of the released gas is within this range.

HA4

Initiating Condition – ALERT

Confirmed Security Event in a Plant PROTECTED AREA.

Operating Mode Applicability: All

Example Emergency Action Levels: (1 or 2)

1. INTRUSION into the plant PROTECTED AREA by a HOSTILE FORCE.

2. Other security events as determined from (site-specific) Safeguards Contingency Plan and reported by the (site-specific) security shift supervision

Basis:

This class of security events represents an escalated threat to plant safety above that contained in the NOUE. A confirmed INTRUSION report is satisfied if physical evidence indicates the presence of a HOSTILE FORCE within the PROTECTED AREA.

Consideration should be given to the following types of events when evaluating an event against the criteria of the site specific Security Contingency Plan: SABOTAGE, HOSTAGE / EXTORTION, and STRIKE ACTION. The Safeguards Contingency Plan identifies numerous events/conditions that constitute a threat/compromise to a Station's security. Only those events that involve Actual or Potential Substantial degradation to the level of safety of the plant need to be considered. The following events would not normally meet this requirement; (e.g., Failure by a Member of the Security Force to carry out an assigned/required duty, internal disturbances, loss/compromise of safeguards materials or strike actions).

INTRUSION into a VITAL AREA by a HOSTILE FORCE will escalate this event to a Site Area Emergency.

Reference is made to (site-specific) security shift supervision because these individuals are the designated personnel on-site qualified and trained to confirm that a security event is occurring or has occurred. Training on security event classification confirmation is closely controlled due to the strict secrecy controls placed on the plant Security Plan.

HAZARDS AND OTHER CONDITIONS AFFECTING PLANT SAFETY

HA5

Initiating Condition – ALERT

Control Room Evacuation Has Been Initiated.

Operating Mode Applicability: All

Example Emergency Action Level:

1. Entry into (site-specific) procedure for control room evacuation.

Basis:

With the control room evacuated, additional support, monitoring and direction through the Technical Support Center and/or other emergency response facility is necessary. Inability to establish plant control from outside the control room will escalate this event to a Site Area Emergency.

HA6

Initiating Condition -- ALERT

Other Conditions Existing Which in the Judgment of the Emergency Director Warrant Declaration of an Alert.

Operating Mode Applicability: All

Example Emergency Action Level:

1. Other conditions exist which in the judgment of the Emergency Director indicate that events are in process or have occurred which involve actual or likely potential substantial degradation of the level of safety of the plant. Any releases are expected to be limited to small fractions of the EPA Protective Action Guideline exposure levels .

Basis:

This EAL is intended to address unanticipated conditions not addressed explicitly elsewhere but that warrant declaration of an emergency because conditions exist which are believed by the Emergency Director to fall under the Alert emergency class.

HAZARDS AND OTHER CONDITIONS AFFECTING PLANT SAFETY

HS1

Initiating Condition – SITE AREA EMERGENCY

Confirmed Security Event in a Plant VITAL AREA.

Operating Mode Applicability: All

Example Emergency Action Levels: (1 or 2)

1. INTRUSION into the plant VITAL AREA by a HOSTILE FORCE.

2. Other security events as determined from (site-specific) Safeguards Contingency Plan and reported by the (site-specific) security shift supervision

Basis:

This class of security events represents an escalated threat to plant safety above that contained in the Alert IC in that a HOSTILE FORCE has progressed from the PROTECTED AREA to a VITAL AREA.

Consideration should be given to the following types of events when evaluating an event against the criteria of the site specific Security Contingency Plan: SABOTAGE and HOSTAGE / EXTORTION. The Safeguards Contingency Plan identifies numerous events/conditions that constitute a threat/compromise to a Station's security. Only those events that involve Actual or Likely Major failures of plant functions needed for protection of the public need to be considered. The following events would not normally meet this requirement; (e.g., Failure by a Member of the Security Force to carry out an assigned/required duty, internal disturbances, loss/compromise of safeguards materials or strike actions).

Loss of Plant Control would escalate this event to a GENERAL EMERGENCY.

Reference is made to (site-specific) security shift supervision because these individuals are the designated personnel on-site qualified and trained to confirm that a security event is occurring or has occurred. Training on security event classification confirmation is closely controlled due to the strict secrecy controls placed on the plant Security Plan.

HAZARDS AND OTHER CONDITIONS
AFFECTING PLANT SAFETY

HS2

Initiating Condition – SITE AREA EMERGENCY

Control Room Evacuation Has Been Initiated and Plant Control Cannot Be Established.

Operating Mode Applicability: All

Example Emergency Action Level:

1. Control room evacuation has been initiated.

AND

Control of the plant cannot be established per (site-specific) procedure within (site-specific) minutes.

Basis:

Expeditious transfer of safety systems has not occurred but fission product barrier damage may not yet be indicated. The intent of this IC is to capture those events where control of the plant cannot be reestablished in a timely manner. Site-specific time for transfer based on analysis or assessments as to how quickly control must be reestablished without core uncovering and/or core damage. This time should not exceed 15 minutes without additional justification. The determination of whether or not control is established at the remote shutdown panel is based on Emergency Director (ED) judgment. The ED is expected to make a reasonable, informed judgment within the site-specific time for transfer that the licensee has control of the plant from the remote shutdown panel.

The intent of the EAL is to establish control of important plant equipment and knowledge of important plant parameters in a timely manner. Primary emphasis should be placed on those components and instruments that supply protection for and information about safety functions. Typically, these safety functions are reactivity control (ability to shutdown the reactor and maintain it shutdown), reactor water level (ability to cool the core), and decay heat removal (ability to maintain a heat sink) for a BWR. The equivalent functions for a PWR are reactivity control, RCS inventory, and secondary heat removal.

Escalation of this event, if appropriate, would be by Fission Product Barrier Degradation, Abnormal Rad Levels/Radiological Effluent, or Emergency Director Judgment ICs.

HS3

Initiating Condition – SITE AREA EMERGENCY

Other Conditions Existing Which in the Judgment of the Emergency Director Warrant Declaration of Site Area Emergency.

Operating Mode Applicability: All

Example Emergency Action Level:

1. Other conditions exist which in the judgment of the Emergency Director indicate that events are in process or have occurred which involve actual or likely major failures of plant functions needed for protection of the public. Any releases are not expected to result in exposure levels which exceed EPA Protective Action Guideline exposure levels beyond the site boundary.

Basis:

This EAL is intended to address unanticipated conditions not addressed explicitly elsewhere but that warrant declaration of an emergency because conditions exist which are believed by the Emergency Director to fall under the emergency class description for Site Area Emergency.

HG1

Initiating Condition – GENERAL EMERGENCY

Security Event Resulting in Loss Of Physical Control of the Facility.

Operating Mode Applicability: All

Example Emergency Action Level:

1. A HOSTILE FORCE has taken control of plant equipment such that plant personnel are unable to operate equipment required to maintain safety functions.

Basis:

This IC encompasses conditions under which a HOSTILE FORCE has taken physical control of VITAL AREAs (containing vital equipment or controls of vital equipment) required to maintain safety functions and control of that equipment cannot be transferred to and operated from another location. Typically, these safety functions are reactivity control (ability to shut down the reactor and keep it shutdown) reactor water level (ability to cool the core), and decay heat removal (ability to maintain a heat sink) for a BWR. The equivalent functions for a PWR are reactivity control, RCS inventory, and secondary heat removal. If control of the plant equipment necessary to maintain safety functions can be transferred to another location, then the above initiating condition is not met.

This EAL should also address loss of physical control of spent fuel pool cooling systems if imminent fuel damage is likely (e.g., freshly off-loaded reactor core in pool).

Loss of physical control of the control room or remote shutdown capability alone may not prevent the ability to maintain safety functions per se. Design of the remote shutdown capability and the location of the transfer switches should be taken into account.

HG2

Initiating Condition – GENERAL EMERGENCY

Other Conditions Existing Which in the Judgment of the Emergency Director Warrant Declaration of General Emergency.

Operating Mode Applicability: All

Example Emergency Action Level:

1. Other conditions exist which in the judgment of the Emergency Director indicate that events are in process or have occurred which involve actual or imminent substantial core degradation or melting with potential for loss of containment integrity. Releases can be reasonably expected to exceed EPA Protective Action Guideline exposure levels offsite for more than the immediate site area.

Basis:

This EAL is intended to address unanticipated conditions not addressed explicitly elsewhere but that warrant declaration of an emergency because conditions exist which are believed by the Emergency Director to fall under the General Emergency class.

Recognition Category S

System Malfunction

INITIATING CONDITION MATRIX

NOUE	ALERT	SITE AREA EMERGENCY	GENERAL EMERGENCY
SU1 Loss of All Offsite Power to Essential Busses for Greater Than 15 Minutes. *Op. Modes: Power Operation, Startup, Hot Standby, Hot Shutdown*	**SA5** AC power capability to essential busses reduced to a single power source for greater than 15 minutes such that any additional single failure would result in station blackout. *Op. Modes: Power Operation, Startup, Hot Standby, Hot Shutdown*	**SS1** Loss of All Offsite Power and Loss of All Onsite AC Power to Essential Busses. *Op. Modes: Power Operation, Startup, Hot Standby, Hot Shutdown*	**SG1** Prolonged Loss of All Offsite Power and Prolonged Loss of All Onsite AC Power to Essential Busses. *Op. Modes: Power Operation, Startup, Hot Standby, Hot Shutdown*
	SA2 Failure of Reactor Protection System Instrumentation to Complete or Initiate an Automatic Reactor Scram Once a Reactor Protection System Setpoint Has Been Exceeded and Manual Scram Was Successful. *Op. Modes: Power Operation, Startup, Hot Standby*	**SS2** Failure of Reactor Protection System Instrumentation to Complete or Initiate an Automatic Reactor Scram Once a Reactor Protection System Setpoint Has Been Exceeded and Manual Scram Was NOT Successful. *Op. Modes: Power Operation, Startup*	**SG2** Failure of the Reactor Protection System to Complete an Automatic Scram and Manual Scram was NOT Successful and There is Indication of an Extreme Challenge to the Ability to Cool the Core. *Op. Modes: Power Operation, Startup*
SU2 Inability to Reach Required Shutdown Within Technical Specification Limits. *Op. Modes: Power Operation, Startup, Hot Standby, Hot Shutdown*	**SA3** *Deleted*	**SS4** Complete Loss of Heat Removal Capability. *Op. Modes: Power Operation, Startup, Hot Standby, Hot Shutdown*	
SU3 UNPLANNED Loss of Most or All Safety System Annunciation or Indication in The Control Room for Greater Than 15 Minutes *Op. Modes: Power Operation, Startup, Hot Standby, Hot Shutdown*	**SA4** UNPLANNED Loss of Most or All Safety System Annunciation or Indication in Control Room With Either (1) a SIGNIFICANT TRANSIENT in Progress, or (2) Compensatory Non-Alarming Indicators are Unavailable. *Op. Modes: Power Operation, Startup, Hot Standby, Hot Shutdown*	**SS6** Inability to Monitor a SIGNIFICANT TRANSIENT in Progress. *Op. Modes: Power Operation, Startup, Hot Standby, Hot Shutdown*	

Recognition Category S

System Malfunction

INITIATING CONDITION MATRIX

SU7 *Deleted*

SU4 Fuel Clad Degradation.
Op. Modes: Power Operation, Startup, Hot Standby, Hot Shutdown

SU5 RCS Leakage.
Op. Modes: Power Operation, Startup, Hot Standby, Hot Shutdown

SU6 UNPLANNED Loss of All Onsite or Offsite Communications Capabilities.
Op. Modes: Power Operation, Startup, Hot Standby, Hot Shutdown

SU8 Inadvertent Criticality.
Op Modes: Hot Standby, Hot Shutdown

SA1 *Deleted*

SS3 Loss of All Vital DC Power.
Op. Modes: Power Operation, Startup, Hot Standby, Hot Shutdown

SS5 *Deleted*

SU1

Initiating Condition – NOTIFICATION OF UNUSUAL EVENT

Loss of All Offsite Power to Essential Busses for Greater Than 15 Minutes.

Operating Mode Applicability: Power Operation
Startup
Hot Standby
Hot Shutdown

Example Emergency Action Level:

1. Loss of power to (site-specific) transformers for greater than 15 minutes.

AND

At least (site-specific) emergency generators are supplying power to emergency busses.

Basis:

Prolonged loss of AC power reduces required redundancy and potentially degrades the level of safety of the plant by rendering the plant more vulnerable to a complete Loss of AC Power (e.g., Station Blackout). Fifteen minutes was selected as a threshold to exclude transient or momentary power losses.

Plants that have the capability to cross-tie AC power from a companion unit may take credit for the redundant power source in the associated EAL for this IC. Inability to effect the cross-tie within 15 minutes warrants declaring a NOUE.

SU2

Initiating Condition – NOTIFICATION OF UNUSUAL EVENT

Inability to Reach Required Shutdown Within Technical Specification Limits.

Operating Mode Applicability: Power Operation
Startup
Hot Standby
Hot Shutdown

Example Emergency Action Level:

1. Plant is not brought to required operating mode within (site-specific) Technical Specifications LCO Action Statement Time.

Basis:

Limiting Conditions of Operation (LCOs) require the plant to be brought to a required shutdown mode when the Technical Specification required configuration cannot be restored. Depending on the circumstances, this may or may not be an emergency or precursor to a more severe condition. In any case, the initiation of plant shutdown required by the site Technical Specifications requires a one hour report under 10 CFR 50.72 (b) Non-emergency events. The plant is within its safety envelope when being shut down within the allowable action statement time in the Technical Specifications. An immediate NOUE is required when the plant is not brought to the required operating mode within the allowable action statement time in the Technical Specifications. Declaration of a NOUE is based on the time at which the LCO-specified action statement time period elapses under the site Technical Specifications and is not related to how long a condition may have existed. Other required Technical Specification shutdowns that involve precursors to more serious events are addressed by other System Malfunction, Hazards, or Fission Product Barrier Degradation ICs.

SU3

Initiating Condition – NOTIFICATION OF UNUSUAL EVENT

UNPLANNED Loss of Most or All Safety System Annunciation or Indication in The Control Room for Greater Than 15 Minutes

Operating Mode Applicability: Power Operation
Startup
Hot Standby
Hot Shutdown

Example Emergency Action Level:

1. UNPLANNED loss of most or all (site-specific) annunciators or indicators associated with safety systems for greater than 15 minutes.

Basis:

This IC and its associated EAL are intended to recognize the difficulty associated with monitoring changing plant conditions without the use of a major portion of the annunciation or indication equipment.

Recognition of the availability of computer based indication equipment is considered (e.g., SPDS, plant computer, etc.).

Quantification of "Most" is arbitrary, however, it is estimated that if approximately 75% of the safety system annunciators or indicators are lost, there is an increased risk that a degraded plant condition could go undetected. It is not intended that plant personnel perform a detailed count of the instrumentation lost but use the value as a judgment threshold for determining the severity of the plant conditions.

It is further recognized that most plant designs provide redundant safety system indication powered from separate uninterruptable power supplies. While failure of a large portion of annunciators is more likely than a failure of a large portion of indications, the concern is included in this EAL due to difficulty associated with assessment of plant conditions. The loss of specific, or several, safety system indicators should remain a function of that specific system or component operability status. This will be addressed by the specific Technical Specification. The initiation of a Technical Specification imposed plant shutdown related to the instrument loss will be reported via 10 CFR 50.72. If the shutdown is not in compliance with the Technical Specification action, the NOUE is based on SU2 "Inability to Reach Required Shutdown Within Technical Specification Limits."

(Site-specific) annunciators or indicators for this EAL must include those identified in the Abnormal Operating Procedures, in the Emergency Operating Procedures, and in other EALs (e.g., area, process, and/or effluent rad monitors, etc.).

Fifteen minutes was selected as a threshold to exclude transient or momentary power losses.

Due to the limited number of safety systems in operation during cold shutdown, refueling, and defueled modes, no IC is indicated during these modes of operation.

This NOUE will be escalated to an Alert if a transient is in progress during the loss of annunciation or indication.

SU4

Initiating Condition -- NOTIFICATION OF UNUSUAL EVENT

Fuel Clad Degradation.

Operating Mode Applicability: Power Operation
Startup
Hot Standby
Hot Shutdown

Example Emergency Action Levels: (1 or 2)

1. (Site-specific) radiation monitor readings indicating fuel clad degradation greater than Technical Specification allowable limits.

2. (Site-specific) coolant sample activity value indicating fuel clad degradation greater than Technical Specification allowable limits.

Basis:

This IC is included as a NOUE because it is considered to be a potential degradation in the level of safety of the plant and a potential precursor of more serious problems. EAL #1 addresses site-specific radiation monitor readings such as BWR air ejector monitors, PWR failed fuel monitors, etc., that provide indication of fuel clad integrity. EAL #2 addresses coolant samples exceeding coolant technical specifications for iodine spike. Escalation of this IC to the Alert level is via the Fission Product Barrier Degradation Monitoring ICs. Though the referenced Technical Specification limits are mode dependent, it is appropriate that the EAL's be applicable in all modes, as they indicate a potential degradation in the level of safety of the plant. The companion IC to SU8 for the Cold Shutdown/Refueling modes is CU5.

SYSTEM MALFUNCTION

SU5

Initiating Condition – NOTIFICATION OF UNUSUAL EVENT

RCS Leakage.

Operating Mode Applicability: Power Operation
Startup
Hot Standby
Hot Shutdown

Example Emergency Action Levels: (1 or 2)

1. Unidentified or pressure boundary leakage greater than 10 gpm.

2. Identified leakage greater than 25 gpm.

Basis:

This IC is included as a NOUE because it may be a precursor of more serious conditions and, as result, is considered to be a potential degradation of the level of safety of the plant. The 10 gpm value for the unidentified and pressure boundary leakage was selected as it is observable with normal control room indications. Lesser values must generally be determined through time-consuming surveillance tests (e.g., mass balances). The EAL for identified leakage is set at a higher value due to the lesser significance of identified leakage in comparison to unidentified or pressure boundary leakage. In either case, escalation of this IC to the Alert level is via Fission Product Barrier Degradation ICs.

SU6

Initiating Condition -- NOTIFICATION OF UNUSUAL EVENT

UNPLANNED Loss of All Onsite or Offsite Communications Capabilities.

Operating Mode Applicability: Power Operation
Startup
Hot Standby
Hot Shutdown

Example Emergency Action Levels: (1 or 2)

1. Loss of all (site-specific list) onsite communications capability affecting the ability to perform routine operations.

2. Loss of all (site-specific list) offsite communications capability.

Basis:

The purpose of this IC and its associated EALs is to recognize a loss of communications capability that either defeats the plant operations staff ability to perform routine tasks necessary for plant operations or the ability to communicate problems with offsite authorities. The loss of offsite communications ability is expected to be significantly more comprehensive than the condition addressed by 10 CFR 50.72.

The availability of one method of ordinary offsite communications is sufficient to inform state and local authorities of plant problems. This EAL is intended to be used only when extraordinary means (e.g., relaying of information from radio transmissions, individuals being sent to offsite locations, etc.) are being utilized to make communications possible.

Site-specific list for onsite communications loss must encompass the loss of all means of routine communications (e.g., commercial telephones, sound powered phone systems, page party system (Gaitronics) and radios / walkie talkies).

Site-specific list for offsite communications loss must encompass the loss of all means of communications with offsite authorities. This should include the ENS, commercial telephone lines, telecopy transmissions, and dedicated phone systems.

SYSTEM MALFUNCTION

SU8

Initiating Condition -- NOTIFICATION OF UNUSUAL EVENT

Inadvertent Criticality.

OPERATING MODE APPLICABILITY Hot Standby
Hot Shutdown

Example Emergency Action Level: (1 or 2)

1. An UNPLANNED extended positive period observed on nuclear instrumentation.

2. An UNPLANNED sustained positive startup rate observed on nuclear instrumentation.

Basis:

This IC addresses inadvertent criticality events. While the primary concern of this IC is criticality events that occur in Cold Shutdown or Refueling modes (NUREG 1449, Shutdown and Low-Power Operation at Commercial Nuclear Power Plants in the United States), the IC is applicable in other modes in which inadvertent criticalities are possible. This IC indicates a potential degradation of the level of safety of the plant, warranting a NOUE classification. This IC excludes inadvertent criticalities that occur during planned reactivity changes associated with reactor startups (e.g., criticality earlier than estimated). The Cold Shutdown/Refueling IC is CU8.

This condition can be identified using period monitors/startup rate monitor. The term "extended" is used in order to allow exclusion of expected short term positive periods/startup rates from planned fuel bundle or control rod movements during core alteration for PWRs and BWRs. These short term positive periods/startup rates are the result of the increase in neutron population due to subcritical multiplication.

Escalation would be by the Fission Product Barrier Matrix, as appropriate to the operating mode at the time of the event, or by Emergency Director Judgment.

Initiating Condition – ALERT

Failure of Reactor Protection System Instrumentation to Complete or Initiate an Automatic Reactor Scram Once a Reactor Protection System Setpoint Has Been Exceeded and Manual Scram Was Successful.

Operating Mode Applicability: Power Operation
Startup
Hot Standby

Example Emergency Action Level:

1. Indication(s) exist that indicate that reactor protection system setpoint was exceeded and automatic scram did not occur, and a successful manual scram occurred.

Basis:

This condition indicates failure of the automatic protection system to scram the reactor. This condition is more than a potential degradation of a safety system in that a front line automatic protection system did not function in response to a plant transient and thus the plant safety has been compromised, and design limits of the fuel may have been exceeded. An Alert is indicated because conditions exist that lead to potential loss of fuel clad or RCS. Reactor protection system setpoint being exceeded, rather than limiting safety system setpoint being exceeded, is specified here because failure of the automatic protection system is the issue. A manual scram is any set of actions by the reactor operator(s) at the reactor control console which causes control rods to be rapidly inserted into the core and brings the reactor subcritical (e.g., reactor trip button, Alternate Rod Insertion). Failure of manual scram would escalate the event to a Site Area Emergency.

SA4

Initiating Condition – ALERT

UNPLANNED Loss of Most or All Safety System Annunciation or Indication in Control Room With Either (1) a SIGNIFICANT TRANSIENT in Progress, or (2) Compensatory Non-Alarming Indicators are Unavailable.

Operating Mode Applicability: Power Operation
Startup
Hot Standby
Hot Shutdown

Example Emergency Action Level:

1. UNPLANNED loss of most or all (site-specific) annunciators or indicators associated with safety systems for greater than 15 minutes.

AND

Either of the following: (a or b)

a. A SIGNIFICANT TRANSIENT is in progress.

OR

b. Compensatory non-alarming indications are unavailable.

Basis:

This IC and its associated EAL are intended to recognize the difficulty associated with monitoring changing plant conditions without the use of a major portion of the annunciation or indication equipment during a transient. Recognition of the availability of computer based indication equipment is considered (e.g., SPDS, plant computer, etc.).

"Planned" loss of annunciators or indicators includes scheduled maintenance and testing activities.

Quantification of "Most" is arbitrary, however, it is estimated that if approximately 75% of the safety system annunciators or indicators are lost, there is an increased risk that a degraded plant condition could go undetected. It is not intended that plant personnel perform a detailed count of the instrumentation lost but use the value as a judgment threshold for determining the severity of the plant conditions. It is also not intended that the Shift Supervisor be tasked with making a judgment decision as to whether additional personnel are required to provide increased monitoring of system operation.

It is further recognized that most plant designs provide redundant safety system indication powered from separate uninterruptable power supplies. While failure of a large portion of annunciators is more likely than a failure of a large portion of indications, the concern is included in this EAL due to difficulty associated with assessment of plant conditions. The loss of specific, or several, safety system indicators should remain a function of that specific system or component operability status. This will be addressed by the specific Technical Specification. The initiation of a Technical Specification imposed plant shutdown related to the instrument loss will be reported via 10 CFR 50.72. If the shutdown is not in compliance with the Technical Specification action, the NOUE is based on SU2 "Inability to Reach Required Shutdown Within Technical Specification Limits."

Site-specific annunciators or indicators for this EAL must include those identified in the Abnormal Operating Procedures, in the Emergency Operating Procedures, and in other EALs (e.g., area, process, and/or effluent rad monitors, etc.).

"Compensatory non-alarming indications" in this context includes computer based information such as SPDS. This should include all computer systems available for this use depending on specific plant design and subsequent retrofits. If both a major portion of the annunciation system and all computer monitoring are unavailable, the Alert is required.

Due to the limited number of safety systems in operation during cold shutdown, refueling and defueled modes, no IC is indicated during these modes of operation.

This Alert will be escalated to a Site Area Emergency if the operating crew cannot monitor the transient in progress.

SA5

Initiating Condition – ALERT

AC power capability to essential busses reduced to a single power source for greater than 15 minutes such that any additional single failure would result in station blackout.

Operating Mode Applicability: Power Operation
Startup
Hot Standby
Hot Shutdown

Example Emergency Action Level:

1. AC power capability to site-specific essential busses reduced to a single power source for greater than 15 minutes

AND

Any additional single failure will result in station blackout.

Basis:

This IC and the associated EALs are intended to provide an escalation from IC SU1, "Loss of All Offsite Power To Essential Busses for Greater Than 15 Minutes." The condition indicated by this IC is the degradation of the offsite and onsite power systems such that any additional single failure would result in a station blackout. This condition could occur due to a loss of offsite power with a concurrent failure of one emergency generator to supply power to its emergency busses. Another related condition could be the loss of all offsite power and loss of onsite emergency diesels with only one train of emergency busses being backfed from the unit main generator, or the loss of onsite emergency diesels with only one train of emergency busses being backfed from offsite power. The subsequent loss of this single power source would escalate the event to a Site Area Emergency in accordance with IC SS1, "Loss of All Offsite and Loss of All Onsite AC Power to Essential Busses."

At multi-unit stations, the EALs should allow credit for operation of installed design features, such as cross-ties or swing diesels, provided that abnormal or emergency operating procedures address their use. However, these stations must also consider the impact of this condition on other shared safety functions in developing the site specific EAL.

SS1

Initiating Condition – SITE AREA EMERGENCY

Loss of All Offsite Power and Loss of All Onsite AC Power to Essential Busses.

Operating Mode Applicability: Power Operation
Startup
Hot Standby
Hot Shutdown

Example Emergency Action Level:

1. Loss of power to (site-specific) transformers.

AND

Failure of (site-specific) emergency generators to supply power to emergency busses.

AND

Failure to restore power to at least one emergency bus within (site-specific) minutes from the time of loss of both offsite and onsite AC power.

Basis:

Loss of all AC power compromises all plant safety systems requiring electric power including RHR, ECCS, Containment Heat Removal and the Ultimate Heat Sink. Prolonged loss of all AC power will cause core uncovering and loss of containment integrity, thus this event can escalate to a General Emergency. The (site-specific) time duration should be selected to exclude transient or momentary power losses, but should not exceed 15 minutes.

Escalation to General Emergency is via Fission Product Barrier Degradation or IC SG1, "Prolonged Loss of All Offsite Power and Prolonged Loss of All Onsite AC Power."

Consideration should be given to operable loads necessary to remove decay heat or provide Reactor Vessel makeup capability when evaluating loss of AC power to essential busses. Even though an essential bus may be energized, if necessary loads (i.e., loads that if lost would inhibit decay heat removal capability or Reactor Vessel makeup capability) are not operable on the energized bus then the bus should not be considered operable. If this bus was the only energized bus then a Site Area Emergency per SS1 should be declared.

SYSTEM MALFUNCTION

SS2

Initiating Condition -- SITE AREA EMERGENCY

Failure of Reactor Protection System Instrumentation to Complete or Initiate an Automatic Reactor Scram Once a Reactor Protection System Setpoint Has Been Exceeded and Manual Scram Was NOT Successful.

Operating Mode Applicability: Power Operation
Startup

Example Emergency Action Level:

1. Indication(s) exist that automatic and manual scram were not successful.

Basis:

Automatic and manual scram are not considered successful if action away from the reactor control console was required to scram the reactor.

Under these conditions, the reactor is producing more heat than the maximum decay heat load for which the safety systems are designed. A Site Area Emergency is indicated because conditions exist that lead to imminent loss or potential loss of both fuel clad and RCS. Although this IC may be viewed as redundant to the Fission Product Barrier Degradation IC, its inclusion is necessary to better assure timely recognition and emergency response. Escalation of this event to a General Emergency would be via Fission Product Barrier Degradation or Emergency Director Judgment ICs.

SYSTEM MALFUNCTION

SS3

Initiating Condition – SITE AREA EMERGENCY

Loss of All Vital DC Power.

Operating Mode Applicability: Power Operation
Startup
Hot Standby
Hot Shutdown

Example Emergency Action Level:

1. Loss of All Vital DC Power based on (site-specific) bus voltage indications for greater than 15 minutes.

Basis:

Loss of all DC power compromises ability to monitor and control plant safety functions. Prolonged loss of all DC power will cause core uncovering and loss of containment integrity when there is significant decay heat and sensible heat in the reactor system. Escalation to a General Emergency would occur by Abnormal Rad Levels/Radiological Effluent, Fission Product Barrier Degradation, or Emergency Director Judgment ICs. Fifteen minutes was selected as a threshold to exclude transient or momentary power losses.

Initiating Condition – SITE AREA EMERGENCY

Complete Loss of Heat Removal Capability.

Operating Mode Applicability:

Power Operation
Startup
Hot Standby
Hot Shutdown

Example Emergency Action Level:

1. Loss of core cooling and heat sink (PWR).

1. Heat Capacity Temperature Limit Curve exceeded (BWR).

Basis:

This EAL addresses complete loss of functions, including ultimate heat sink, required for hot shutdown with the reactor at pressure and temperature. Reactivity control is addressed in other EALs. For BWRs the loss of heat removal function is indicated by the Heat Removal Capability Temperature Limit Curve being exceeded.

Under these conditions, there is an actual major failure of a system intended for protection of the public. Thus, declaration of a Site Area Emergency is warranted. Escalation to General Emergency would be via Abnormal Rad Levels / Radiological Effluent, Emergency Director Judgment, or Fission Product Barrier Degradation ICs.

Initiating Condition – SITE AREA EMERGENCY

Inability to Monitor a SIGNIFICANT TRANSIENT in Progress.

Operating Mode Applicability: Power Operation
Startup
Hot Standby
Hot Shutdown

Example Emergency Action Level:

1. a. Loss of most or all (site-specific) annunciators associated with safety systems.

AND

b. Compensatory non-alarming indications are unavailable.

AND

c. Indications needed to monitor (site-specific) safety functions are unavailable.

AND

d. SIGNIFICANT TRANSIENT in progress.

Basis:

This IC and its associated EAL are intended to recognize the inability of the control room staff to monitor the plant response to a transient. A Site Area Emergency is considered to exist if the control room staff cannot monitor safety functions needed for protection of the public.

(Site-specific) annunciators for this EAL should be limited to include those identified in the Abnormal Operating Procedures, in the Emergency Operating Procedures, and in other EALs (e.g., rad monitors, etc.)

"Compensatory non-alarming indications" in this context includes computer based information such as SPDS. This should include all computer systems available for this use depending on specific plant design and subsequent retrofits.

(Site-specific) indications needed to monitor safety functions necessary for protection of the public must include control room indications, computer generated indications and dedicated annunciation capability. The specific indications should be those used to determine such functions as the ability to shut down the reactor, maintain the core cooled, to maintain the reactor coolant system intact, and to maintain containment intact.

"Planned" and "UNPLANNED" actions are not differentiated since the loss of instrumentation of this magnitude is of such significance during a transient that the cause of the loss is not an ameliorating factor.

Quantification of "Most" is arbitrary, however, it is estimated that if approximately 75% of the safety system annunciators or indicators are lost, there is an increased risk that a degraded plant condition could go undetected. It is not intended that plant personnel perform a detailed count of the instrumentation lost but use the value as a judgment threshold for determining the severity of the plant conditions. It is also not intended that the Shift Supervisor be tasked with making a judgment decision as to whether additional personnel are required to provide increased monitoring of system operation.

Initiating Condition – GENERAL EMERGENCY

Prolonged Loss of All Offsite Power and Prolonged Loss of All Onsite AC Power to Essential Busses.

Operating Mode Applicability: Power Operation
Startup
Hot Standby
Hot Shutdown

Example Emergency Action Level:

1. Loss of power to (site-specific) transformers.

AND

Failure of (site-specific) emergency diesel generators to supply power to emergency busses.

AND

Either of the following: (a or b)

a. Restoration of at least one emergency bus within (site-specific) hours is <u>not</u> likely

OR

b. (Site-Specific) Indication of continuing degradation of core cooling based on Fission Product Barrier monitoring.

Basis:

Loss of all AC power compromises all plant safety systems requiring electric power including RHR, ECCS, Containment Heat Removal and the Ultimate Heat Sink. Prolonged loss of all AC power will lead to loss of fuel clad, RCS, and containment. The (site-specific) hours to restore AC power can be based on a site blackout coping analysis performed in conformance with 10 CFR 50.63 and Regulatory Guide 1.155, "Station Blackout," as available. Appropriate allowance for offsite emergency response including evacuation of surrounding areas should be considered. Although this IC may be viewed as redundant to the Fission Product Barrier Degradation IC, its inclusion is necessary to better assure timely recognition and emergency response.

This IC is specified to assure that in the unlikely event of a prolonged station blackout, timely recognition of the seriousness of the event occurs and that declaration of a General Emergency occurs as early as is appropriate, based on a reasonable assessment of the event trajectory.

The likelihood of restoring at least one emergency bus should be based on a realistic appraisal of the situation since a delay in an upgrade decision based on only a chance of mitigating the event could result in a loss of valuable time in preparing and implementing public protective actions. In addition, under these conditions, fission product barrier monitoring capability may be degraded. Although it may be difficult to predict when power can be restored, it is necessary to give the Emergency Director a reasonable idea of how quickly (s)he may need to declare a General Emergency based on two major considerations:

1. Are there any present indications that core cooling is already degraded to the point that Loss or Potential Loss of Fission Product Barriers is imminent? (Refer to Tables 3 and 4 for more information.)

2. If there are no present indications of such core cooling degradation, how likely is it that power can be restored in time to assure that a loss of two barriers with a potential loss of the third barrier can be prevented?

Thus, indication of continuing core cooling degradation must be based on Fission Product Barrier monitoring with particular emphasis on Emergency Director judgment as it relates to imminent Loss or Potential Loss of fission product barriers and degraded ability to monitor fission product barriers.

SYSTEM MALFUNCTION

SG2

Initiating Condition -- GENERAL EMERGENCY

Failure of the Reactor Protection System to Complete an Automatic Scram and Manual Scram was NOT Successful and There is Indication of an Extreme Challenge to the Ability to Cool the Core.

Operating Mode Applicability: Power Operation
Startup

Example Emergency Action Level:

1. Indications exist that automatic and manual scram were not successful.

AND

Either of the following: (a or b)

a. Indication(s) exists that the core cooling is extremely challenged.

OR

b. Indication(s) exists that heat removal is extremely challenged.

Basis:

Automatic and manual scram are not considered successful if action away from the reactor control console is required to scram the reactor.

Under the conditions of this IC and its associated EALs, the efforts to bring the reactor subcritical have been unsuccessful and, as a result, the reactor is producing more heat than the maximum decay heat load for which the safety systems were designed. Although there are capabilities away from the reactor control console, such as emergency boration in PWRs, or standby liquid control in BWRs, the continuing temperature rise indicates that these capabilities are not effective. This situation could be a precursor for a core melt sequence.

For PWRs, the extreme challenge to the ability to cool the core is intended to mean that the core exit temperatures are at or approaching 1200 degrees F or that the reactor vessel water level is below the top of active fuel. For plants using CSFSTs, this EAL equates to a Core Cooling RED condition and an entry into function restoration procedure FR-S.1. For BWRs, the extreme challenge to the ability to cool the core is intended to mean that the reactor vessel water level cannot be restored and maintained above Minimum Steam Cooling RPV Water Level as described in the EOP bases.

Another consideration is the inability to initially remove heat during the early stages of this sequence. For PWRs, if emergency feedwater flow is insufficient to remove the amount of heat required by design from at least one steam generator, an extreme challenge should be considered to exist. For plants using CSFSTs, this EAL equates to a Heat Sink RED condition. For BWRs, considerations include inability to remove heat via the main condenser, or via the suppression pool or torus (e.g., due to high pool water temperature).

In the event either of these challenges exist at a time that the reactor has not been brought below the power associated with the safety system design (typically 3 to 5% power) a core melt sequence exists. In this situation, core degradation can occur rapidly. For this reason, the General Emergency declaration is intended to be anticipatory of the fission product barrier matrix declaration to permit maximum offsite intervention time.

Appendix A
Basis for Radiological Effluent Initiating Conditions

Introduction

This appendix supplements the basis information provided in Section 5 for initiating conditions AU1, AA1, AS1, and AG1. Since the publication of revision 2 of this methodology, there have been numerous questions raised as utilities worked to implement the IC and EALs. Additional feedback was provided by the staff of the Nuclear Regulatory Commission. It became apparent that the brief basis provided for each IC was not sufficient. When revision 3 of this document was in preparation, it was decided to incorporate this appendix to provide the needed additional guidance and clarification. The NUMARC/NESP-007 effluent IC/EALs represent a departure from previous EAL practice and understanding these differences and their technical bases will facilitate site specific implementation of the NUMARC/NESP-007 classification methodology.

This appendix will be structured into seven major sections. They are:

1. Purpose of the effluent ICs/EALs and their relationship to other ICs/EALs
2. Explanation of the ICs
3. Explanation of the example EALs and their relationship to the ICs
4. Interface between the ICs/EALs and the Offsite Dose Calculation Manual (ODCM)
5. Monitor setpoints versus EAL thresholds.
6. The impact of meteorology
7. The impact of source term

A.1 Purpose of the Effluent ICs/EALs

ICs AU1, AA1, AS1, and AG1 provide classification thresholds for UNPLANNED and/or uncontrolled releases of radioactivity to the environment. In as much as the purpose of emergency planning at nuclear power plants is to minimize the consequences of radioactivity releases to the environment, these ICs would appear to be controlling. However, classification of emergencies on the basis of radioactivity releases is not optimum, particularly those classifications based on radiation monitor indications. Such classifications can be deficient for several reasons, including:

- In significant emergency events, a radioactivity release is seldom the initiating event, but rather, is the consequence of some other condition. Relying on an indication of a release may not be sufficiently anticipatory.
- The relationship between an effluent monitor indication caused by a release and the offsite conditions that result is a function of several parameters (e.g., meteorology, source term) which can change in value by orders of magnitude between normal and emergency conditions and from event to event. The appropriateness of these classifications is dependent on how well the parameter values assumed in pre-establishing the classification thresholds match those that are present at the time of the incident.

Section 3.3 of NUMARC/NESP-007 emphasizes the need for accurate assessment and classification of events, recognizing that over-classification, as well as under-classification, is to be avoided. Primary emphasis is intended to be placed on plant conditions in classifying emergency events. Effluent ICs were included, however, to provide a basis for classifying events that cannot be readily classified on the basis of plant condition alone. Plant condition ICs are included to address the precursors to radioactivity release in order to ensure anticipatory action. The effluent

ICs do not stand alone, nor do the plant condition ICs. The inclusion of both categories more fully addresses the potential event spectrum and compensates for potential deficiencies in either. This is a case in which the whole is greater than the sum of the parts.

From the discussion that follows, it should become clear how the various aspects of the NUMARC/NESP-007 effluent ICs/EALs work together to provide for reasonably accurate and timely emergency classifications. While some aspects of the radiological effluent EALs may appear to be potentially unconservative, one also needs to consider IC/EALs in other recognition categories that compensate for this condition. During site specific implementation of these ICs/EALs, changes to some of these aspects might appear advantageous. While site specific changes are anticipated, caution must be used to ensure that these changes do not impact the overall effectiveness of the ICs / EALs.

A.2. Initiating Conditions

There are four radiological effluent ICs provided in NUMARC/NESP-007. The IC and the fundamental basis for the ultimate classification for the four classifications are:

General (AG1)	Offsite Dose Resulting from an Actual or Imminent Release of Gaseous Radioactivity Exceeds 1000 mR TEDE or 5000 mR Thyroid CDE for the Actual or Projected Duration of the Release Using Actual Meteorology.
Site Area (AS1)	Offsite Dose Resulting from an Actual or Imminent Release of Gaseous Radioactivity Exceeds 100 mR TEDE or 500 mR Thyroid CDE for the Actual or Projected Duration of the Release.
Alert (AA1)	Any UNPLANNED Release of Gaseous or Liquid Radioactivity to the Environment that Exceeds 200 Times Radiological Technical Specifications for 15 Minutes or Longer.
NOUE (AU1)	Any UNPLANNED Release of Gaseous or Liquid Radioactivity to the Environment that Exceeds Two Times Radiological Technical Specifications for 60 Minutes or Longer.

The fundamental basis of AU1 and AA1 ICs differs from that for AS1 and AG1 ICs. It is important to understand the differences.

- The Radiological Effluent Technical Specifications (RETS) (similar controls are included in the ODCMs of those facilities that implemented Generic Letter 89-01) are associated with particular offsite doses and dose rate limits. For showing compliance with these limits, facility Offsite Dose Calculation Manuals (ODCM) establish methodologies for establishing effluent monitor alarm setpoints, based on defined source term and meteorology assumptions.
- AU1 and AA1 are **NOT** based on these particular values of offsite dose or dose rate but, rather, on the loss of plant control implied by a radiological release that exceeds a specified multiple of the RETS release limits for a specified period of time.
- The RETS multiples are specified only to distinguish AU1 and AA1 from non-emergency conditions and from each other. While these multiples obviously correspond to an offsite dose, the classification emphasis is on a release that does not comply with a license commitment for an extended period of time.
- While some of the example EALs for AU1 and AA1 use indications of offsite dose rates as **symptoms** that the RETS may be exceeded, the IC, and the classification, are **NOT** concerned with the particular value of offsite dose. While there may be quantitative inconsistencies involved with this protocol, the qualitative basis of the EAL, i.e., loss of plant control, is not affected.

- The basis of the AS1 and AG1 ICs **IS** a particular value of offsite dose for the event duration. AG1 is set to the value of the EPA PAG. AS1 is a fraction (10%) of the EPA PAG. As such, these ICs are consistent with the fundamental definitions of a Site Area and General Emergency.

A.3 Example Emergency Action Levels

For each of the classifications, NUMARC/NESP-007 provides some example emergency action levels and bases. Ideally, the example EALs would correspond numerically with the thresholds expressed in the respective IC. Two cases are applicable to the effluent EALs:

1. The EAL corresponds numerically to the threshold in the respective IC. For example, a field survey result of 1000 mrem/hr for a projected release duration of one hour corresponds directly to AG1.
2. The EAL corresponds numerically to the threshold in the respective IC under certain assumed conditions. For example, an effluent monitor reading that equates to 100 mrem for the projected duration of the release corresponds numerically to AS1 *if* the actual meteorology, source term, and release duration matches that used in establishing the monitor thresholds.

There are four typical example EALs:

- <u>Effluent Monitor Readings</u>: These EALs are pre-calculated values that correspond to the condition identified in the IC for a given set of assumptions.
- <u>Field Survey Results</u>: These example EALs are included to provide a means to address classifications based on results from field surveys.
- <u>Perimeter Monitor Indications:</u> For sites having them, perimeter monitors can provide a direct indication of the offsite consequences of a release.
- <u>Dose Assessment Results</u>: These example EALs are included to provide a means to address classifications based on dose assessments.

A.3.1 Effluent Monitor Readings

As noted above, these EALs are pre-calculated values that correspond to the condition identified in the IC for a given set of assumptions. The degree of correlation is dependent on how well the assumed parameters (e.g., meteorology, source term, etc.) represent the actual parameters at the time of the emergency.

<u>AS1 and AG1</u>

Classifications should be made under these EALs if VALID (e.g., channel check, comparison to redundant/diverse indication, etc.) effluent radiation monitor readings exceed the pre-calculated thresholds. In a change from previous versions of this methodology, confirmation by dose assessments is no longer required as a prerequisite to the classification. Nonetheless, dose assessments are important components of the overall accident assessment activities when significant radioactivity releases have occurred or are projected. Dose assessment results, when they become available, may serve to confirm the validity of the effluent radiation monitor EAL, may indicate that an escalation to a higher classification is necessary, or may indicate that the classification wasn't warranted. AS1 and AG1 both provide that, if dose assessment results are available, the classification should be based on the basis of the dose assessment result rather than the effluent radiation monitor EAL.

<u>AU1 and AA1</u>

ODCMs provide a methodology for determining default and batch-specific effluent monitor alarm setpoints pursuant to Standard Technical Specification (STS) 3.3.3.9. These setpoints are intended to show that releases are within STS 3.11.2.1. The applicable limits are 500 mrem/year whole body or 3000 mrem/year skin from noble gases. (Inhalation dose rate limits are not addressed here since the specified surveillance involves collection and analysis of composite samples. This after-the-fact assessment could not be an made in a timely manner conducive to accident classification.) These setpoints are calculated using default source terms or batch-specific sample isotopic results and annual average χ/Q. Since the meteorology data is pre-defined, there is a direct correlation between the monitor setpoints and the RETS limits. Although the actual χ/Q may be different, NUREG-1022, Event Reporting Guidelines 10 CFR 50.72 and 50.73, provided *"...Annual average meteorological data should be used for determining offsite airborne concentrations of radioactivity to maintain consistency with the technical specifications (TS) for reportability thresholds."* The ODCM methodology is based on long term continuous releases. However, its use here in a short term release situation is appropriate. Remember that the AU1 and AA1 ICs are based on a loss of plant control indicated by the failure to comply with a multiple of the RETS release limits for an extended period and that the ODCM provides the methodology for showing compliance with the RETS.

To obtain the EAL thresholds, multiply the ODCM setpoint for each monitor by 2 (AU1) or 200 (AA1). It would be preferable to reference *"2 x ODCM Setpoint"* or *"200 x ODCM Setpoint"* as the EAL threshold. In this manner, the EAL would always change in step with changes in the ODCM setpoint (e.g., for a batch or special release. In actual practice, there may be an "warning" and a "high" alarm setpoint. The setpoint that is closest in value to the RETS limit should be used. Facility ODCMs may lower the actual setpoint to provide an administrative "safety margin". Also, if there is more than one unit or release stack on the site, the RETS limits may be apportioned. Two possible approaches to obtain the EAL thresholds are:

- The *"2x"* and *"200x"* multiples could be increased to address the reduced setpoints. For example, if the stack monitor were set to 50% of the RETS limit, the EAL threshold could be set to *"4x"* and *"400x"* the setpoint on that monitor.
- The reduced setpoints could be ignored and the "2x" and "200x" multiples used as specified. While numerically conservative, using a single set of multipliers would probably be desirable from a human engineering standpoint.

In a change from previous versions of this methodology, confirmation by dose assessments is no longer required as a prerequisite to the classification. While assessments with real meteorology may have provided a basis for escalating to AS1 (or AG1), the assessments could not confirm the AU1 or AA1 classifications since compliance with the RETS is demonstrated using *annual average* meteorology – not – actual meteorology.

Nonetheless, dose assessments are important components of the overall accident assessment activities when significant radioactivity releases have occurred or are projected. Dose assessment results, when they become available, may indicate that an escalation to a higher classification is necessary. AS1 and AG1 both provide that, if dose assessment results are available, the classification should be based on the basis of the dose assessment result rather than the effluent radiation monitor EAL.

In typical practice, the radiological effluent monitor alarms would have been set, on the basis of ODCM requirements, to indicate a release that could exceed the RETS limits. Alarm response procedures call for an assessment of the alarm to determine whether or not RETS have been exceeded. Utilities typically have methods for rapidly assessing an abnormal release in order to determine whether or not the situation is reportable under 10 CFR 50.72. Since a radioactivity release of a magnitude comparable to the RETS limits will not create a need for offsite protective measures, it would be reasonable to use these abnormal release assessment methods to initiate dose assessment techniques using actual meteorology and projected source term and release duration.

A.3.2 Perimeter Monitor, Field Survey Results, Dose Projection Results

<u>AS1 and AG1</u>

The perimeter monitor and field survey results are included to provide a means for classification based on actual measurements. There is a 1:1 correlation (with consideration of release duration) between these EALs and the IC since all are dependent on actual meteorology.

Dose projection result EALs are included to provide a basis for classification based on results from assessments triggered at lower emergency classifications. If the dose assessment results are available at the time that the classification is made, the results should be used in conjunction with this EAL for classifying the event <u>rather</u> than the effluent radiation monitor EAL.

Although the IC references TEDE and thyroid CDE as criteria, field survey results and perimeter monitor indications will generally not be reported in these dose quantities, but rather in terms of a dose rate. For this reason, the field survey EALs are based on a β-γ dose rate and a thyroid CDE value, both assuming one hour of exposure (or inhalation). If individual site analyses indicate a longer or shorter duration for the period in which the substantial portion of the activity is released, the longer duration should be used for the field survey and/or perimeter monitor EALs.

<u>AU1 and AA1</u>

As discussed previously, the threshold in these ICs is based on exceeding a multiple of the RETS for an extended period. The applicable RETS limit is the instantaneous dose rate provided in Standard Technical Specification (STS) 3.11.2.1. While these three EALs are also expressed in dose rate, they are dependent on *actual* meteorology. However, compliance with the RETS is demonstrated using *annual average* meteorology. Due to this, the only time that there would be a 1:1 correlation between the IC and these EALs is when the value of the actual meteorology matched the annual average -- an unlikely situation. For this reason, these EALs can only be indirect indicators that the RETS may be exceeded. The three example EALs are consistent with the fundamental basis of AU1 and AA1, that of a uncontrolled radioactivity release that indicates a loss of plant control. A dose rate, at or beyond the site boundary, greater than 0.1 mR/hr for 60 minutes or 10.0 mR/hr for 15 minutes is consistent with this fundamental basis, regardless of the lack of numerical correlation to the RETS. The time periods chosen for the NOUE AU1 (60 minutes) and Alert AA1 (15 minutes) are indicative of the relative risks based on the loss of ability to terminate a release.

The numeric values shown in AU1 and AA1 are based on a release rate not exceeding 500 mrem per year, converted to a rate of: $500 \div 8766 = 0.057$ mR/hr. If we take a multiple of 2, as specified in the NOUE threshold, this equates to a dose rate of about 0.11 mR/hr, which rounds to the 0.1 mR/hr specified in AU1. Similarly for the AA1 EALs, we obtain 10 mR/hr.

In AU1 and AA1, reference is made to *automatic real-time dose assessment capability*. In AS1 and AG1, the reference is to *dose assessment*. This distinction was made since it is unlikely that a dose assessment using manual methods would be initiated without some prior indication, e.g., a effluent monitor EAL.

A.4 Interface Between ODCM and ICs/EALs

For AU1 and AA1, a strong link was established with the facility's ODCM. It was the intent of the NUMARC/NESP EAL Task Force to have the AU1 and AA1 EALs indexed to the ODCM alarm setpoints. This was done for several reasons:

- To allow the EALs to use the monitor setpoints already in place in the facility ODCM, thus eliminating the need for a second set of values as the EALs. The EAL could reference "2x ODCM Setpoint" or "200x ODCM Setpoint" for the monitors addressed in the ODCM. Extensive calculations would only be necessary for monitors not addressed in the ODCM.

- To take advantage of the alarm setpoint calculational methodology already documented in the facility ODCM.
- To ensure that the operators had an alarm to indicate the abnormal condition. If the monitor EAL threshold was less than the default ODCM setpoint, the operators could be in the position of having exceeded an EAL and not knowing it.
- To simplify the IC/EAL by eliminating the need to address planned and UNPLANNED releases, continuous or batch releases, monitored or unmonitored releases. Any release that complies with the radiological effluent technical specifications (RETS) (or ODCM controls for utilities that have implemented GL 89-01) would not exceed a monitor EAL threshold.
- To eliminate the possibility of a planned release (e.g., containment / drywell purge) resulting in effluent radiation monitor readings that exceed an classification threshold that was based on a different calculation method. ODCMs typically require specific alarm setpoints for such releases. If the release can be authorized under the provisions of the ODCM/RETS, an emergency classification is not warranted. If the monitor EAL threshold is indexed to the ODCM setpoint (e.g., *"...2 x ODCM setpoint..."*) the monitor EAL will always change in step with the ODCM setpoint.
- Although the ODCM is intended to address long term routine releases, its use here for short term releases is appropriate. The IC is specified in terms of a release that exceeds RETS for an extended period of time. Compliance to the RETS is shown using the ODCM methodology.

A.5 Setpoints versus Monitor EALs

Effluent monitors typically have provision for two separate alarm setpoints associated with the level of measured radioactivity. (There may be other alarms for parameters such as low sample flow.) These setpoints are typically established by the facility ODCM. As such, at most sites the values of the monitor EAL thresholds will not be implemented as actual alarm setpoints, but would be tabulated in the classification procedure. If the monitor EAL thresholds are calculated as suggested herein they will be higher than the ODCM alarm setpoints by at least a factor of two (i.e., AU1). This alarm alerts the operator to compare the monitor indication to the EAL thresholds. The NUMARC/NESP-007 effluent EALs do NOT require alarm setpoints based on the monitor EALs. However, if spare alarm channels are available (e.g., high range channels), the monitor EAL threshold could be used as the alarm setpoint.

A.6 The Impact of Meteorology

The existence of uncertainty between actual event meteorology and the meteorology assumed in establishing the EALs was identified above. It is important to note that uncertainty is present regardless of the meteorology data set assumed. The magnitude of the potential difference and, hence, the degree of conservatism will depend on the data set selected. Data sets that are intended to ensure low probability of under-conservative assessments have a high probability of being over-conservative. For nuclear power plants, there are different sets of meteorological data used for different purposes. The two primary sets are:

- For accident analyses purposes, sector χ/Q values are set at that value that is exceeded only 0.5% of the hours wind blows into the sector. The highest of the 16 sector values is the maximum sector χ/Q value. The site χ/Q value is set at that value that is exceeded only 5% of the hours for all sectors. The higher of the sector or site χ/Q values is used in accident analyses.

- For routine release situations, annual average χ/Q values are calculated for specified receptor locations and at standard distances in each of the 16 radial sectors. In setting ODCM alarm set points, the annual average χ/Q value for the most restrictive receptor at or beyond the site boundary is used. The sector annual average χ/Q value is normalized for the percentage of time that the wind blows into that sector. In an actual event, the wind direction may be into the affected sector for the entire release duration. Many sites experience typical sector χ/Qs that are 10-20 times higher than the calculated annual average for the sector.

In developing the effluent EALs, the NUMARC EAL Task Force elected to use annual average meteorology for establishing effluent monitor EAL thresholds. This decision was based on the following considerations.

- Use of the accident χ/Qs, may be too conservative. For some sites, the difference between the accident χ/Q and the annual average χ/Q can be a factor of 100-1000. With this difference in magnitude, the calculated monitor EALs for AS1 or AG1 might actually be less than the ODCM alarm setpoints, resulting in unwarranted classifications for releases that might be in compliance with ODCM limits.
- The ODCM and the RETS are based in part on annual average χ/Q (non-normalized). ODCMs already provide alarm setpoints based on annual average χ/Q that could be used for AU1 and AA1.
- Use of a χ/Q more restrictive than the χ/Q used to establish ODCM alarm setpoints could create a situation in which the EAL value would be less than the ODCM setpoint. In this case, the operators would have no alarm indication to alert them of the emergency condition.
- Use of one χ/Q value for AU1 and AA1 and another for AS1 and AG1 might result in monitor EALs that would not progress from low to high classifications. Instead, the AS1 and AA1 EALs might overlap.

Plant specific consideration must be made to determine if annual average meteorology is adequately conservative for site specific use. If not one of the two more conservative techniques described above should be selected. It is incumbent upon the licensee to ensure that the selection is properly implemented to provide consistent classification escalation.

The impact of the differences between the assumed annual average meteorology and the actual meteorology depends on the particular EAL.

- For the AU1 and AA1 effluent monitor EALs, there is no impact since the IC and the EALs are based on annual average meteorology by definition.
- For the field survey, perimeter monitor, and dose assessment results EALs in AS1 and AG1, there is no impact since the IC and these EALs are based on actual meteorology.
- For the AS1 and AG1 effluent monitor EALs, there may be differences since the IC is based on actual meteorology and the monitor EALs are calculated on the basis of annual average meteorology or, on a site specific basis, one of the more conservative derivatives of annual average meteorology. This is considered as acceptable in that dose assessments using actual meteorology will be initiated for significant radioactivity releases. Needed escalations can be based on the results of these assessments. As discussed previously, this delay was deemed to be acceptable since in significant

release situations, the plant condition EALs should provide the anticipatory classifications necessary for the implementation of offsite protective measures.

- For the field survey, perimeter monitor, and dose assessment results EALs in AU1 and AA1, there is an impact. These three EALs are dependent on actual meteorology. However, the threshold values for all of the AU1 and AA1 EALs are based on the assumption of annual average meteorology. If the actual and annual average meteorology were equal, the IC and all of the EALs would correlate. Since it is likely that the actual meteorology will exceed the annual average meteorology, there will be numerical inconsistencies between these EALs and the IC. The three example EALs are consistent with the fundamental basis of AU1 and AA1, that of a uncontrolled radioactivity release that indicates a loss of plant control. A dose rate, at or beyond the site boundary, greater than 0.1 mR/hr for 60 minutes or 10.0 mR/hr for 15 minutes is consistent with this fundamental basis, regardless of the lack of numerical correlation to the RETS.

A.7 The Impact of Source Term

The ODCM methodology should be used for establishing the monitor EAL thresholds for these ICs. The ODCM provides a default source term based on expected releases. In many cases, the ODCM source term is derived from expected and/or design releases tabulated in the FSAR.

For AS1 and AG1, the bases suggests the use of the same source terms used for establishing monitor EAL thresholds for AU1 and AA1. This guidance is provided to avoid potential overlaps between effluent monitor EALs for AA1 and AS1. Other source terms may be appropriate. In any case, efforts should be made to obtain and use best estimate (For Example: NUREG 1465), as opposed to conservative, source terms for all four ICs.

Even if the same source term is used for all four ICs, the analyst must consider the impact of overly conservative iodine to noble gas ratios. The AU1 and AA1 IC thresholds are based on external noble gas exposure. The AS1 and AG1 ICs are based on either TEDE or thyroid CDE. TEDE includes a contribution from inhalation exposure (i.e., CEDE) while the thyroid CDE is due solely to inhalation exposure. The inhalation exposure is sensitive to the iodine concentration in the source term. Since AU1 and AA1 are based on noble gases, and AS1 and AG1 are dependent on noble gases <u>and</u> iodine, an over conservative iodine to noble gas ratio could result in AS1 and AG1 monitor EAL thresholds that either overlap or are too close to the AA1 monitor EAL thresholds.

As with meteorology, assessment of source terms has uncertainty. This uncertainty is compensated for by the anticipatory classifications provided by ICs in other recognition categories.

Appendix B

Basis For Implementation of Category C, D, AND E Initiating Conditions By NUREG-0654/FEMA-REP-1 Users

NUMARC/NESP-007, Revision 2 (January 1992), was originally developed and approved as an alternative emergency action level (EAL) methodology that could be used in lieu of NUREG-0654 Appendix 1 example initiating conditions (ICs). Regulatory Guide 1.101, "Emergency Planning and Preparedness for Nuclear Power Plants," Revision 3, allowed licensees to continue using previously approved ICs/EALs based on NUREG-0654 or submit for approval ICs/EALs based on NUMARC/NESP-007 to satisfy provisions of 10 CFR 50.47 (b) (4) and Section IV.B of Appendix E, "Emergency Planning and Preparedness for Production and Utilization Facilities," to 10 CFR Part 50.

In 1994, the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Division of Radiation Safety and Safeguards, Emergency Preparedness Branch developed a Branch Technical Position paper to support the NRC regional staffs' technical review of EAL changes proposed by licensees who had not fully implemented the guidance in NUMARC/NESP-007. This paper provided examples of acceptable changes licensees could make to site-specific EALs developed from NUREG-0654 utilizing the technical bases under the example EALs in NUMARC/NESP-007. The NUREG-0654 example initiating conditions addressed by this position paper were Site Area Emergency #9, Alerts #9 and #11, and Notification of Unusual Events #1, #4, #8, #9, #11 (partially), and #15. It was noted that licensees could provide the NRC other changes that utilized NUMARC/NESP-007 guidance for evaluation on their individual merits and their complement to the licensee's classification scheme as a whole. Note that the Branch Technical position was subsequently incorporated into EPPOS 1.

During development of NEI 97-03 Revision 3 it was determined enhancements to address classification of events that occur during periods of plant shutdowns and refueling were needed. Additionally the need for EALs for permanently defueled sites and ISFSIs were identified. The decision was made to defer these enhancements for inclusion in NEI 99-01 Revision 4. These ICs/EALs were fashioned so they could be implemented throughout the industry, i.e., by licensees with EALs based on either NUMARC/NESP-007 or NUREG-0654 example ICs. NUREG-0654-based EAL users may develop site-specific thresholds by using the bases contained in Appendix C, Basis for Cold Shutdown/Refueling ICs, Appendix D, Basis for Permanently Defueled Stations ICs, and Appendix E, Basis for ISFSI ICs.

Adjustments to existing NUREG-0654-based EAL sets may be warranted coincident with the implementation of these site-specific Recognition Category C, D and/or E ICs/EALs. For example, it may be appropriate to define (if not previously defined) or redefine the mode applicability of an EAL based on NUREG-0654 Example IC General Emergency #2 (Loss of 2 of 3 Fission Product Barriers with potential loss of 3RD barrier) when adding the CG1 IC/EAL. Application of this approach may eliminate potential mode applicability conflicts or overlaps in existing and new IC/EALs. It is not the intent of this document to require NUREG-0654 users to adopt mode applicability or implement Recognition Category C in its entirety.

The guidance which addresses cold shutdown/refueling IC/EALs in NEI 99-01 is intended to address both NUMARC/NESP-007 and NUREG-0654 users. For NUREG-0654 users, the scope of the cold shutdown/refueling initiative is limited to the "new" IC/EALs (CU2, CU4, CA1, CA2, and CG1), CA4 (compare with NUREG-054 Example Alert 10), and CS1 and CS2 (partially related to NUREG-0654 Example Site Area 10).

Appendix C

Basis for Cold Shutdown/Refueling Initiating Conditions

Introduction

Recognition Category C is a new category of IC/EALs. Recognition Category S IC/EALs that were only applicable in cold shutdown or refueling have been removed from Recognition Category S and incorporated into the Recognition Category C. Those Category S IC/EALs that had applicability in modes other than just cold shutdown and/or refueling had their applicability changed and now exist in Recognition Categories C and S. In order to adequately address shutdown loss of inventory and loss of decay heat removal capability events new IC/EALs were added. The following matrix shows the relationship of Category C to Category S.

Category C IC/EAL	Category S IC/EAL	New	Significantly Revised	Described in this Appendix
CU1	SU5			X
CU2		X		X
CU3	SU1			
CU4		X		X
CU5	SU4			
CU6	SU6			
CU7	SU7			
CU8	SU8			
CA1		X		X
CA2		X		X
CA3	SA1			
CA4	SA3		X	X
CS1	SS5		X	X
CS2	SS5		X	X
CG1		X		X

Recognition Category C completely replaces Recognition Category S when in Cold Shutdown and Refueling modes. It should be noted that the applicable Recognition Category A and H IC/EALs still apply when in Cold Shutdown and Refueling modes. Recognition Category F is not applicable to either the Cold Shutdown or Refueling modes.

Planning assumptions addressed in the development of the Category C IC/EALs are:

1. Variability of Initial Conditions - There will be a wide variability of initial conditions for the events addressed herein due to different plant configurations that could occur during shutdown periods. During power operations, the Fission Product Barrier Matrix classifies events on the loss or challenge to the fission product barriers. During shutdown conditions, these barriers may have intentionally been defeated. For this reason, these EALs are function and performance-based to the extent possible.

2. Redundancy and Diversity of Instruments - The redundancy and diversity of instruments typically used during power operations may be unavailable during shutdown periods. For example, in BWRs, loss of forced flow through the shutdown cooling, reactor recirculation, or reactor cleanup systems may result in the loss of accurate reactor coolant temperature measurement. In some PWRs core exit thermocouples are disconnected prior to removing the reactor vessel head. Loss of forced decay heat removal flow may then render RCS loop or

RHR inlet temperature instruments readings invalid. For this reason, these EALs provide for alternative site specific time-based EALs in addition to the instrumentation EALs.

3. Available Decay Heat - The potential for core damage is directly related to the amount of decay heat available. Events that occur earlier in shutdown will have the potential for greater consequence than will events that occur later in shutdown. This threshold would be reached sooner for events that occur early in a shutdown than those that occur late in a shutdown. For this reason, these EALs provide thresholds based on temperature increase.

   The core damage potential is a function of the latent heat available and the capability of systems to remove the heat. During shutdown evolutions redundancy of many system components may have been intentionally decreased to facilitate maintenance therefore potentially increasing the probability that an event could lead to core damage.

   Available decay heat decreases from time of core shutdown. Approximately 6% of full power core thermal heat is available immediately after shutdown. At 30 days from shutdown, available decay heat is approximately 0.1% reactor power. Therefore the threat of core damage due to decay heat generation decreases over time. Typically, refueling mode is not entered until 100 hours after shutdown effectively limiting the availability of decay heat.

4. Release Potential - The radionuclide inventory in the core is approximately 0.6 Ci/watt following extended operation at power. Thus, at shutdown, the core inventory for a typical 3000 Mwt reactor may be as much as 1.8E9 Ci, of which more than 1.0E7 Ci is iodine. With the 8.3 day half-life of I-131, there is a potential for significant radioactivity release well into a shutdown period.

5. Compatibility - The format and specific wording of the example EALs is expected to be modified to be compatible with individual utility nomenclature and procedure writing guidelines, provided that the intent of the example EAL is maintained.

6. Operating Experience - For BWRs, the shutdown EALS are intended to address concerns raised by NRC Office for Analysis and Evaluation of Operational Data (AEOD) Report AEOD/EG09, "BWR Operating Experience Involving Inadvertent Draining of the Reactor Vessel," dated August 8, 1986. This report states: "In broadest terms, the dominant causes of inadvertent reactor vessel draining are related to the operational and design problems associated with the residual heat removal system when it is entering into or exiting from the shutdown cooling mode. During this transitional period water is drawn from the reactor vessel, cooled by the residual heat removal system heat exchangers (from the cooling provided by the service water system), and returned to the reactor vessel. First, there are piping and valves in the residual heat removal system which are common to both the shutdown cooling mode and other modes of operation such as low pressure coolant injection and suppression pool cooling. These valves, when improperly positioned, provide a drain path for reactor coolant to flow from the reactor vessel to the suppression pool or the radwaste system. Second, establishing or exiting the shutdown cooling mode of operation is entirely manual, making such evolutions vulnerable to personnel and procedural errors. Third, there is no comprehensive valve interlock arrangement for all the residual heat removal system valves that could be activated during shutdown cooling. Collectively, these factors have contributed to the repetitive occurrences of the operational events involving the inadvertent draining of the reactor vessel."

INITIATING CONDITIONS

The four initiating conditions classify the shutdown event on the basis of the Potential Loss or Loss of one or more of the cold shutdown barrier functions.

General Emergency (GE)

The GE is declared on the occurrence of the loss of function of all three barriers. If all three barriers are lost, the ability to maintain fission product inventory within the containment no longer exists. This represents a direct path for radioactive inventory to be released to the environment. This is consistent with the definition of a GE.

Site Area Emergency (SAE)

The two IC/EALs identified as SAE events are considered to involve the actual or likely losses of plant functions needed for the protection of the public. These IC/EALs represent a loss of one fission product barrier with the potential or actual loss of a second barrier. Additionally the IC/EALs address the status of the containment boundary in the classification scheme. The fact that these IC/EALs call for a SAE reflects the lower latent energy available to cause core melt. These IC/EALs also reflect the decreased availability of motive force for release of core activity in the unlikely event that fuel damage should occur. This is consistent with the fundamental definition of an SAE.

Alert

The four IC/EALs identified as Alert events are considered to represent substantial degradation in the level of safety of the plant. This is consistent with the fundamental definition of an Alert.

Notification of Unusual Event (NOUE)

The eight IC/EALs identified as NOUE events are considered to represent potential degradation in the level of safety of the plant. This is consistent with the fundamental definition of an Unusual Event.

EXAMPLE EALs

The Recognition Category C example IC/EALs are based on concerns raised by Generic Letter 88-17, *Loss of Decay Heat Removal*, SECY 91-283, *Evaluation of Shutdown and Low Power Risk Issues*, NUREG-1449, *Shutdown and Low-Power Operation at Commercial Nuclear Power Plants in the United States*, and, NUMARC 91-06, *Guidelines for Industry Actions to Assess Shutdown Management*. A number of variables, such as initial vessel level, or shutdown heat removal system design, can have a significant impact on heat removal capability challenging the fuel clad barrier. The Loss example EAL represents the inability to restore and maintain RPV level to above the top of active fuel. Fuel damage is probable if RPV level cannot be restored, as available decay heat will cause boiling, further reducing the RPV level.

CU1, CU2, CU4, CA1, CA2, and CA4 IC/EALs are provided to serve as precursors to a loss of heat removal due to loss of inventory or function. CS1 and CS2 example EALs represent a significant loss of RCS inventory. The magnitude of this loss of water indicates that makeup systems have not been effective and may not be capable of preventing further RPV level decrease and potential core uncovery. EAL modifiers such as "for X minutes" are used when indications of level are unavailable to indicate the lack of a success path to restore inventory and the potential for core uncovery. In the context of CS1 and CS2 EALs, “containment closure” is the action taken to secure primary or secondary containment and its associated structures, systems, and components as a functional barrier to fission product release under existing plant conditions. CG1 example EALs indicate that core uncovery due to loss of inventory has occurred for a period that could result in core damage. Additionally EALs that describe challenge to the Containment Barrier are included.

Appendix D
Basis for Permanently Defueled Station Initiating Conditions

Introduction

Recognition Category D is a new category that provides IC/EALs for Permanently Defueled stations. Category D was written to provide a stand alone set of IC/EALs for Permanently Defueled Stations. IC/EALs from Recognition Category A, C, F, S, and H were reviewed for applicability and where applicable have been included to address all Permanently Defueled station events.

A Permanently Defueled station is basically a spent fuel storage facility. This appendix is based on the assumption that the spent fuel was generated by an operating nuclear power station under a 10CFR50 license that has ceased operations and intends to store the spent fuel for some period of time. The spent fuel is stored in a pool of water that serves as both the cooling medium for decay heat and shielding from direct radiation. The primary functions of this pool configuration become the emphasis of emergency classification methodology.

When in the permanently defueled condition, the licensee receives approval for exemption from specific emergency planning requirements. These exemptions must be approved by the NRC. The source term and relative risks associated with pool storage are the basis for maintaining only an onsite emergency plan. Calculations are provided in the licensing process that quantify radioactive releases associated with plausible accidents as documented in the stations Safety Analysis Report (SAR).

D.1 Purpose of the Permanently Defueled ICs/EALs

The emergency classifications used are those provided by NUREG 0654/FEMA Rep.1. The NOUE classifications provide an increased awareness for abnormal conditions. The Alert classifications are specific to the actual or potential effects on the spent fuel in storage. The source term and motive force available in the permanently defueled condition is insufficient to warrant classifications of Site Area Emergency or General Emergency levels. Analyses for the credible design basis accidents are provided in the SAR.

Section 3.3 of NUMARC/NESP-007 emphasizes the need for accurate assessment and classification of events, recognizing that over-classification, as well as under-classification, is to be avoided. Primary emphasis is intended to be placed on observable conditions in classifying emergency events. In the permanently defueled condition, these conditions are primarily associated with the spent fuel, the spent fuel pool systems used to provide cooling, and shielding. Effluent IC/EALs were included, however, to provide a basis for classifying events that cannot be readily classified based on observable condition alone.

D.2. Initiating Conditions

There are two radiological effluent IC/EALs provided. The IC/EALs and the fundamental basis for classifications are:

Alert (D-AA1)	Any UNPLANNED Release of Gaseous or Liquid Radioactivity to the Environment that Meets or Exceeds 200 times the Technical Specification Release Limit for 15 Minutes or Longer.

NOUE (D-AU1) Any UNPLANNED Release of Gaseous or Liquid Radioactivity to the Environment that Meets or Exceeds 2 times the Technical Specification Release Limit for 60 Minutes or Longer.

D-AU1 and D-AA1 are **NOT** based on these particular values of offsite dose or dose rate but, rather, on the loss of plant control implied by a radiological release that exceeds a specified multiple of the RETS release limits for a specified period of time.

IC/EALs D-AU1 and D-AA1 provide classification thresholds for UNPLANNED and/or uncontrolled releases of radioactivity to the environment. Calculations supporting the release rates specified in the EAL threshold values should be provided which quantify expected doses at the Restricted Area Boundary. The major isotope of concern in the permanently defueled condition is Kr-85.

Alert (D-AA2) UNCONTROLLED increase in plant radiation levels that impede operations.

NOUE (D-AU2) UNCONTROLLED increase in plant radiation levels.

IC/EALs D-AU2 and D-AA2 provide classification thresholds for UNPLANNED and/or uncontrolled increases of radiation levels. These IC/EALs are concerned with unexpected increases in radiation levels within the facility that may affect operations. The Alert IC/EAL is specific to areas that will result in exposure to plant personnel. An increase of 100 mR/hr must also be accompanied by some impeded operations. The 100 mR/hr is arbitrary and may be set at a reasonable value for a specific application with justification for that value provided. The value of 15 mR/hr is derived from the GDC 19 value of 5 Rem in 30 days with adjustment for expected occupancy times. Although Section III.D.3 of NUREG-0737, *"Clarification of TMI Action Plan Requirements"*, provides that the 15 mR/hr value can be averaged over the 30 days, the value is used in this threshold without averaging, as a 30 day duration implies an event potentially more significant than an Alert. The NOUE uses a moderate increase in monitored radiation level that is not the result of a planned evolution and the source of the increase is not immediately recognized and controlled. The value selected (25 mR/hr) is arbitrary and may be set at a reasonable value for a specific application with justification for that value provided. This IC/EAL is included to raise awareness of an abnormal condition.

One system malfunction is provided that is directly related to the permanently defueled condition methodology. The Spent Fuel pool inventory and temperature are the primary parameters that indicate the potential for fuel damage.

NOUE (D-SU1) Decrease in Spent Fuel Pool level OR temperature increase that is not the result of a planned evolution.

The Site Specific value for decreasing level should be based on either the Technical Specification value for Spent Fuel Pool level or a calculated level that will result in prohibitive radiation levels in the Fuel Building. Justification for the level used in the EAL threshold value should allow for time to correct the level decrease prior to classification.

The site-specific temperature should be chosen based on the starting point for fuel damage calculations in the SAR. Typically, this temperature is 125^0 to 150^0F. Spent Fuel Pool temperature is normally maintained well below this point thus allowing time to correct the cooling system malfunction prior to classification.

It is assumed that the level and temperature thresholds described above result from an unplanned evolution. The NOUE is thus used to heighten awareness of control problems associated with spent fuel pool inventory or temperature control. Both of these conditions would have a long lead-time before fuel damage could occur due to decay heat.

Alert (D-HA1)	Confirmed security event in the Fuel Building or Control Room.
NOUE (D-HU1)	Confirmed security event with potential loss of level of safety of the plant.

A confirmed INTRUSION report is satisfied if physical evidence indicates the presence of a HOSTILE FORCE within the Fuel Handling Building or Control Room. An Alert classification is warranted to account for the potential fuel damage that may be inflicted by a HOSTILE FORCE.

The NOUE is based on (site-specific) Site Security Plans. Security events that do not represent a potential degradation in the level of safety of the plant are reported under 10 CFR 73.71 or in some cases under 10 CFR 50.72.

Reference is made to (site-specific) security shift supervision because these individuals are the designated personnel on-site qualified and trained to confirm that a security event is occurring or has occurred. Training on security event classification confirmation is closely controlled due to the strict secrecy controls placed on the plant Security Plan.

Alert (D-HA2)	Other conditions judged warranting declaration of ALERT.
NOUE (D-HU2)	Other conditions judged warranting declaration of an UNUSUAL EVENT

The Emergency Director has the discretion to classify events based on the classification level definitions. This discretion should be used when conditions or events are observed and no specific IC/EAL is apparent. A discretionary Alert will provide the onshift crew with additional personnel to address the abnormal condition. The NOUE will heighten awareness of the abnormal condition.

NOUE (D-HU3)	Natural or destructive phenomena inside the Protected Area affecting the ability to maintain spent fuel integrity.

Natural and destructive phenomena are classified at the NOUE level because of the unknown factors of the effects when they occur. Escalation to an Alert is through the observable effects of the natural and destructive phenomena via D- AA2.

Appendix E
Basis for ISFSI Initiating Conditions

Introduction

An Independent Spent Fuel Storage Installation (ISFSI) is a complex that is designed and constructed for the interim storage of spent nuclear fuel and other radioactive materials associated with spent fuel storage. An ISFSI which is located on the site of another facility may share common utilities/services and be physically connected with the other facility yet still be considered independent provided, that such sharing of utilities and services or physical connections does not: (1) Increase the probability or consequences of an accident or malfunction of components, structures, or systems that are important to safety; or (2) reduce the margin of safety as defined in the basis for any technical specification of either facility.

A Dry Cask Storage System (DCSS) may be used to store spent nuclear fuel under either a site-specific or general license to operate an ISFSI. At present, any holder of an active reactor operating license under 10 CFR Part 50, has the authority to construct and operate an ISFSI under the provisions of the general license. Requirements for construction and pre-operational activities of such an ISFSI are discussed in Subparts K and L of 10 CFR Part 72. The requirements for pursuing a site-specific ISFSI license are discussed in Subparts B and C of 10 CFR Part 72.

E.1 Purpose of the ISFSI IC/EALs

The analysis of potential onsite and offsite consequences of accidental releases associated with the operation of an ISFSI is contained in NUREG-1140, A Regulatory Analysis on Emergency Preparedness for Fuel Cycle and Other Radioactive Material Licensees. NUREG-1140 concluded that the postulated worst-case accident involving an ISFSI has insignificant consequences to the public health and safety. This evaluation shows that the maximum offsite dose to a member of the public offsite due to an accidental release of radioactive materials would not exceed 1 rem effective dose equivalent or an intake of 2 milligrams of soluble uranium (due to chemical toxicity).

The Final Rule governing Emergency Planning Licensing Requirements for Independent Spent Fuel Storage Facilities was posted in the Federal Register on June 22, 1995 (Federal Register Volume 60, Number 120 June 22, 1995, Pages 32430-32442). The rule indicated that a significant amount of the radioactive material contained within a cask must escape its packaging and enter the atmosphere for there to be a significant environmental impact resulting from an accident involving the dry storage of spent nuclear fuel. There are two primary factors that protect the public health and safety from this unlikely dry storage radioactive material release event.

The first deals with regulatory requirements imposed on the design for the cask. Regulatory requirements have sufficient safety margins so that (during normal storage cask handling operations, off-normal events, adverse environmental conditions, and severe natural phenomena) the casks can not release a significant part of its inventory to the atmosphere.

The second factor deals with the cask general design criteria. The cask criteria requires that 1) design provides confinement safety functions during the unlikely but credible design basis events, 2) the fuel clad must be protected against degradation that leads to gross rupture, and 3) the fuel must be retrievable. These general design criteria place an upper bound on the energy a cask can absorb before the fuel is damaged. No credible dynamic events were identified that could impart such significant amounts of energy to a storage cask after that cask is placed at the ISFSI. The second factor also considers the lack of dispersal mechanisms and the age of the spent fuel. There is no significant dispersal mechanism for the radioactive material contained within a storage cask. Spent fuel required to be stored in an ISFSI must be cooled for at least 1 year. Based on the design limitations of most cask systems, the majority of spent fuel is cooled greater than 5 years. At this age, spent fuel has a heat generation rate that is too low to cause significant particulate dispersal in the unlikely event of a cask confinement boundary failure. Consequently, formal offsite planning is not required because the postulated worst-case accident involving an ISFSI has insignificant consequences to the public health and safety.

10 CFR 72.32 provides two means for satisfying its requirements. 10 CFR 72.32 (a) requires that the application for an ISFSI be accompanied by an Emergency Plan. 10 CFR 72.32 (c) allows that the emergency plan required by 10 CFR 50.47 for a nuclear power reactor licensed for operation by the Commission shall be deemed to satisfy the requirements for an ISFSI located on the site or located within the exclusion area as defined in 10 CFR 100. 10 CFR 72.32 (a) requires that an ISFSI Emergency Plan include a classification system for classifying accidents as "alerts". In contrast to the 10 CFR 72.32 requirements, regulations governing 10 CFR 50.47 emergency plans specify four emergency classes: (1) notification of unusual events, (2) alert, (3) site area emergency, and (4) general emergency, and require a determination of the adequacy of onsite and offsite emergency plans.

NUREG-1567, Standard Review Plan for Spent Fuel Dry Storage Facilities (Draft Report for Comment), Appendix C, Emergency Planning, references Regulatory Guide (RG) 3.67, Standard Format and Content for Emergency Plans for Fuel Cycle and Materials Facilities, as providing guidance on preparation of emergency plans for ISFSIs. RG 3.67 Section C.3, describes "the concept that fuel cycle and materials facilities do not present the same degree of hazard (by orders of magnitude) as are presented by nuclear power plants. Thus, the classification scheme for these facilities is different." RG 3.67 Section C.3.1 states "[a]n alert is defined as an incident that has led or could lead to a release to the environment of radioactive or other hazardous material, but the release is not expected to require a response by an offsite response organization to protect persons offsite."

The expectations for offsite response to an "alert" classified under a 10 CFR 72.32 emergency plan are generally consistent with those for a notification of unusual event in a 10 CFR 50.47 emergency plan, i.e., to provide assistance if requested. Even with regard to activation of a licensee's emergency response organization (ERO), the ERO for a 10 CFR 72.32 emergency plan is not that prescribed under a 10 CFR 50.47 emergency plan, e.g., no Emergency Technical Support. Consequently, the "alerts" contemplated by NUREG-1567, Appendix C, Emergency Planning, Section C.4.3.1, have been classified as NOUEs herein. To do otherwise could lead to an inappropriate response posture on the part of offsite response organizations.

NUREG-1567, Appendix C, Emergency Planning, Section C.4.3.1, descriptions of initiating events appear below:

- Fire onsite that might affect radioactive material of systems important to safety
- Severe natural phenomenon projected to occur that might affect radioactive material or systems important to safety (e.g., flood, tsunami, hurricane, tidal surge, hurricane force winds)
- Severe natural phenomenon or other incidents have occurred that may have affected radioactive material or systems important to safety, but initial assessment is not complete (e.g., beyond design basis earthquake, flood, tsunami, hurricane, tidal surge, hurricane force winds, tornado missiles, explosion, release of flammable gas)
- Elevated radiation levels or airborne contamination levels within the facility indicate severe loss of control (factor of 100 over normal levels)
- Ongoing security compromise (greater than 15 minutes)

- Accidental release of radioactivity within building confinement barrier (pool or waste management facility)
- Discovery of condition that creates a criticality hazard
- Other conditions that warrant precautionary activation of the licensee's emergency response organization

Note that 10 CFR 72.32 also discusses emergency planning license application requirements for Monitored Retrievable Storage Facilities (MRS) and for ISFSIs that may process and/or repackage spent fuel. 10 CFR 72.32 (b) requires that an Emergency Plan for an MRS or one of these more complex ISFSIs include a classification system for classifying accidents as "alerts" or "site area emergencies." NUREG-1567 Section C.4.3.2 provides a list of events that may initiate a site area emergency at one of these facilities. However, these facilities are beyond the scope of this discussion.

NUREG-1536, Standard Review Plan for Dry Cask Storage Systems, provides guidance for performing safety reviews of applications for approval of spent fuel DCSS. The principal purposes of the DCSS Standard Review Plan (SRP) are to ensure the quality and consistency of staff reviews and to establish a well-defined basis from which to evaluate proposed changes in the scope of reviews.

Accidents and events associated with natural phenomena may share common regulatory and design limits. By contrast, anticipated occurrences (off-normal conditions) are distinguished, in part, from accidents or natural phenomena by the appropriate regulatory guidance and design criteria. For example, the radiation dose from an off-normal event must not exceed the limits specified in 10 CFR Part 20 and 10 CFR 72.104(a), whereas the radiation dose from an accident or natural phenomenon must not exceed the specifications of 10 CFR 72.106(b). Accident conditions may also have different allowable structural criteria.

According to NUREG 1536, the following accidents should be evaluated in the SAR. Because of the NRC's defense-in-depth approach, each should be evaluated regardless of whether it is highly unlikely or highly improbable. These do not constitute the only accidents that should be addressed if the SAR is to serve as a reference for accidents for the site-specific application. Others that may be derived from a hazard analysis could include accidents resulting from operational error, instrument failure, lightning, and other occurrences. Accident situations that are not credible because of design features or other reasons should be identified and justified in the SAR.

- Section 2.0-V.2.b(3) - Accident Conditions
  - (a) Cask Drop
  - (b) Cask Tipover
  - (c) Fire
  - (d) Fuel Rod Rupture
  - (e) Leakage of the Confinement Boundary
  - (f) Explosive Overpressure
  - (g) Air Flow Blockage
- Section 2.0-V.2.b(4) - Natural Phenomena Events
  - (a) Flood
  - (b) Tornado
  - (c) Earthquake
  - (d) Burial under Debris
  - (e) Lightning
  - (f) Other natural phenomena events (including seiche, tsunami, and hurricane)

The emergency classifications used are those provided by NUREG 0654/FEMA Rep.1. NOUE classifications provide an increased awareness for abnormal conditions. The source term and motive force available at a simple ISFSI is insufficient to warrant classifications above the NOUE level using the 10 CFR 50 emergency classification scheme.

Section 3.3 of NUMARC/NESP-007 emphasizes the need for accurate assessment and classification of events. It is intended that primary emphasis be placed on observable conditions in classifying emergency events. For an ISFSI, these conditions are primarily associated with the CONFINEMENT BOUNDARY of a loaded fuel storage cask.

E.2. Initiating Conditions

There is one abnormal radiological event IC/EAL provided. The IC/EAL and the fundamental basis for this classification is:

NOUE (E-AU1) Unexpected increase in ISFSI radiation.

IC E-AU1 provides a classification threshold for an UNPLANNED and/or uncontrolled increases of radiation levels. This IC is included to raise awareness of an abnormal condition.

This NOUE is used to heighten awareness of control problems associated with the ISFSI cask CONFINEMENT BOUNDARY.

NOUE (E-HU1) Damage to a loaded cask CONFINEMENT BOUNDARY.

The Emergency Director has the discretion to classify events based on the classification level definitions. This discretion should be used when conditions or events are observed and no specific IC/EAL is apparent. The NOUE will heighten awareness of the abnormal condition. Natural phenomena events and accident conditions are classified at the NOUE level in the event that a loaded cask CONFINEMENT BOUNDARY is damaged or violated.

NOUE (E-HU2) Security event with potential loss of level of safety of the ISFSI.

The NOUE is based on (site-specific) ISFSI Security Plans. Security events that do not represent a potential degradation in the level of safety are reported under 10 CFR 73.71 or in some cases under 10 CFR 50.72.

Reference is made to (site-specific) security shift supervision because these individuals are the designated personnel on-site qualified and trained to confirm that a security event is occurring or has occurred. Training on security event classification confirmation is closely controlled due to the strict secrecy controls placed on the plant Security Plan.

The term "Protected Area" is defined by 10 CFR 73.2(a) as "an area encompassed by physical barriers and to which access is controlled." Response to, and classification of, an un-neutralized intrusion into an operating plant's Protected Area and a separate ISFSI Protected Area would differ significantly. The Final Rule governing Physical Protection for Spent Nuclear Fuel and High-Level Radioactive Waste (Federal Register Volume 63, Number 94, dated May 15, 1998, Pages 26955-26963), stated that "[t]he Commission believes that the appropriate level of physical protection for spent fuel and high-level radioactive waste lies somewhere between industrial-grade security and the level that is required at operating power reactors. The Commission also notes that the nature of spent fuel and of its storage mechanisms offers unique advantages in protecting the material." Further, "[t]he Commission never intended that onsite physical protection personnel at an ISFSI would provide a response to a safeguards event other than calling for assistance from local law enforcement or other designated response force unless their timely response could not be ensured." 10 CFR 73.51 calls for unarmed watchmen, not armed guards. Therefore, it is reasonable to treat the "Protected Area" around the operating units and around the ISFSI differently with regard to the EALs governing classification unless the ISFSI Protected Area is bounded by the plant Protected Area. This same rationale may be applicable to natural or other hazards in addition to Security events.