Am

U.S. Nuclear Regulatory Commission

Meeting with Nuclear Energy Institute Regarding
Emergency Action Level Guidance
February 28, 2007

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NEI 99-01

Rev. 5

(NUMARC/NESP-007)

(FINAL DRAFT)

Methodology for Development of Emergency Action Levels

February 2007

ACKNOWLEDGEMENTS

Revision 5 of this Nuclear Energy Institute (NEI) report incorporates Frequently Asked Questions (FAQs) generated by users and developers during conversion from previous classification schemes to NEI 99-01, Rev. 4 and Security Emergency Action Levels (EALs) with the Hostile Action changes endorsed by the Nuclear Regulatory Commission (NRC) in Regulatory Issue Summary RIS 2006-12 on July 19, 2006. 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 and extensive technical support provided by the members of the EAL FAQ Task Force.

Revision 5 recognized implementation difficulties, interpretations and errors of Revision 4 and was developed through use of a FAQ format where stakeholders submitted concerns to the NEI Task Force and technical solutions were found to better transition the classification process.

FOREWORD

Revision 5 of this report incorporates Frequently Asked Questions (FAQs) generated by users and developers during conversion from previous classification schemes to NEI 99-01, Revision 4 and Security EALs with the Hostile Action changes endorsed by the NRC in RIS 2006-12 on July 19, 2006.

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EAL Revision Task Force
2006

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EXECUTIVE SUMMARY

Revision 5 to NEI 99-01 represents several years of use and implementation of the NEI 99-01 methodology. Initially, portions of Revision 4 were superseded by NRC Bulletin 2005-02 "Emergency Preparedness And Response Actions For Security-Based Events" to immediately implement changes to the security philosophy following the events of September 11, 2001. This process was accomplished using a NEI White Paper "Enhancements to Emergency Preparedness Programs For Hostile Action", May 2005 (Revised November 18, 2005) and endorsed by the NRC in RIS 2006-12 on July 19, 2006. The security changes are formalized with Revision 5.

In order to address development and implementation issues, a FAQ process was used to take input from the industry and the NRC. The NEI 99-01 EAL FAQ Task Force evaluated each concern presented and provided an industry perspective to each. The Task Force presented the recommendations to the NRC for consideration and approval. FAQs that were acceptable are incorporated with this change.

ACRONYMS

AC	Alternating Current
APRM	Average Power Range Meter
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/CNMT	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
FAA	Federal Aviation Administration
FBI	Federal Bureau of Investigation
FEMA	Federal Emergency Management Agency
FSAR	Final Safety Analysis Report
GE	General Emergency
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
Keff	Effective Neutron Multiplication Factor

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
NPP	Nuclear Power Plant
NRC	Nuclear Regulatory Commission
NSSS	Nuclear Steam Supply System
NORAD	North American Aerospace Defense Command
NOUE	Notification Of Unusual Event
NUMARC	Nuclear Management and Resources Council
OBE	Operating Basis Earthquake
OCA	Owner Controlled Area
ODCM	Off-site Dose Calculation Manual
ORO	Off-site Response Organization
PA	Protected Area
POAH	Point of Adding Heat
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

The historical background for the development of NEI 99-01, "Methodology for Development of Emergency Action Levels" is contained in Revision 4 and includes the processes used to evolve from NUREG 0654 based EALs to the NEI methodology.

2.0 CHANGES INCORPORATED WITH REVISION 5

This section summarizes the more significant changes made to the EAL methodology with Revision 5. This section is not intended to be a complete tabulation of changes. 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

The significant portions of Section 3.0 were retained for developers changing from NUREG 0654 to NEI 99-01, Rev 5 EAL methodology. The sections concerning plant specific implementation policy have been removed. Developer notes were differentiated from the bases by brackets and italic font.

2.2 Section 4.0, Human Factors Considerations

Words that could be confused with similar sounding words were replaced in EALs, e.g., "rise and drop" replaced "increase and decrease." Similarly, mathematical symbols were replaced with text, e.g., "greater than or equal to" replaced " $\geq$".

2.3 Section 5.0, Generic EAL Guidance

The Security specific definitions have been added. Several definitions that are no longer used in this document have been removed. Sections of the basis have been designated as developer information and a paragraph explaining the use of this information was added. Additional information regarding site-specific implementation was added in response to numerous questions received during utility implementation efforts.

2.4 Section 5.0, Recognition Category A

FAQs 2006-13 (AA2) and -25 (AA3) were implemented.

2.5 Section 5.0, Recognition Category C

FAQs 2006-01 and -08 (CA1), 2006-04 and -18 (CA3), 2006-05 (CS2), 2006-06 and -07 (CA2), 2006-09 and -10 (CS1), 2006-11 (CS2), 2006-12 (CU4), 2006-14 (CU1), 2006-15 (CU5), 2006-17 (CU3) and 2006-19 (CG1) were implemented. CU5 was deleted. CA1 and CA2 were combined due to the similarity between BWR and PWR EALs..

2.6 Section 5.0, Recognition Category D

No significant changes.

2.7 Section 5.0, Recognition Category E

Deleted E-HU2 IAW the NRC Bulletin 2005-02 "Emergency Preparedness And Response Actions For Security-Based Events" and NEI White paper "Enhancements to Emergency Preparedness Programs For Hostile Action", May 2005 (Revised November 18, 2005) and endorsed by the NRC in RIS 2006-12 on July 19, 2006.

2.8 Section 5.0, Recognition Category F

FAQ 2006-20 (BWR Containment Loss 3) was implemented.

2.9 Section 5.0, Recognition Category H

FAQs 2006-22 (HU1), 2006-23 (HU3) and 2006-24 (HA3) were implemented.

2.10 Section 5.0, Recognition Category S

FAQs 2006-02 (SU1), 2006-03 (SS1) and 2006-16 (SG1) were implemented. Added SU9 and deleted SS4.

3.0 DEVELOPMENT OF BASIS FOR GENERIC APPROACH

3.1 Definitions Used to Develop 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 NRC, for grouping off normal nuclear power plant conditions according to (1) their relative radiological seriousness, and (2) the time-sensitive on-site 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 IC that places the plant in a given emergency class. An EAL can be: an instrument reading; an equipment status indicator; a measurable parameter (on-site or off-site); 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 On-site" is an example of an "NOUE" IC in NUREG-0654 that also can be an event-based EAL.

3.2 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 on-site and off-site 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, off-site 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 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.

3.3 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 these symptoms indicate 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 could 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 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)

3.4 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.

3.5 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 methodology 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.

3.6 Emergency Class Descriptions

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

(1) The potential impact on radiological safety, either as known now 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 off-site dose consequence considerations that were not included in NUREG-0654 Appendix 1.

NOTIFICATION OF UNUSUAL EVENT (NOUE): Events are in process or have occurred which indicate a potential degradation of the level of safety of the plant or indicate a security threat to facility protection has been initiated. No releases of radioactive material requiring off-site 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 off-site response.

ALERT: Events are in process or have occurred which involve an actual or potential substantial degradation of the level of safety of the plant or a security event that involves probable life threatening risk to site personnel or damage to site equipment because of HOSTILE ACTION. Any releases are expected to be limited to small fractions of the EPA PAG 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.

SITE AREA EMERGENCY (SAE): Events are in process or have occurred which involve actual or likely major failures of plant functions needed for protection of the public or HOSTILE ACTIONS that result in intentional damage or malicious acts; 1) toward site personnel or equipment that could lead to the likely failure of or; 2) that prevent effective access to, equipment needed for the protection of the public. Any releases are not expected to result in exposure levels which exceed EPA PAG 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 off-site emergency response agency concerns as to timely declaration of a General Emergency.

GENERAL EMERGENCY (GE): Events are in process or have occurred which involve actual or IMMINENT substantial core degradation or melting with potential for loss of containment integrity or HOSTILE ACTION that results in an actual loss of physical control of the facility. Releases can be reasonably expected to exceed EPA Protective Action Guideline exposure levels off-site 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 loss or potential loss of the third barrier constitutes a General Emergency.

3.7 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 trip/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 analysis, PRA). PSAs have been completed for all individual plants PSAs can be used as a good first approximation of the relevant ICs and risk associated with emergency conditions for existing plants. Each plant has an Individual Plant

Evaluation (IPE) and an Individual Plant Evaluation for External Events (IPEEE). Generic insights from a PSA/ PRA, the IPE, IPEEE 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. PRAs show that leading contributors to latent fatalities were containment bypass, large LOCA with early containment failure, Station Blackout longer 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 off-site 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%.

3.8 Emergency Action Levels

ICs/EALs are for UNPLANNED events. A planned evolution involves preplanning to address the limitations imposed by the condition, the performance of required surveillance testing, and the implementation of specific controls prior to knowingly entering the condition. Planned evolutions to test, manipulate, repair, perform maintenance or modifications to systems and equipment that result in an EAL Threshold Value being met or exceeded are not subject to classification and activation requirements as long as the evolution proceeds as planned. However, these conditions may be subject to the reporting requirements of 10 CFR 50.72.

Classifications are based on evaluation of each Unit. All classifications are to be based upon VALID indications, reports or conditions. Indications, reports or conditions are considered VALID when they are verified by (1) an instrument channel check, or (2) indications on related or redundant indications, or (3) by direct observation by plant personnel, such that doubt related to the indication's operability, the condition's existence, or the report's accuracy is removed. Implicit in this definition is the need for timely assessment.

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.

The Emergency Director must remain alert to events or conditions that lead to the conclusion that exceeding the EAL threshold is IMMINENT. Under certain plant conditions, an alternate instrument or a temporary instrument may be installed to facilitate monitoring the parameter. In addition, visual observation may be sufficient to detect that a parameter is approaching or has reached a classifiable threshold. In these cases, the classification of the event is appropriate even if the instrument normally used to monitor the parameter is inoperable or has otherwise failed to detect the threshold. 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.

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 off-site 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 (OBE), 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 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 threshold 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.

3.9 Treatment Of Multiple Events And Emergency Class Upgrading

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 threshold 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 Classifying 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. 2, Section 3, should be applied.

Existing guidance for classifying transient events addresses the period of time of event recognition and classification (15 minutes). However, in cases when an EAL declaration criteria may be met momentarily during the normal expected response of the plant, declaration requirements should not be considered to be met when the conditions are a part of the designed plant response or result in appropriate operator actions.

3.11 Operating Mode Applicability

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.

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.

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			

3.12 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).

3.13 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. Off-site 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:

Use of visual cues in the plant procedures signaling 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, such as directly copying NUREG-0654 Appendix 1 language; adding plant-specific indications to clarify NUREG-0654; using procedure language, including specific tag numbers for instrument readings and alarms; deliberately omitting instrument tag numbers; using 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 off-site 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 on-site and off-site) 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 EALs for NOUEs to primarily symptom- or barrier-based EALs 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 that 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 ICs 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 IC matrix versus Emergency Class is first shown. For Recognition Category F, the barrier-based EALs are presented in Tables 5-F-1 and 5-F-2 for BWRs and Tables 5-F-1 and 5-F-3 for PWRs. 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. Appendices A, C, D, and E provide detailed guidance on implementing their corresponding Recognition Categories.

  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 alternatives 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 off-site 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 (e.g., 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 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, which have been specified, correspond to conditions that 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.

Portions of the basis are specifically designated as information necessary for the development of the site specific thresholds of the EALs. These developer information sections are in [*brackets and italicized*]. The information contained in these portions consists of references, examples, instructions for calculations, etc. These portions of the basis need not be included in the technical basis document supporting the EALs. In some cases, the information developed from the developer information may be appropriate to include in the technical basis document. In addition, the appendices are developer information in their entirety.

5.3 Site Specific Implementation

The guidance presented here is not intended to be applied to plants as-is. However, the benefits of aligning with the guidance as closely as possible may be realized in improved interface with the NRC and other utilities, and better positioning to adopt future enhancements such as FAQs. The guidance is intended to provide the logic for developing site-specific IC/EALs using site-specific IC/EAL presentation methods (formats). Each utility will need to implement the IC/EALs using site-specific instrumentation, nomenclature, plant arrangement, method of presentation, etc. When plant design prevents use of ICs/EALs prescribed in the guidance document, other indications that address the subject condition should be implemented. RIS 2003-18 and its supplements 1 and 2 clarify the expectations for alignment with the guidance document and the associated regulatory review requirements.

The generic guidance includes 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 off-site 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: A group of (site-specific #) or more persons violently protesting station operations or activities at the site.

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

CONTAINMENT CLOSURE: The site-specific procedurally defined action taken to secure primary or secondary containment (BWR) and its associated structures, systems, and components as a functional barrier to fission product release under existing plant conditions.

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

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

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

HOSTILE ACTION: An act toward a Nuclear Power Plant or its personnel that includes the use of violent force to destroy equipment, take HOSTAGES, and/or intimidate the licensee to achieve an end. This includes attack by air, land, or water using guns, explosives, PROJECTILEs, vehicles, or other devices used to deliver destructive force. Other acts that satisfy the overall intent may be included. HOSTILE ACTION should not be construed to include acts of civil disobedience or felonious acts that are not part of a concerted attack on the Nuclear Power Plant. Non-terrorism-based EALs should be used to address such activities (i.e., violent acts between individuals in the OWNER CONTROLLED AREA).

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): An atmospheric concentration of any toxic, corrosive or asphyxiant substance that poses an immediate threat to life or would interfere with an individual's ability to escape from a dangerous atmosphere.

IMMINENT: Mitigation actions have been ineffective, additional actions are not expected to be successful, and trended information indicates that the event or condition will occur. Where IMMINENT timeframes are specified, they shall apply.

INTRUSION: 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.

INDEPENDENT SPENT FUEL STORAGE INSTALLATION (ISFSI): A complex that is designed and constructed for the interim storage of spent nuclear fuel and other radioactive materials associated with spent fuel storage.

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.

NORMAL PLANT OPERATIONS: Activities at the plant site associated with routine testing, maintenance, or equipment operations, in accordance with normal operating or administrative procedures. Entry into abnormal or emergency operating procedures, or deviation from normal security or radiological controls posture, is a departure from NORMAL PLANT OPERATIONS.

POINT OF ADDING HEAT: a Unit specific reactor power level at which sufficient energy is being added to the reactor coolant from the reactor to result in a bulk coolant temperature increase. [This value may vary slightly based on plant core loading and time of life. For purposes of identifying the Unit specific reactor power level, a typical value may be chosen to prevent having to recalculate this setpoint. Sites may choose to operationally have their staff identify that the reactor is at the POAH and not develop a specific power level equivalent to the POAH.]

PROJECTILE: An object directed toward a Nuclear Power Plant that could have an effect sufficient to cause concern for its continued operability, reliability, or safety of personnel.

PROTECTED AREA: (site-specific) typically the area which normally encompasses all controlled areas within the security PROTECTED AREA fence..

RUPTURED: (PWRs) in a steam generator, existence of primary-to-secondary leakage of a magnitude sufficient to require or cause a reactor trip and safety injection.

SIGNIFICANT TRANSIENT: An UNPLANNED event involving one or more of the following: (1) automatic turbine runback greater than 25% thermal reactor power, (2) electrical load rejection greater than 25% full electrical load, (3) Reactor Trip, (4) Safety Injection Activation, or (5) thermal power oscillations greater than 10%.

STRIKE ACTION: A work stoppage within the PROTECTED AREA by a body of workers to enforce compliance with demands made on (site-specific). The STRIKE ACTION must threaten to interrupt NORMAL PLANT OPERATIONS.

UNPLANNED: A parameter change or an event that is not the result of an intended evolution and requires corrective or mitigative actions.

VALID: An indication, report, or condition, is considered to be VALID when it is verified by (1) an instrument channel check, (2) indications on related or redundant indicators, or (3) by direct observation by plant personnel, such that doubt related to the indicator's operability, the condition's existence, or the report's accuracy is removed. Implicit in this definition is the need for timely assessment.

VISIBLE DAMAGE: Damage to equipment or structure that is readily observable without measurements, testing, or analysis. Damage is sufficient to cause concern regarding the continued operability or reliability of the affected structure, system, or component. Example damage includes: deformation due to heat or impact, denting, penetration, rupture, cracking, and paint blistering. Surface blemishes (e.g., paint chipping, scratches) should not be included.

VITAL AREA: (site-specific) Typically any area, normally within the PROTECTED AREA, that contains equipment, systems, components, or material, the failure, destruction, or release of which could directly or indirectly endanger the public health and safety by exposure to radiation.

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 Radiological Effluent Technical Specifications for 60 Minutes or Longer.** *Op. Modes: All*	**AA1** **Any UNPLANNED Release of Gaseous or Liquid Radioactivity to the Environment Exceeds 200 Times the Radiological Effluent Technical Specifications for 15 Minutes or Longer.** *Op. Modes: All*	**AS1** **Off-site 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** **Off-site 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 Rise in Plant Radiation.** *Op. Modes: All*	**AA3** **Release of Radioactive Material or Rise 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*		

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ABNORMAL RAD LEVELS/RADIOLOGICAL EFFLUENT

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 Off-site 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 ODCM 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 off-site 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 ODCM 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 setpoint will be based on radiation monitor readings to exceed two times the Technical Specification limit and releases are not terminated within 60 minutes. 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 ÷ 8766 × 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 ODCM 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 Rise in Plant Radiation.

Operating Mode Applicability: All

Example Emergency Action Levels: (1 or 2)

1. a. VALID (site-specific) indication of uncontrolled water level drop 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) Area Radiation Monitor reading rise

2. UNPLANNED VALID Area Radiation Monitor readings rise 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, 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 encountered during operation of plant processes that represent a degradation in the control of radioactive material, and represent a potential degradation in the level of safety of the plant. This EAL excludes in-plant radiation levels that may result from use of radiographic sources. 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 Off-site 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 the features and/or controls established to prevent unintentional releases, or control and monitor intentional releases. [*Some sites may find it advantageous to address gaseous and liquid releases with separate initiating conditions and EALs.*]

The ODCM 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 off-site 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*] addresses effluent or accident radiation monitors on non-routine release pathways (i.e., for which a discharge permit would not normally be prepared). [*To ensure a realistic near-linear escalation path, a setpoint should be selected roughly half-way between the AU1 EAL #2 value and the value calculated for AS1 rad monitor value. The setpoint will be based on radiation monitor readings to exceed two hundred times the Technical Specification limit and releases are not terminated within 60 minutes.* 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 ODCM 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.*]

ABNORMAL RAD LEVELS/RADIOLOGICAL EFFLUENT

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 elevated 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. A water level drop in the reactor refueling cavity, spent fuel pool or fuel transfer canal that will result in irradiated fuel becoming uncovered.

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*].

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, 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 Rise 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 as a result of an uncontrolled plant process 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 as a result of an uncontrolled plant process 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. [*It is recommended that the annual administrative exposure limit for the site be used as the basis for this value assuming a one hour exposure.*] 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.*]

ABNORMAL RAD LEVELS/RADIOLOGICAL EFFLUENT

AS1

Initiating Condition -- SITE AREA EMERGENCY

Off-site 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 used should be the same as those used for determining the monitor reading EALs in ICs AU1 and AA1. The same source term (noble gases, particulates, and halogens) may also be used as long as it maintains a realistic and near linear escalation 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.*

If proper escalations do not result from the use of the same source term, if the calculated values are unrealistically high, or if correlation between the values and dose assessment values does not exist, then consider using an accident source term for AS1 and AG1 calculations.]

[*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.*]

ABNORMAL RAD LEVELS/RADIOLOGICAL EFFLUENT

AG1

Initiating Condition -- GENERAL EMERGENCY

Off-site 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. 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.]

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/RPV Inventory with Irradiated Fuel in the RPV. *Op. Modes: Cold Shutdown; Refueling*	**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**	Deleted	**CS2**	Loss of RPV Inventory Affecting Core Decay Heat Removal Capability with Irradiated Fuel in the RPV. Op. Modes: Refueling		
CU3	Loss of All Off-site Power to Essential Busses for Greater Than 15 Minutes. *Op. Modes: Cold Shutdown, Refueling*	**CA3**	Loss of All Off-site Power and Loss of All On-site 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*				
CU6	UNPLANNED Loss of All OnsiteOn-site or OffsiteOff-site Communications Capabilities. *Op. Modes: Cold Shutdown, Refueling, Defueled*						
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*						

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SYSTEM MALFUNCTION

CU1

Initiating Condition -- NOTIFICATION OF UNUSUAL EVENT

RCS Leakage.

Operating Mode Applicability: Cold Shutdown

Example Emergency Action Levels:

1. Unable to maintain or restore level within {site specific pressurizer or RPV level target band} due to RCS leakage for greater than 15 minutes. (PWR)

1. Unable to maintain or restore RPV level greater than {site specific low level RPS actuation setpoint} due to RCS leakage for greater than 15 minutes. (BWR)

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 inability to establish and maintain level at the low end of the desired target band for 15 minutes is indicative of loss of RCS inventory. Prolonged loss of RCS Inventory may result in escalation to the Alert level via either IC CA1 (Loss of RCS) 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 the refueling mode the RCS is not intact and RPV level and inventory are monitored by different means. 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. RCS leakage escalation under will be by CA1.*]

SYSTEM MALFUNCTION

CU2

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 drop below the RPV flange for greater than 15 minutes

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

   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 CA1 (Loss of RCS/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*].

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 CA1 would be appropriate. [*For PWRs,*] if RPV level continues to decrease and reaches the Bottom ID of the RCS Loop then escalation to CA1 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).*]

[EAL 2 relates primarily to the *refueling mode when 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 CA1 or RCS heatup via CA4.*]

SYSTEM MALFUNCTION

CU3

Initiating Condition -- NOTIFICATION OF UNUSUAL EVENT

Loss of All Off-site Power to Emergency Busses for Greater Than 15 Minutes.

Operating Mode Applicability: Cold Shutdown
Refueling

Example Emergency Action Level:

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

Basis:

Prolonged loss of off-site 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 losses of off-site power. [*The site specific emergency generators is the minimum allowed by Technical Specifications in the applicable modes.*]

[*Plants that have a proceduralized capability to cross-tie AC power from an off-site power supply of a companion unit may take credit for the redundant power source in the associated EAL for this IC. Inability to achieve the cross-tie within 15 minutes warrants declaring a NOUE.*]

[*EAL consideration may be given for a non-emergency (i.e., not safety-related) power source if both of the following conditions are met.*

a. The source is capable of supplying power to at least one train of safety-related loads necessary to establish and maintain cold shutdown in the event of a loss of off-site power coincident with the loss of all emergency generators.
b. The contingent use of the power source must be recognized in emergency operating procedures.]

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 greater than 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.

[*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 CA1 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.

SYSTEM MALFUNCTION

CU6

Initiating Condition -- NOTIFICATION OF UNUSUAL EVENT

UNPLANNED Loss of All On-site or Off-site Communications Capabilities.

Operating Mode Applicability: Cold Shutdown
Refueling
Defueled

Example Emergency Action Levels: (1 or 2)

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

2. Loss of all (site-specific list) off-site 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 off-site authorities. The loss of off-site 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 off-site 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 off-site locations, etc.) are being utilized to make communications possible.

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

SYSTEM MALFUNCTION

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 in less than 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.*]

SYSTEM MALFUNCTION

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 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/RPV Inventory with Irradiated Fuel in the RPV.

Operating Mode Applicability: Cold Shutdown
Refueling

Example Emergency Action Levels: (1 or 2)

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

2. a. Loss of RCS/RPV inventory as indicated by unexplained {site-specific} sump or tank level rise

   AND

   b. RCS/RPV level cannot be monitored for greater than 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 occurred. 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).*]

[*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.*]

[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. 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 CG1 basis. Therefore this EAL meets the definition for an Alert.]

If RPV level continues to lower then escalation to Site Area will be via CS1 (Loss of RPV Inventory Affecting Core Decay Heat Removal Capability).

SYSTEM MALFUNCTION

CA3

Initiating Condition -- ALERT

Loss of All Off-site Power and Loss of All On-site AC Power to Emergency Busses.

Operating Mode Applicability: Cold Shutdown
Refueling
Defueled

Example Emergency Action Level:

1. a. Loss of off-site power to (site-specific) emergency busses .

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 in less than 15 minutes from the time of loss of both off-site and on-site 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.

SYSTEM MALFUNCTION

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. With RCS integrity established 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 rise of greater than {site specific} psig.

Basis:

CONTAINMENT CLOSURE is the {site specific} procedurally defined action taken to secure primary or secondary containment (BWR) and its associated structures, systems, and components as a functional barrier to fission product release under existing plant conditions.

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 greater than 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

[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.

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 greater than 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 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.

<u>**SYSTEM MALFUNCTION**</u>

CS1

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 <u>not</u> 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)

   <u>**OR**</u>

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

2. With CONTAINMENT CLOSURE established

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

   <u>**OR**</u>

   b. RPV level cannot be monitored for greater than 30 minutes with a loss of RPV inventory as indicated by either:
      - Unexplained {site-specific} sump or tank level rise
      - 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.

CONTAINMENT CLOSURE is the {site specific} procedurally defined action taken to secure primary or secondary containment (BWR) and its associated structures, systems, and components as a functional barrier to fission product release under existing plant conditions.

[*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.*]

[*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.*] [*Since BWRs have RCS penetrations below the setpoint, continued level decrease may be indicative of pressure boundary leakage.*]

The 30-minute duration 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 (Off-site 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).

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:
      - {Site-specific} radiation monitor reading greater than {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:
      - {Site-specific} radiation monitor reading greater than {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.*]

CONTAINMENT CLOSURE is the {site specific} procedurally defined action taken to secure primary or secondary containment (BWR) and its associated structures, systems, and components as a functional barrier to fission product release under existing plant conditions.

[*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).*]

[*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 {site-specific} monitor indication and possible alarm. [*EAL 1.b and EAL 2.b should conservatively estimate a site-specific dose rate setpoint indicative of core uncovery (ie., level at TOAF). For BWRs that do not have installed radiation monitors capable of indicating core uncovery, alternate site specific level indications of core uncovery should be used.*]

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 (Off-site 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).

<u>SYSTEM MALFUNCTION</u>

CG1

Initiating Condition -- GENERAL EMERGENCY

Loss of RPV Inventory Affecting Fuel Clad Integrity with Containment Challenged and 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 {site-specific indications}

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

   OR

   b. Cannot be monitored with indication of core uncovery for greater than 30 minutes as evidenced by one or more of the following:
   - Containment High Range Radiation Monitor reading greater than {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 <u>not</u> 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 to detect inventory loss. 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 other site-specific indications.
[*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 other site-specific indications.*].

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.

[*In the cold shutdown mode, normal RCS level and RPV level instrumentation systems will normally be available to detect decreasing RPV water level. 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.*]

[*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.

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.

[*Site shutdown contingency plans typically provide for re-establishing CONTAINMENT CLOSURE following a loss of heat removal or RCS inventory functions.*] If CONTAINMENT 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. CONTAINMENT CLOSURE is the {site specific} procedurally defined action taken to secure primary or secondary containment (BWR) and its associated structures, systems, and components as a functional barrier to fission product release under existing plant conditions.

[*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 or conditions 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.]

Recognition Category D

Permanently Defueled Station Malfunction

INITIATING CONDITION MATRIX

NOUE		ALERT	
D-AU1	UNPLANNED release of gaseous or liquid radioactivity to the environment greater than 2 times the Technical Specification Release Limit for greater than 60 Minutes. *Op. Mode: Not Applicable*	**D-AA1**	UNPLANNED release of gaseous or liquid radioactivity to the environment greater than 200 times the Technical Specification Release Limit for $\geq$ 15 Minutes. *Op. Mode: Not Applicable*
D-AU2	UNCONTROLLED rise in plant radiation levels. *Op. Mode: Not Applicable*	**D-AA2**	UNCONTROLLED rise in plant radiation levels that impedes operations *Op. Mode: Not Applicable*
D-SU1	Drop in Spent Fuel Pool level OR temperature rise 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*		

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D-AU1

Initiating Condition -- NOTIFICATION OF UNUSUAL EVENT

UNPLANNED release of gaseous or liquid radioactivity to the environment greater than or equal to 2 times the Technical Specification Release Limit for greater than or equal to 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 greater than or equal to 60 Minutes.
2. Grab sample results indicate UNPLANNED gaseous release rates or liquid concentrations greater than or equal to 2 times the Technical Specification Release Limit for greater than or equal to 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 less than 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 rise in plant radiation levels.

Operating Mode Applicability: Not Applicable

Example Emergency Action Level:

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

Basis:

UNCONTROLLED means an increase in less than 12 hours of monitored radiation level that is not the result of a planned evolution and the source of the increase 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.

PERMANENTLY DEFUELED STATION MALFUNCTION

D-SU1

Initiating Condition -- NOTIFICATION OF UNUSUAL EVENT

Drop in Spent Fuel Pool Level OR temperature rise 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 drop in spent fuel pool with all irradiated fuel assemblies remaining covered by water.

   AND

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

2. Spent Fuel Pool temperature rise to greater than [site-specific] °F that is not the result of a planned evolution.

Basis:

Classification of a 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).]

PERMANENTLY DEFUELED STATION MALFUNCTION

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.*]

PERMANENTLY DEFUELED STATION MALFUNCTION

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 or indicate a security threat to facility protection has been initiated.

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 have 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 in less than 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 have 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 addresses 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 have caused damage that results in radiation levels increasing by 100 mr/hr and impedes operation of systems needed to maintain spent fuel integrity.

PERMANENTLY DEFUELED STATION MALFUNCTION

D-AA1

Initiating Condition -- ALERT

UNPLANNED release of gaseous or liquid radioactivity to the environment greater than or equal to 200 times the Technical Specification Release Limit for greater than or equal to 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 greater than or equal to 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 less than 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 rise 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 rise 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 and 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 or a security event that involves probable life threatening risk to site personnel or damage to site equipment because of intentional malicious dedicated efforts of HOSTILE ACTION. 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-HU1 Damage to a loaded cask CONFINEMENT BOUNDARY.
Op. Mode: Not Applicable

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EVENTS RELATED TO ISFSI

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 or SAR referenced in the cask('s) Certificate of Compliance and the related NRC Safety Evaluation Report 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, PROJECTILE damage, FIRE damage or natural phenomena affecting a cask (e.g., seismic event, tornado, etc.). If the site specific ISFSI certificate of Compliance and related NRC SER show through analysis to have no potential effect on the CONFINEMENT BOUNDARY, the analyzed events are not required in the site specific list.*]

[*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.

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Table 5-F-1

Recognition Category F

Fission Product Barrier Degradation

INITIATING CONDITION MATRIX

See Table 5-F-2 for BWR Example EALs
See Table 5-F-3 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 Loss or 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 off-site 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.

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. 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 Loss or 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. Primary Containment Conditions**		**1. Primary Containment Conditions**	
Primary coolant activity greater than (site-specific value)	Not Applicable	Primary containment pressure greater than (site-specific value) due to RCS leakage	Not Applicable	Primary containment pressure rise followed by a rapid unexplained drop in primary containment pressure. **OR** Primary containment pressure response not consistent with LOCA conditions	Primary containment pressure greater than (site-specific value) and rising **OR** Deflagration concentrations exists inside primary containment **OR** RPV pressure and suppression pool temperature cannot be maintained below the HCTL
OR		**OR**		**OR**	
2. Reactor Vessel Water Level		**2. Reactor Vessel Water Level**		**2. Reactor Vessel Water Level**	
RPV water level cannot be restored and maintained above [site-specific RPV water level corresponding to the requirement for primary containment flooding]	RPV water level cannot be restored and maintained above [site-specific RPV water level corresponding to the top of active fuel] or cannot be determined	RPV water level cannot be restored and maintained above [site-specific RPV water level corresponding to the top of active fuel] or cannot be determined	Not Applicable	Not Applicable	Primary Containment Flooding required
		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. 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 Loss or 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. Not Applicable		**3. RCS Leak Rate**		**3. Primary Containment Isolation Failure or Bypass**	
Not applicable	Not applicable	(Site-specific) Indication of an unisolable Main Steamline Break **OR** Emergency RPV Depressurization is required	RCS leakage greater than 50 gpm inside the drywell **OR** Unisolable primary system leakage outside primary containment as indicated by area temperature or area radiation greater than the Max Normal values	Failure of both valves in any one line to close AND direct downstream pathway to the environment exists after primary containment isolation signal **OR** Intentional primary containment venting per EOPs **OR** Unisolable primary system leakage outside primary containment as indicated by area temperature or area radiation greater than the Max Safe Operating values	Not applicable
OR		**OR**		**OR**	
4. Primary Containment Radiation Monitoring		**4. Primary containment Radiation Monitoring**		**4. Significant Radioactive Inventory in Primary Containment**	
Primary containment radiation monitor reading greater than (site-specific value) r	Not Applicable	Primary containment radiation monitor reading greater than (site-specific value)	Not Applicable	Not applicable	Primary containment radiation monitor reading greater than (site-specific value)
OR		**OR**		**OR**	
5. 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**	
6. 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 or 6)

The Fuel Clad barrier consists of fuel bundle 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 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 the Minimum Steam Cooling RPV Water Level or the jet pump suction without the requisite Core Spray cooling flow. This is the minimum value to assure core cooling without further degradation of the clad.*]

[*For BWRs, the BWROG EPGs/SAGs provide explicit direction when RPV water level cannot be determined. Since the loss of ability to determine if adequate core cooling is being provided presents a significant challenge to the fuel clad barrier, a potential loss of the fuel clad barrier is specified.*]

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..*]

3. Not applicable

4. Primary 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 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.

5. 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.

6. 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 Off-site Power and Prolonged Loss of All On-site 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. Primary Containment Conditions

The (site-specific) primary containment 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) RPV water level corresponds to the level which is used in EOPs to indicate challenge of core cooling. [*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. Unisolable high-energy line breaks such as HPCI, Feedwater, RWCU, or RCIC may also represent a significant loss of the RCS barrier.*]

Plant symptoms requiring Emergency RPV Depressurization per the {site-specific} EOPs are indicative of a loss of the RCS barrier. [*If Emergency RPV depressurization is required, the plant operators are directed to open safety relief valves (SRVs) and keep them open. Even though the RCS is being vented into the suppression pool, a loss of the RCS should be considered to exist due to the diminished effectiveness of the RCS pressure barrier to a release of fission products beyond its boundary.*]

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 primary containment is determined from site-specific temperature or area radiation Max Normal setpoints 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. Primary Containment Radiation Monitoring

The (site-specific) reading is a value which indicates the release of reactor coolant to the primary 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 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 primary containment 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 Off-site Power and Prolonged Loss of All On-site 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. Primary Containment Conditions

Rapid unexplained loss of pressure [*i.e., not attributable to drywell spray or condensation effects*] following an initial pressure increase from a high energy line break indicates a loss of containment integrity. Primary containment pressure should increase as a result of mass and energy release into containment from a LOCA. Thus, primary containment 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 primary containment design pressure.

[*BWRs specifically define the limits associated with explosive mixtures in terms of deflagration concentrations of hydrogen and oxygen. For Mk I/II containments the deflagration limits are "6% hydrogen and 5% oxygen in the drywell or suppression chamber". For Mk III containments, the limit is the "Hydrogen Deflagration Overpressure Limit"*]

[*The Heat Capacity Temperature Limit (HCTL) is the highest suppression pool temperature from which Emergency RPV Depressurization will not raise:*

- *Suppression chamber temperature above the maximum temperature capability of the suppression chamber and equipment within the suppression chamber which may be required to operate when the RPV is pressurized, or*

- *Suppression chamber pressure above Primary Containment Pressure Limit A, while the rate of energy transfer from the RPV to the containment is greater than the capacity of the containment vent.*

The HCTL is a function of RPV pressure and suppression pool water level. It is utilized to preclude failure of the containment and equipment in the containment necessary for the safe shutdown of the plant and therefore, the inability to maintain plant parameters below the limit constitutes a potential loss of containment.]

2. Reactor Vessel Water Level

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

The potential loss requirement for Primary Containment Flooding indicates adequate core cooling cannot be established and maintained and that core melt is possible. [*Severe Accident Guidelines (SAGs) direct the operators to perform Containment Flooding when Reactor Vessel Level cannot be restored and maintained greater than a {site specific value} or RPV level cannot be determined with indication that core damage is occurring.*] Entry into Primary Containment Flooding procedures is a logical escalation in response to the inability to maintain adequate core cooling.

The conditions in this potential loss EAL represents a potential core melt sequence 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 possible.

3. Primary Containment Isolation Failure or Bypass

This EAL is intended to cover the inability to isolate the containment when containment isolation is required. [*Additionally, the {site-specific} EOPs may direct containment isolation valve logic(s) to be intentionally bypassed, regardless of radioactivity release rates. Under these conditions with a valid containment isolation signal, the containment should also be considered lost if containment venting is actually performed.*]

In addition, the presence of area radiation or temperature Max Safe Operating setpoints indicating unisolable primary system leakage outside the primary containment are covered after a containment isolation. The indicators should be confirmed to be caused by RCS leakage.

Intentional venting of primary containment for primary containment pressure or combustible gas control per EOPs to the secondary containment and/or the environment is considered a loss of containment. [*Containment venting for pressure when not in an accident situation should not be considered.*]

[*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.

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 off-site 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. The Containment Barrier should not be declared lost or potentially lost based on exceeding Technical Specification action statement criteria, unless there is an event in progress requiring mitigation by the Containment barrier. When no event is in progress (Loss or Potential Loss of either Fuel Clad and/or RCS) the Containment Barrier status is addressed by Technical Specifications. [*See also IC SG1, "Prolonged Loss of All Off-site Power and Prolonged Loss of All On-site AC Power", for additional information*.]

TABLE 5-F-3

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, multiple events could occur which result in the conclusion that exceeding the loss or Potential loss thresholds is IMMINENT. 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 Loss or 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	RCS leak rate greater than available makeup capacity as indicated by a loss of RCS subcooling	RCS leak rate greater than the {site specific capacity of one charging pump in the normal charging mode} with Letdown isolated.	A containment pressure rise followed by a rapid unexplained drop in containment pressure. 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 depressurization-ion actuation setpoint with less than one full train of depressurization equipment operating
OR		**OR**		**OR**	
3. Core Exit Thermocouple Readings		**3. Not Applicable**		**3. Core Exit Themocouple Reading**	
greater than (site-specific) degree F	greater than (site-specific) degree F	Not applicable	Not applicable	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
OR		**OR**		**OR**	

TABLE 5-F-3

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, multiple events could occur which result in the conclusion that exceeding the loss or Potential loss thresholds is IMMINENT. 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 Loss or 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**
4. Reactor Vessel Water Level		**4. 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		**OR**		**OR**	
5. Not Applicable		**5. Not Applicable**		**5. CNMT Isolation Valves Status After CNMT Isolation**	
Not Applicable	Not Applicable	Not Applicable	Not Applicable	Valve(s) not closed AND direct downstream pathway to the environment exists after CTMT isolation signal	Not Applicable
OR		**OR**		**OR**	
6. Containment Radiation Monitoring		**6. 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
OR		**OR**		**OR**	
7. Other (Site-Specific) Indications		**7. 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**	
8. Emergency Director Judgment		**8. 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-3
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 or 7 or 8)

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.*] 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 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. **Not Applicable**

6. **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.

7. **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.*]

8. **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 Off-site Power and Prolonged Loss of All On-site AC Power", for additional information.*]

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

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, 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 to be the flow rate equivalent to one charging pump discharging to the charging header. The intent of this condition is met if attempts to isolate Letdown are NOT successful.*] 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. Not Applicable

4. SG Tube Rupture

This EAL addresses 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 Westinghouse Owners Group 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.

5. Not Applicable

6. 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.

7. 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.*]

8. 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 Off-site Power and Prolonged Loss of All On-site 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 and 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, 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 from a primary or secondary high energy line break 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 off-site 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 Emergency 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 addresses 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 off-site 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. The Containment Barrier should not be declared lost or potentially lost based on exceeding Technical Specification action statement criteria, unless there is an event in progress requiring mitigation by the Containment barrier. When no event is in progress (Loss or Potential Loss of either Fuel Clad and/or RCS) the Containment Barrier status is addressed by Technical Specifications. [*See also IC SG1,* *"Prolonged Loss of All Off-site Power and Prolonged Loss of All On-site 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 or Destructive Phenomena Affecting the PROTECTED AREA. *Op. Modes: All*	**HA1** Natural or Destructive Phenomena Affecting the Plant VITAL AREA. *Op. Modes: All*		
HU2 FIRE Within PROTECTED AREA Boundary Not Extinguished In Less Than 15 Minutes of Detection OR EXPLOSION within the PROTECTED AREA Boundary. *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, Corrosive, Asphyxiant, or Flammable Gases Deemed Detrimental to NORMAL PLANT OPERATIONS. *Op. Modes: All*	**HA3** Requited Access To a VITAL AREA Is Prohibited Due To Release of Toxic, Corrosive, Asphyxiant or Flammable Gases *Op. Modes: All*		
HU4 Confirmed Security Event Which Indicates a Potential Degradation in the Level of Safety of the Plant. *Op. Modes: All*	**HA4** Deleted	**HS1** Deleted	**HG1** HOSTILE ACTION 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*	
	HA7 Notification of an Airborne Attack Threat *Op. Modes: All*	**HS4** Site Attack (Notification of HOSTILE ACTION within the Protected Area) *Op. Modes: All*	
	HA8 Notification of HOSTILE ACTION within the OCA *Op. Modes: All*		

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HAZARDS AND OTHER CONDITIONS AFFECTING PLANT SAFETY

HU1

Initiating Condition -- NOTIFICATION OF UNUSUAL EVENT

Natural or 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)

1. Seismic event identified by any **TWO** of the following:
   - Earthquake felt in plant
   - Seismic event confirmed by (site-specific indication or method)
   - National Earthquake Center

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 systems required for safe shutdown of the plant, or structures containing those systems.

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

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

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

Basis:

These EALs are categorized on the basis of the occurrence of an event of sufficient magnitude to be of concern to plant operators. [*Areas identified 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.*]

The National Earthquake Center can confirm or deny that an earthquake has occurred in the area of the plant.

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 should be based on site-specific FSAR design basis or the highest reading available for wind speed.*] If such damage is confirmed visually or by other in-plant indications, the event may be escalated to Alert.

EAL 3 addresses 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.

EAL 4 addresses 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 PROJECTILES 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 5 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, which 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 6 is other site specific phenomena [*such as hurricane, flood, or seiche*]that 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 the PROTECTED AREA Boundary Not Extinguished Within 15 Minutes of Detection OR EXPLOSION within the PROTECTED AREA Boundary.

Operating Mode Applicability: All

Example Emergency Action Level: (1 or 2)

1. FIRE in any of the following (site-specific) areas not extinguished in less than 15 minutes of control room notification or receipt a control room FIRE alarm:

   (Site-specific) list

2. Report by plant personnel of an unanticipated EXPLOSION affecting systems required for safe shutdown of the plant, or structures containing those systems.

Basis:

The purpose of this IC is to address the magnitude and extent of FIRES or EXPLOSIONS that may be potentially significant precursors to damage to safety systems.

For EAL 1, 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/actuation. Verification of a fire detection system alarm includes actions that can be taken within 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. Immediately adjacent implies that the area immediately adjacent contains or may contain equipment or cabling that could impact equipment located in the vital area or the fire could damage equipment inside the vital area or that precludes access to vital areas.*]

For EAL 2 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 is sufficient for declaration.*] The Emergency director also needs to consider any security aspects of the EXPLOSION, if applicable.

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

HAZARDS AND OTHER CONDITIONS AFFECTING PLANT SAFETY

HU3

Initiating Condition – NOTIFICATION OF UNUSUAL EVENT

Release of Toxic, Corrosive, Asphyxiant, or Flammable Gases Deemed Detrimental to NORMAL PLANT OPERATIONS.

Operating Mode Applicability: All

Example Emergency Action Levels: (1 or 2)

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

2. Report by Local, County or State Officials for evacuation or sheltering of site personnel based on an off-site 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, corrosive, asphyxiant 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.*] The fact that SCBA may be worn does not eliminate the need to declare the event.

[*An Asphyxiant is a gas capable of reducing the level of oxygen in the body to dangerous levels. Most commonly, asphyxiants work by merely displaying air in an enclosed environment. This reduces the concentration of oxygen below the normal level of around 19%, which can lead to breathing difficulties, unconsciousness or even death.*]

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

HAZARDS AND OTHER CONDITIONS AFFECTING PLANT SAFETY

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 or 2 or 3)

1. A security event that does NOT constitute a HOSTILE ACTION as reported by the (site-specific) security shift supervision.
2. A credible site specific security threat notification.
3. A validated notification from NRC providing information of an aircraft threat.

Basis:

[*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 Safeguards Contingency Plan.*]

EAL 1 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.*] Security events assessed as HOSTILE ACTIONS are classifiable under HA8, HS4, and HG1.

[*Consideration should be given to the following types of events which may not degrade the level of safety of the plant when evaluating an event against the criteria of the site specific Security Contingency Plan: CIVIL DISTURBANCE and STRIKE ACTION.*]

EAL 2 is to ensure that appropriate notifications for the security threat are made in a timely manner. This includes information of a credible threat. [*Only the plant to which the specific threat is made need declare the Notification of an Unusual Event.*]

The intent of EAL 3 is to ensure that notifications for the aircraft threat are made in a timely manner and that Off-site Response Organizations and plant personnel are at a state of heightened awareness regarding the credible threat. Validation is performed by calling the NRC or by other approved methods of authentication. [*Only the plant to which the specific threat is made need declare the Notification of Unusual Event. This EAL is met when a plant receives information regarding an aircraft threat from NRC. Should the threat involve an airliner (airliner is meant to be a large aircraft with the potential for causing significant damage to the plant) then escalation to Alert via HA7 would be appropriate if the airliner is less than 30 minutes away from the plant .The NRC Headquarters Operations Officer (HOO) will communicate to the licensee if the threat* *involves an airliner. The status of the plane may be provided by NORAD through the NRC. It is not the intent of this EAL to replace existing non-hostile related EALs involving aircraft.*]

[*The determination of "credible" is made through use of information found in the (site-specific) Safeguards Contingency Plan.*]

A higher initial classification could be made based upon the nature and timing of the security threat and potential consequences. [*The licensee shall consider upgrading the emergency response status and emergency classification in accordance with the [site security specific] Safeguards Contingency Plan and Emergency Plans.*]

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 or indicate a security threat to facility protection has been initiated. No releases of radioactive material requiring off-site response or monitoring are expected unless further degradation of safety systems occurs.

Basis:

This EAL addresses 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 or 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. a. Seismic event greater than Operating Basis Earthquake (OBE) as indicated by seismic instrumentation {site-specific OBE limit}.

   AND

   b. Confirmed by **EITHER**:
   - Earthquake felt in plant
   - National Earthquake Center

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

   (site specific list)

3. Vehicle crash within PROTECTED AREA boundary and resulting in VISIBLE DAMAGE to any safety structure, system, or component in the following plant structures or Control Room indication of degraded performance of those safety systems:

   (site specific list)

4. Turbine failure-generated PROJECTILEs result in any VISIBLE DAMAGE to or penetration of safety structure, system, or component in the following plant structures or Control Room indication of degraded performance of those safety systems:

   (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 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:

These EALs escalate from 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 a higher classification will be based on 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 2, 3, 4, 5 should specify site-specific safety structure, system, or component and functions required for safe shutdown of the plant.*]

[*EAL 3 addresses crashes of vehicle types large enough to cause significant damage to safety structure, system, or component containing functions and systems required for safe shutdown of the plant.*]

[*EAL 4 addresses the threat to safety related equipment imposed by PROJECTILEs generated by main turbine rotating component failures. This site-specific list of areas should include all areas containing safety structure, system, or component, their controls, and their power supplies.*] This EAL is, therefore, consistent with the definition of an ALERT in that if main turbine rotating component PROJECTILEs have damaged or penetrated areas containing safety structure, system, or component 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 access, 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 safety structure, system, or component 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 is other site-specific phenomena [*such as hurricane, flood, or seiche*] that 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

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 required to establish or maintain safe shutdown.

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.*]

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*

[*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.

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.

HAZARDS AND OTHER CONDITIONS AFFECTING PLANT SAFETY

HA3

Initiating Condition -- ALERT

Required Access to a VITAL AREA Is Prohibited Due To Release of Toxic, Corrosive, Asphyxiant or Flammable Gases.

Operating Mode Applicability: All

Example Emergency Action Levels:

1. Required access to a VITAL AREA is prohibited due to report or detection of toxic, corrosive, asphyxiant, or flammable gases.

Basis:

This IC addresses gas releases 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.

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.

The fact that SCBA may be worn does not eliminate the need to declare the event.

An Asphyxiant is a gas capable of reducing the level of oxygen in the body to dangerous levels. Most commonly, asphyxiants work by merely displacing air in an enclosed environment. This reduces the concentration of oxygen below the normal level of around 19%, which can lead to breathing difficulties, unconsciousness or even death.

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.

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 facilities is necessary. Inability to establish plant control from outside the control room will escalate this event to a Site Area Emergency.

HAZARDS AND OTHER CONDITIONS AFFECTING PLANT SAFETY

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 potential substantial degradation of the level of safety of the plant or a security event that involves probable life threatening risk to site personnel or damage to site equipment because of HOSTILE ACTION. Any releases are expected to be limited to small fractions of the EPA Protective Action Guideline exposure levels.

Basis:

This EAL addresses 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

HA7

Initiating Condition -- ALERT

Notification of an Airborne Attack Threat.

Operating Mode Applicability: All

Example Emergency Action Level:

1. A validated notification from NRC of an airliner attack threat less than 30 minutes away.

Basis:

The intent of this EAL is to ensure that notifications for the airliner attack threat are made in a timely manner and that Off-site Response Organizations and plant personnel are at a state of heightened awareness regarding the credible threat. Validation is performed by calling the NRC or by other approved methods of authentication. [*Only the plant to which the specific threat is made need declare the Alert.*] This EAL is met when a plant receives information regarding an airliner attack threat from NRC and the airliner is less than 30 minutes away from the plant.

This EAL addresses the contingency of a very rapid progression of events due to an airborne hostile attack such as that experienced on September 11, 2001. This EAL is not premised solely on the potential for a radiological release. Rather the issue includes the need for assistance due to the possibility for significant and indeterminate damage from such an attack. [*Although vulnerability analyses show nuclear plants to be robust, it is appropriate for Off-site Response Organizations to be notified and encouraged to activate (if they do not normally) to be better prepared should it be necessary to consider further actions. Airliner is meant to be a large aircraft with the potential for causing significant damage to the plant. The status and size of the plane may be provided by NORAD through the NRC.*]

Initiating Condition -- ALERT

Notification of HOSTILE ACTION within the OCA

Operating Mode Applicability: All

Example Emergency Action Level:

1. A notification from the Site Security Force that a HOSTILE ACTION is occurring or has occurred within the OCA.

Basis:

This EAL addresses the potential for a very rapid progression of events due to a HOSTILE ACTION. [*This EAL is not intended to address incidents that are accidental or acts of civil disobedience, such as hunters or physical disputes between employees within the OCA or PA. That initiating condition is adequately addressed by other EALs.*]

This EAL addresses the contingency for a very rapid progression of events due to an airborne hostile attack such as that experienced on September 11, 2001 and the possibility for additional attacking aircraft. It is not intended to address accidental aircraft impact as that initiating condition is adequately addressed by other EALs. This EAL is not premised solely on the potential for a radiological release. Rather the issue includes the need for assistance due to the possibility for significant and indeterminate damage from additional air, land or water attack elements. [*Although vulnerability analyses show nuclear plants to be robust, it is appropriate for Off-site Response Organizations to be notified and to activate in order to be better prepared to respond should protective actions become necessary. If not previously notified by NRC that the aircraft impact was intentional, then it would be expected, although not certain, that notification by an appropriate Federal agency would follow. In this case, appropriate federal agency is intended to be NORAD, FBI, FAA or NRC. However, the declaration should not be unduly delayed awaiting Federal notification. Airliner is meant to be a large aircraft with the potential for causing significant damage to the plant. The status and size of the plane may be provided by NORAD through the NRC.*]

This IC/EAL addresses the immediacy of an expected threat arrival or impact on the site within a relatively short time. The fact that the site is an identified attack target with minimal time available for further preparation requires a heightened state of readiness and implementation of protective measures that can be effective (on-site evacuation, dispersal or sheltering) before arrival or impact.

This EAL is not premised solely on adverse health effects caused by a radiological release. Rather the issue is the immediate need for assistance due to the nature of the event and the potential for significant and indeterminate damage. [*Although nuclear plant security officers are well trained and prepared to protect against HOSTILE ACTION, it is appropriate for Off-site Response Organizations to be notified and encouraged to begin activation (if they do not normally) to be better prepared should it be necessary to consider further actions.*]

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 in less than (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 Emergency Director 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 or HOSTILE ACTION that results in intentional damage or malicious acts; (1) toward site personnel or equipment that could lead to the likely failure of or; (2) that prevent effective access to equipment needed for the 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 addresses 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.

HAZARDS AND OTHER CONDITIONS AFFECTING PLANT SAFETY

HS4

Initiating Condition -- SITE AREA EMERGENCY

Site Attack (Notification of HOSTILE ACTION within the Protected Area)

Operating Mode Applicability: All

Example Emergency Action Level:

1. A notification from the site security force that a HOSITLE ACTION is occurring or has occurred within the PROTECTED AREA.

Basis:

This condition represents an escalated threat to plant safety above that contained in the Alert IC in that a HOSTILE FORCE has progressed from the Owner Controlled Area to the PROTECTED AREA. [*Although nuclear plant security officers are well trained and prepared to protect against HOSTILE ACTION, it is appropriate for Off-site Response Organizations to be notified and encouraged to begin preparations for public protective actions (if they do not normally) to be better prepared should it be necessary to consider further actions.*]

- This EAL addresses the potential for a very rapid progression of events due to a dedicated attack. It is not intended to address incidents that are accidental or acts of civil disobedience[, *such as hunters or physical disputes between employees within the OCA or PA*]. [*That initiating condition is adequately addressed by other EALs.*]

This EAL addresses the contingency for a very rapid progression of events due to an airborne hostile attack such as that experienced on September 11, 2001 and the possibility for additional attacking aircraft. It is not intended to address accidental aircraft impact as that initiating condition is adequately addressed by other EALs. This EAL is not premised solely on the potential for a radiological release. Rather the issue includes the need for assistance due to the possibility for significant and indeterminate damage from additional attack elements. [*Although vulnerability analyses show nuclear plants to be robust, it is appropriate for Off-site Response Organizations to be notified and to activate in order to be better prepared to respond should protective actions become necessary. If not previously notified by NRC that the aircraft impact was intentional, then it would be expected, although not certain, that notification by an appropriate Federal agency would follow. In this case, appropriate federal agency is intended to be NORAD, FBI, FAA or NRC. However, the declaration should not be unduly delayed awaiting Federal notification. Airliner is meant to be a large aircraft with the potential for causing significant damage to the plant. The status and size of the plane may be provided by NORAD through the NRC.*]

This EAL addresses the immediacy of a threat to impact site VITAL AREAS within a relatively short time. The fact that the site is under serious attack with minimal time available for additional assistance to arrive requires ORO readiness and preparation for the implementation of protective measures.

Licensees should consider upgrading the classification to a General Emergency based on actual plant status after impact or progression of attack.

HAZARDS AND OTHER CONDITIONS AFFECTING PLANT SAFETY

HG1

Initiating Condition -- GENERAL EMERGENCY

HOSTILE ACTION Resulting in Loss Of Physical Control of the Facility.

Operating Mode Applicability: All

Example Emergency Action Level: (1 or 2)

1. A HOSTILE ACTION has occurred such that plant personnel are unable to operate equipment required to maintain safety functions.
2. A HOSTILE ACTION has caused failure of Spent Fuel Cooling Systems and IMMINENT fuel damage is likely for a freshly off-loaded reactor core in pool.

Basis:

This IC encompasses conditions under which a HOSTILE ACTION has resulted in a loss of 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 also addresses failure of spent fuel cooling systems as a result of HOSTILE ACTION if IMMINENT fuel damage is likely[*(e.g., freshly off-loaded reactor core in pool). "Freshly" is defined by site-specific requirements.*]

[*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.*] [*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.*]

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 or HOSTILE ACTION that results in an actual loss of physical control of the facility. Releases can be reasonably expected to exceed EPA Protective Action Guideline exposure levels off-site for more than the immediate site area.

Basis:

This EAL addresses 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 Off-site Power to Emergency 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 Off-site Power and Loss of All On-site AC Power to Emergency Busses. *Op. Modes: Power Operation, Startup, Hot Standby, Hot Shutdown*	**SG1** Prolonged Loss of All Off-site Power and Prolonged Loss of All On-site AC Power to Emergency Busses. *Op. Modes: Power Operation, Startup, Hot Standby, Hot Shutdown*
	SA2 Failure Of Reactor Protection System, Automatic AND Manual To Establish The Reactor Subcritical. *Op. Modes: Power Operation, Startup, Hot Standby*	**SS2** Failure of Reactor Protection System, Automatic AND Manual to Reduce Power Below Safety System Design Limit. *Op. Modes: Power Operation, Startup*	**SG2** Failure of the Reactor Protection System, Automatic AND Manual and 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*		
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 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 On-site or Off-site Communications Capabilities.
Op. Modes: Power Operation, Startup, Hot Standby, Hot Shutdown

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

SU9 Failure of the Reactor Protection System, Automatic OR Manual and Subcriticality Was Achieved.
Op Modes: Power Operation, Startup

SA1 *Deleted*

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

SS5 *Deleted*

SYSTEM MALFUNCTION

SU1

Initiating Condition -- NOTIFICATION OF UNUSUAL EVENT

Loss of All Off-site Power to Emergency Busses for Greater Than 15 Minutes.

Operating Mode Applicability:

Power Operation
Startup
Hot Standby
Hot Shutdown

Example Emergency Action Level:

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

Basis:

Prolonged loss of off-site 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 losses of off-site power. [*The site specific emergency generators are the minimum allowed by Technical Specifications in the applicable modes.*]

[*Plants that have a proceduralized capability to cross-tie AC power from an off-site power supply of a companion unit may take credit for the redundant power source in the associated EAL for this IC. Inability to affect the cross-tie within 15 minutes warrants declaring a NOUE.*]

[*EAL consideration may be given for a non-emergency (i.e., not safety-related) power source if both of the following conditions are met.*

a. The source is capable of supplying power to at least one train of safety-related loads necessary to establish and maintain cold shutdown in the event of a loss of off-site power coincident with the loss of all emergency generators.
b. The contingent use of the power source must be recognized in emergency operating procedures.]

SYSTEM MALFUNCTION

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 four 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.*]

SYSTEM MALFUNCTION

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 greater than approximately 75% of the following for greater than 15 minutes:

   a. Control Room Safety System Annunciation (site specific)

   OR

   b. Control Room Safety System indication (site specific)

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 uninterruptible 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.

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).*]

Relief valve normal operation should be excluded from this IC. However, a relief valve that operates and fails to close per design should be considered applicable to this IC if the relief valve cannot be isolated. For BWR SRVs, an emergency declaration is not appropriate for the opening or cycling of an SRV when no other emergency condition exists.

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.

SYSTEM MALFUNCTION

SU6

Initiating Condition -- NOTIFICATION OF UNUSUAL EVENT

UNPLANNED Loss of All On-site or Off-site 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) on-site communications capability affecting the ability to perform routine operations.

2. Loss of all (site-specific list) off-site 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 off-site authorities. [*The loss of off-site 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 off-site 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 off-site locations, etc.) are being utilized to make communications possible.*]

[*Site-specific list for on-site 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 off-site communications loss must encompass the loss of all means of communications with off-site 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. An UNPLANNED sustained positive period observed on nuclear instrumentation. (BWR)

1. An UNPLANNED sustained positive startup rate observed on nuclear instrumentation. (PWR)

Basis:

This IC addresses inadvertent criticality 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). The Cold Shutdown/Refueling IC is CU8.

[*This condition can be identified using period monitors/startup rate monitor. The term "sustained" is used in order to allow exclusion of expected short term positive periods/startup rates from planned control rod movements for PWRs and BWRs (such as shutdown bank withdrawal for PWRs). 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.

SYSTEM MALFUNCTION

SU9

Initiating Condition -- NOTIFICATION OF UNUSUAL EVENT

Failure of the Reactor Protection System, Automatic OR Manual, and Subcriticality Was Achieved

Operating Mode Applicability: Power Operation
Startup

Example Emergency Action Level: (1 or 2)

1. An Automatic Reactor Protection System setpoint was exceeded and an automatic actuation was not successful and a successful {site specific} manual actuation resulted in the reactor being subcritical below {site specific POINT OF ADDING HEAT}.
2. All manual {site specific trip pushbuttons/scram switches} were actuated and a actuation was not successful and either an Automatic actuation OR other {site specific manual means} from the Control Room control panels subsequently resulted in the reactor being subcritical below {site specific POINT OF ADDING HEAT}.

Basis:

This condition indicates failure of the Reactor Protection System (either automatic or manual) to initiate a reactor trip/scram; however the reactor was able to be successfully shutdown utilizing other portions of the Reactor Protection System (automatic or manual) or other means from the reactor control panels in a timely manner. [*An NOUE is warranted as this condition is a potential degradation of a safety system in that a portion of the front line protection system did not function in response to a plant transient or initial operator action and thus the plant safety may have been compromised.*]

Failure of the Manual portion of the Reactor Protection System is intended to address a failure of all applicable {site specific} manual reactor trip pushbuttons\switches from the Control Room control panels.

A manual actuation is any set of actions by the reactor operator(s) at the Control Room control panels which causes or should cause control rods to be rapidly inserted into the core and brings the reactor subcritical (e.g., reactor trip button, Alternate Rod Insertion).

The reactor should be considered subcritical when reactor power level has been reduced to {*site specific indication less than the POINT OF ADDING HEAT*} and lowering. [*The POINT OF ADDING HEAT term is used here to describe a power level on one of the nuclear instruments where the reactor would be considered shutdown after a normal trip and after a discernable pause to allow the immediate decay to occur. Typically this value is around 10E-8 amps in the Intermediate Range for a PWR and IRM Range 7 for a BWR.*]

Failure the Reactor Protection System and the inability by other means from the Control Room control panels to complete a reactor trip/scram would escalate the event to an Alert or Site Area Emergency based on reactor power levels.

SYSTEM MALFUNCTION

SA2

Initiating Condition -- ALERT

Failure of Reactor Protection System, Automatic AND Manual, to establish reactor subcritical

Operating Mode Applicability: Power Operation
Startup
Hot Standby

Example Emergency Action Level:

1. An Automatic Reactor Protection System setpoint was exceeded **OR** a Manual reactor trip/scram was initiated.

   AND

   Following the trip/scram actuation, the reactor is critical with reactor power greater than {site specific POINT OF ADDING HEAT}.

Basis:

This condition indicates failure of the Reactor Protection System to reduce power to below the POINT OF ADDING HEAT. This condition is more than a potential degradation of a safety system in that a front line protection system did not function in response to a plant transient or initial operator action and thus the plant safety has been compromised. An Alert is indicated because conditions exist that may lead to potential loss of fuel clad or RCS, however reactor power is below the POINT OF ADDING HEAT.

A manual actuation is any set of actions by the reactor operator(s) at the Control Room control panels which causes or should cause control rods to be rapidly inserted into the core and brings the reactor subcritical (e.g., reactor trip button, Alternate Rod Insertion).

Failure of the Reactor Protection System to trip/scram the reactor with power greater than the Safety System Design Limit 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 Indicators are Unavailable.

Operating Mode Applicability:

Power Operation
Startup
Hot Standby
Hot Shutdown

Example Emergency Action Level: (1 and 2)

1. UNPLANNED loss of greater than approximately 75% of the following for greater than 15 minutes:

   a. Control Room Safety System Annunciation (site specific)

   OR

   b. Control Room Safety System indication (site specific)

2. a. A SIGNIFICANT TRANSIENT is in progress.

   OR

   b. Compensatory 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 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.

SYSTEM MALFUNCTION

SA5

Initiating Condition -- ALERT

AC Power Capability To Emergency 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 emergency 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 Off-site Power To Emergency Busses for Greater Than 15 Minutes."*] The condition indicated by this IC is the degradation of the off-site and on-site power systems such that any additional single failure would result in a station blackout. [*This condition could occur due to a loss of off-site 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 off-site power and loss of on-site emergency diesels with only one train of emergency busses being backfed from the unit main generator, or the loss of on-site emergency diesels with only one train of emergency busses being backfed from off-site 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 Off-site and Loss of All On-site 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.*]

[*EAL consideration may be given for a non-emergency (i.e., not safety-related) power source if both of the following conditions are met.*

a. The source is capable of supplying power to at least one train of safety-related loads necessary to establish and maintain cold shutdown in the event of a loss of off-site power coincident with the loss of all emergency generators.
b. The contingent use of the power source must be recognized in emergency operating procedures.]

SYSTEM MALFUNCTION

SS1

Initiating Condition -- SITE AREA EMERGENCY

Loss of All Off-site Power and Loss of All On-site AC Power to Emergency Busses.

Operating Mode Applicability:

Power Operation
Startup
Hot Standby
Hot Shutdown

Example Emergency Action Level:

1. Loss of off-site power to (site-specific) emergency busses .

AND

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

AND

Failure to restore power to at least one emergency bus in less than (site-specific) minutes from the time of loss of both off-site and on-site 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 Off-site Power and Prolonged Loss of All On-site AC Power."

SYSTEM MALFUNCTION

SS2

Initiating Condition -- SITE AREA EMERGENCY

Failure Of Reactor Protection System, Automatic AND Manual, To Reduce Power Below Safety System Design Limit.

Operating Mode Applicability: Power Operation
Startup

Example Emergency Action Level:

1. An Automatic Reactor Protection System setpoint was exceeded **OR** a Manual reactor trip/scram was initiated.

AND

Following the trip/scram initiation, reactor power is NOT below the {site specific Safety System Design Limit}.

Basis:

Automatic and manual actuation is not considered successful if action away from the Control Room control panels is required to trip/scram the reactor. [*For plants using CSFSTs, this EAL equates to the criteria used to determine a valid Subcriticality Red Path. For BWRs this EAL should be the APRM downscale trip setpoint*]

Under these conditions, the reactor is producing more heat than the maximum decay heat load for which the safety systems are designed (typically 3 to 5% power). 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.*]

A manual actuation is any set of actions by the reactor operator(s) at the Control Room control panels which causes or should cause control rods to be rapidly inserted into the core and brings the reactor subcritical (e.g., reactor trip button, Alternate Rod Insertion).

Escalation of this event to a General Emergency would be due to a prolonged condition leading to challenges in maintaining core-cooling or heat sink.

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.

[*(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.*]

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.

SYSTEM MALFUNCTION

SS6

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 and 2)

1. UNPLANNED loss of greater than approximately 75% of the following for greater than 15 minutes:

   a. Control Room Safety System Annunciation (site specific)

   OR

   b. Control Room Safety System indication (site specific)

2. a. A SIGNIFICANT TRANSIENT is in progress.

   AND

   b. Compensatory indications are unavailable.

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 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.*]

SG1

Initiating Condition -- GENERAL EMERGENCY

Prolonged Loss of All Off-site Power and Prolonged Loss of All On-site AC Power to Emergency Busses.

Operating Mode Applicability:

Power Operation
Startup
Hot Standby
Hot Shutdown

Example Emergency Action Level:

1. Loss of off-site power to (site-specific) emergency busses .

AND

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

AND

Either of the following: (a or b)

a. Restoration of at least one emergency bus in less than (site-specific) hours is not 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 off-site 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?*

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.]

<u>SYSTEM MALFUNCTION</u>

SG2

Initiating Condition -- GENERAL EMERGENCY

Failure of the Reactor Protection System, Automatic AND Manual and Indication of an Extreme Challenge to the Ability to Cool the Core.

Operating Mode Applicability: Power Operation
Startup

Example Emergency Action Level:

1. An Automatic Reactor Protection System setpoint was exceeded **OR** a Manual reactor trip/scram was initiated.

AND

Following the trip/scram initiation, reactor power is NOT below the {site specific Safety System Design Limit}.

AND

Either of the following exist or have occurred due to continued power generation:

a. Indication(s) exists that {site specific} core cooling is extremely challenged.

OR

b. Indication(s) exists that {site specific} heat removal is extremely challenged.

Basis:

Automatic and manual trip/scram is not considered successful if action away from the Control Room control panels was required to trip/scram the reactor.

Under the conditions of this EAL, the efforts to bring the reactor subcritical to the extent that 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, the continuing temperature rise indicates that these capabilities are not effective. For plants using CSFSTs, this equates to a Subcriticality RED condition (an entry into function restoration procedure FR-S.1).*] 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 combined with a Subcriticality RED condition.*

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 combined with a Subcriticality 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 exists 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 off-site 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 Off-site 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 off-site 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/NEI 99-01 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)	Off-site 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)	Off-site 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 off-site doses and dose rate limits. For showing compliance with these limits, facility Off-site 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 off-site dose or dose rate but, rather, on the loss of plant control implied by a radiological release that exceeds a specified multiple of the ODCM release limits for a specified period of time.
- The ODCM multiples are specified only to distinguish AU1 and AA1 from non-emergency conditions and from each other. While these multiples obviously correspond to an off-site 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 off-site dose rates as **symptoms** that the ODCM may be exceeded, the IC, and the classification, are **NOT** concerned with the particular value of off-site 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 off-site 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:

- Effluent Monitor Readings: These EALs are pre-calculated values that correspond to the condition identified in the IC for a given set of assumptions.
- Field Survey Results: These example EALs are included to provide a means to address classifications based on results from field surveys.
- Perimeter Monitor Indications: For sites having them, perimeter monitors can provide a direct indication of the off-site consequences of a release.
- Dose Assessment Results: 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.

AS1 and AG1

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.

AU1 and AA1

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 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 ODCM limits. Although the actual χ/Q may be different, NUREG-1022, <u>Event Reporting Guidelines 10 CFR 50.72 and 50.73</u>, provided "*...Annual average meteorological data should be used for determining off-site 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 ODCM release limits for an extended period and that the ODCM provides the methodology for showing compliance with the ODCM.

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 ODCM 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 ODCM 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 was set to 50% of the ODCM 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 ODCM 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 ODCM limits. Alarm response procedures call for an assessment of the alarm to determine whether or not ODCM limits 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 ODCM limits will not create a need for off-site 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 ODCM for an extended period. The applicable ODCM 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 ODCM 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 ODCM 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 ODCM. 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 / primary containment purge) resulting in effluent radiation monitor readings that exceed a 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 addresses long term routine releases, its use here for short term releases is appropriate. The IC is specified in terms of a release that exceeds ODCM for an extended period of time. Compliance to the ODCM 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 is 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 off-site 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 ODCM.

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, or an accident source term if deemed appropriate. This guidance is provided to promote proper escalations, use realistic values, and correlation between rad monitor values and dose assessment results. Other source terms may be appropriate to achieve these goals. 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 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 on-site 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 off-site dose or dose rate but, rather, on the loss of plant control implied by a radiological release that exceeds a specified multiple of the ODCM 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)	Drop in Spent Fuel Pool level OR temperature rise 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 or 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 or 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 on-site and off-site 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 off-site dose to a member of the public off-site 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 cannot 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 off-site 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 on-site and off-site emergency plans. 10 CFR 72.212(b)(6) requires that a general licensee review its reactor emergency plan to determine if its effectiveness is decreased and make necessary changes.

The expectations for off-site 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 10 CFR 72.32, have been classified as NOUEs herein. To do otherwise could lead to an inappropriate response posture on the part of off-site response organizations.

NUREG-1567, Standard Review Plan for Spent Fuel Dry Storage Facilities, descriptions of initiating events appear below:

- FIRE on-site that might affect radioactive material of systems important to safety
- Severe natural phenomena 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 phenomena 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 PROJECTILEs, 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 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

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.

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FINAL DRAFT

Methodology for Development of Emergency Action Levels Advanced Passive Light Water Reactors

February 2007

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FOREWORD

The initial version of this document was written based on NEI 99-01, Revision 5 in development in late 2006 as a starting point. The NEI EAL Task Force coordinated with the passive light water reactor vendors to consider each IC/EAL and determine its applicability to the design of the plants and to determine what additional IC/EALs would be required. Those ICs/EALs not applicable due to the design were not included.

The approved Design Certification does not include detailed design data for those items specific to a site location. In many cases this data is necessary to determine EAL thresholds. In these cases this document provides a {site specific} placeholder.

The approved Design Certification does not include some detailed design information such as setpoints and some instrument numbers which are being developed by Westinghouse and General Electric. In many cases this data is necessary to determine EAL thresholds. Appropriately, this document provides a [TBD] placeholder for future inclusion. Development of the site specific EAL scheme may continue using this document.

EAL Task Force
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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.

NEI 07-01, Methodology for Development of Emergency Action Levels Advanced Passive Light Water Reactors, is based on the EAL work accomplished through the NUMARC/NESP 007, NEI 99-01 Revision 4 and Revision 5 development process. The history of the development is contained in 99-01 Revision 4 and continues in Revision 5 of the 99-01 document.

The 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
- F - Fission Product Barrier Degradation
- H - HAZARDS or OTHER Conditions Affecting Plant Safety
- S - System Malfunction

Each of the EAL guides in Recognition Categories is structured in the following way:

- Recognition Category - As described above.
- Emergency Class – Notice of Unusual Event (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, Safe/Stable 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 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
ADS	Automatic Depressurization System
AP1000	Advanced Passive 1000 Mw PWR (Westinghouse)
APRM	Average Power Range Monitor
ATWS	Anticipated Transient Without Scram
CDE	Committed Dose Equivalent
CET	Core Exit Thermocouple
CFR	Code of Federal Regulations
Ci	Curie
CMT/CNMT	Containment
CSF	Critical Safety Function
CSFST	Critical Safety Function Status Tree
CVCS	Chemical and Volume Control System
DAS	Diverse Actuation System
DC	Direct Current
DG	Diesel Generator
EAL	Emergency Action Level
ECL	Emergency Classification Level
ED	Emergency Director
EFS	Communication System
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
ESBWR	Economic Simplified Boiling Water Reactor (General Electric)
ESW	Emergency Service Water
FAA	Federal Aviation Administration
FBI	Federal Bureau of Investigation
FEMA	Federal Emergency Management Agency
FSAR	Final Safety Analysis Report
GE	General Emergency
HCTL	Heat Capacity Temperature Limit
HCW	High Conductivity Waste
IC	Initiating Condition
IDLH	Immediately Dangerous to Life and Health
IRWST	In Containment Refueling Water Storage Tank
Keff	Effective Neutron Multiplication Factor
LCO	Limiting Condition of Operation
LCW	Low Conductivity Waste
LER	Licensee Event Report
LFL	Lower Flammability Limit
LOCA	Loss of Coolant Accident
LWR	Light Water Reactor
MCR	Main Control Room
MSL	Main Steam Line
MSIV	Main Steam Isolation Valve
mR	milliRem

ACRONYMS

Mw	Megawatt
NEI	Nuclear Energy Institute
NPP	Nuclear Power Plant
NRC	Nuclear Regulatory Commission
NSSS	Nuclear Steam Supply System
NORAD	North American Aerospace Command
NOUE	Notification Of Unusual Event
OBE	Operating Basis Earthquake
OCA	Owner Controlled Area
ODCM	Off-site Dose Calculation Manual
ORO	Off-site Response Organization
PA	Protected Area
PAG	Protective Action Guide
PCS	Primary Containment System
PIP	Plant Investment Protection
PLS	Plant Control System
PMS	Plant Monitoring and Control System
POAH	Point of Adding Heat
PRA/PSA	Probabilistic Risk Assessment / Probabilistic Safety Assessment
PWR	Pressurized Water Reactor
psig	Pounds per Square Inch Gauge
Q-DCIS	Safety Related Distributed Control and Information System
R	Rem
RCS	Reactor Coolant System
RMS	Radiation Monitoring System
RNS	Normal Residual Heat Removal System
RPS	Reactor Protection System
RPV	Reactor Pressure Vessel
RWCU/SDC	Reactor Water Cleanup/Shutdown Cooling System
SBGTS	Stand-By Gas Treatment System
SG	Steam Generator
SPDS	Safety Parameter Display System
SRO	Senior Reactor Operator
SSE	Safe Shutdown Earthquake
TEDE	Total Effective Dose Equivalent
TBD	To Be Determined
TOAF/TAF	Top of Active Fuel
TSC	Technical Support Center
TVS	Closed Circuit Television System (AP1000)
WE	Westinghouse Electric
WOG	Westinghouse Owners Group

1.0 METHODOLOGY FOR DEVELOPMENT OF EMERGENCY ACTION LEVELS

1.1 Background

NEI 07-01, Methodology for Development of Emergency Action Levels Advanced Passive Light Water Reactors, is based on the EAL work accomplished through the NUMARC/NESP 007, NEI 99-01 Revision 4 and Revision 5 development process. The history of the development is contained in 99-01 Revision 4 and continues in Revision 5 of the 99-01 document.

In 2006 the nuclear power revival of new plants with the advanced passive designs was being planned. The NEI EAL Task Force developed this document to address only the Westinghouse AP1000 and the General Electric ESBWR designs.

2.0 CHANGES INCORPORATED WITH NEI 07-01

Changes will be identified in this section for future revisions.

3.0 DEVELOPMENT OF BASIS FOR GENERIC APPROACH

The generic guidance provided in this document addresses 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. 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 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 on-site 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 (on-site or off-site); 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 On-site" is an example of an "NOUE" IC in NUREG-0654 that also can be an event-based EAL.

3.2 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 on-site and off-site 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, off-site 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.

3.3 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. 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 Procedures (EOPs) Critical Safety Function (CSF) Status Tree Monitoring for the AP1000 and Emergency Procedure and Severe Accident

Guidelines (EPGs/SAGs) for the ESBWR. Challenge to one or more barriers generally is initially identified through instrument readings and periodic sampling. 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 safe/stable 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.

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 cold shutdown and refueling 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.

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)

3.4 Design Differences

Although the same basic concerns with barrier integrity and the major safety problems of nuclear power plants are similar, design differences will have a substantial effect on EALs. In these cases, EAL guidelines unique to AP1000 and ESBWR are specified. These passive design plants incorporate the requirements contained in EPRI Advanced Light Water Reactor (ALWR) Requirements Document. Accordingly, many of the plant safety features for both designs are functionally equivalent.

3.5 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 methodology pays careful attention to these eight characteristics to assure that all are addressed in the proposed EALs. 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.

3.6 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 off-site dose consequence considerations which were not included in NUREG-0654 Appendix 1.

NOTIFICATION OF UNUSUAL EVENT (NOUE): Events are in process or have occurred which indicate a potential degradation of the level of safety of the plant or indicate a security threat to facility protection has been initiated. No releases of radioactive material requiring off-site 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) Completion 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 off-site response.

ALERT: Events are in process or have occurred which involve an actual or potential substantial degradation of the level of safety of the plant or a security event that involves probable life threatening risk to site personnel or damage to site equipment because of HOSTILE ACTION. 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.

SITE AREA EMERGENCY (SAE): Events are in process or have occurred which involve actual or likely major failures of plant functions needed for protection of the public or HOSTILE ACTIONS that result in intentional damage or malicious acts; 1) toward site personnel or equipment that could lead to the likely failure of or; 2) that prevent effective access to, equipment needed for the 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 off-site emergency response agency concerns as to timely declaration of a General Emergency.

GENERAL EMERGENCY (GE): Events are in process or have occurred which involve actual or IMMINENT substantial core degradation or melting with potential for loss of containment integrity or HOSTILE ACTION that results in an actual loss of physical control of the facility. Releases can be reasonably expected to exceed EPA Protective Action Guideline exposure levels off-site 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 loss or potential loss of the third barrier constitutes a General Emergency.

3.7 Emergency Class Thresholds

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

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 trip/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 SAR 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 analysis, PRA). PRAs have been completed for the designs as part of the licensing process. PRAs can be used as a good first approximation of the relevant ICs and risk associated with emergency conditions.

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. 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.

3.8 Emergency Action Levels

ICs/EALs are for unplanned events. A planned evolution involves preplanning to address the limitations imposed by the condition, the performance of required surveillance testing, and the implementation of specific controls prior to knowingly entering the condition. Planned evolutions to test, manipulate, repair, perform maintenance or modifications to systems and equipment that result in an EAL Threshold Value being met or exceeded are not subject to classification and activation requirements as long as the evolution proceeds as planned. However, these conditions may be subject to the reporting requirements of 10 CFR 50.72.

Classifications are based on evaluation of each Unit. All classifications are to be based upon VALID indications, reports or conditions. Indications, reports or conditions are considered VALID when they are verified by (1) an instrument channel check, or (2) indications on related or redundant indications, or (3) by direct observation by plant personnel, such that doubt related to the indication's operability, the condition's existence, or the report's accuracy is removed. Implicit in this definition is the need for timely assessment.

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.

The Emergency Director must remain alert to events or conditions that lead to the conclusion that exceeding the EAL threshold is IMMINENT. Under certain plant conditions, an alternate instrument or a temporary instrument may be installed to facilitate monitoring the parameter. In addition, visual observation may be sufficient to detect that a parameter is approaching or has reached a classifiable threshold. In these cases, the classification of the event is appropriate even if the instrument normally used to monitor the parameter is inoperable or has otherwise failed to detect the threshold. 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..

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 off-site 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. Security events must reflect potential for increasing security threat levels.

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.

Portions of the IC and EAL bases are specifically designated as information necessary for the development of the site specific thresholds of the EALs. These developer information sections are in [*brackets and italicized*]. The information contained in these portions consists of references, examples, instructions for calculations, etc. These portions of the basis need not be included in the plant specific technical basis document supporting the EALs. In some cases, the information developed from the developer information may be appropriate to include in the plant specific technical basis document. In addition, the appendices are developer information in their entirety.

3.9 Treatment of Multiple Events and Emergency Class Upgrading

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 Classifying 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.

Existing guidance for classifying transient events addresses the period of time of event recognition and classification (15 minutes). However, in cases when an EAL declaration criterion may be met momentarily during the normal expected response of the plant, declaration requirements should not be considered to be met when the conditions are a part of the designed plant response or result in appropriate operator actions.

3.11 Operating Mode Applicability

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.

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

3.11.1 ESBWR Operating Modes

Power Operations (1):	Mode Switch in Run
Startup (2):	Mode Switch in Startup or Refuel
Hot Shutdown (3):	Mode Switch in Shutdown, Average Reactor Coolant Temperature greater than 420 °F
Stable Shutdown (4)	Mode Switch in Shutdown, Average Reactor Coolant Temperature less than or equal to 420 °F and greater than 200 °F
Cold Shutdown (5):	Mode Switch in Shutdown, Average Reactor Coolant Temperature less than or equal to 200 °F
Refueling (6):	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

3.11.2 AP1000 Operating Modes

Power Operations (1):	Reactor Power greater than 5%, Keff greater than or equal to 0.99
Startup (2):	Reactor Power less than or equal to 5%, Keff greater than or equal to 0.99
Hot Standby (3):	RCS greater than or equal to 420 °F, Keff less than 0.99
Safe Shutdown (4):	200 °F less than RCS less than 420 °F, Keff less than 0.99
Cold Shutdown (5):	RCS less than 200 °F, Keff less than 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.

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. Off-site 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 referenced 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 off-site 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 on-site and off-site) rise. 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
- F - Fission Product Barrier Degradation
- H - HAZARDS or OTHER Conditions Affecting Plant Safety
- S - System Malfunction

EALs for permanently defueled plants and Independent Spent Fuel Storage Installations are contained in NEI 99-01, current revision and are not addressed in this document.

The Initiating Conditions for each of the above Recognition Categories is 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 5-F-2 and 5-F-3 for ESBWR and AP1000 respectively.

With the exception of Recognition Category F, each of the EAL guides in Recognition Categories 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** - These modes are defined in each licensee's technical specifications. The mode classifications and terminology appropriate to the specific facility should be used.
- **Example Emergency Action Level(s)** – these EALs are examples of conditions and indications that were considered to meet the criteria of the IC.
- **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. Some bases provide information intended to assist with establishing site-specific instrumentation values. Appendices A and C provide detailed guidance on implementing their corresponding Recognition Categories.

For Recognition Category F, basis information is presented in a format consistent with Tables 5-F-1, 2 and 3. 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.

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 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 staffing 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. However, the benefits of aligning with the guidance as closely as possible may be realized in; improved interface with the NRC, improved interface with other utilities, better positioning to adopt future enhancements such as FAQs. The generic guidance is intended to provide the logic for developing site-specific IC/EALs using site-specific IC/EAL presentation methods. Each utility will need to implement the IC/EALs using site-specific needs with regard to instrumentation, nomenclature, plant arrangement, and method of presentation, etc. When plant design prevents use of ICs/EALs prescribed in NEI 07-01, other indications that address the subject condition should be implemented. 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. RIS 2003-18 and its supplements 1 and 2 clarify the expectations for alignment with the guidance document and the associated regulatory review requirements.

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.

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 off-site 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.

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

CIVIL DISTURBANCE: A group of one or more persons violently protesting station operations or activities at the site.

CONTAINMENT CLOSURE: The site specific procedurally defined action taken to secure primary containment (AP1000) or primary or secondary containment (ESBWR) and its associated structures, systems, and components as a functional barrier to fission product release under existing plant conditions.

EXPLOSION: 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.

FAULTED: (AP1000) in a steam generator, the existence of secondary side leakage that results in an uncontrolled drop in steam generator pressure or the steam generator being completely depressurized.

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

HOSTILE ACTION: An act toward a Nuclear Power Plant or its personnel that includes the use of violent force to destroy equipment, take HOSTAGES, and/or intimidates the licensee to achieve an end. This includes attack by air, land, or water using guns, explosives, projectiles, vehicles, or other devices used to deliver destructive force. Other acts that satisfy the overall intent may be included. HOSTILE ACTION should not be construed to include acts of civil disobedience or felonious acts that are not part of a concerted attack on the Nuclear Power Plant. Non-terrorism-based EALs should be used to address such activities, (i.e., violent acts between individuals in the OWNER CONTROLLED AREA).

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): An atmospheric concentration of any toxic, corrosive or asphyxiant substance that poses an immediate threat to life or would interfere with an individual's ability to escape from a dangerous atmosphere.

IMMINENT: Mitigation actions have been ineffective, additional actions are not expected to be successful, and trended information indicates that the event or condition will occur. Where "IMMINENT" timeframes are specified, they shall apply.

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.

NORMAL PLANT OPERATIONS: Activities at the plant site associated with routine testing, maintenance, or equipment operations, in accordance with normal operating or administrative procedures. Entry into abnormal or emergency operating procedures, or deviation from normal security or radiological controls posture, is a departure from NORMAL PLANT OPERATIONS.

POINT OF ADDING HEAT: A Unit specific reactor power level at which sufficient energy is being added to the reactor coolant from the reactor to result in a bulk coolant temperature increase. [This value may vary slightly based on plant core loading and time of life. For purposes of identifying the Unit specific reactor power level, a typical value may be chosen to prevent having to recalculate this setpoint. Sites may choose to operationally have their staff identify that the reactor is at the POAH and not develop a specific power level equivalent to the POAH.]

PROJECTILE: An object directed toward a Nuclear Power Plant that could have an effect sufficient to cause concern for its continued operability, reliability, or safety of personnel.

PROTECTED AREA: (site-specific) Typically, the area which normally encompasses all controlled areas within the security PROTECTED AREA fence.

REACTOR BUILDING ISOLATION: ESBWR equivalent of CONTAINMENT CLOSURE for AP1000.

RUPTURED: (AP1000) in a steam generator, existence of primary-to-secondary leakage of a magnitude sufficient to require or cause a reactor trip and automatic depressurization.

SIGNIFICANT TRANSIENT: An UNPLANNED event involving one or more of the following: (1) automatic turbine runback greater than 25% thermal reactor power, (2) electrical load rejection greater than 25% full electrical load, (3) Reactor Trip/Scram, (4) Safety Injection Actuation, or (5) thermal power oscillations greater than10%.

STRIKE ACTION: A work stoppage within the PROTECTED AREA by a body of workers to enforce compliance with demands made on (site-specific). The STRIKE ACTION must threaten to interrupt NORMAL PLANT OPERATIONS.

UNPLANNED: A parameter change or an event that is not the result of an intended evolution and requires corrective or mitigative actions.

VALID: An indication, report, or condition, is considered to be VALID when it is verified by (1) an instrument channel check, or (2) indications on related or redundant indicators, or (3) by direct observation by plant personnel, such that doubt related to the indicator's operability, the condition's existence, or the report's accuracy is removed. Implicit in this definition is the need for timely assessment.

VISIBLE DAMAGE: Damage to equipment or structure that is readily observable without measurements, testing, or analysis. Damage is sufficient to cause concern regarding the continued operability or reliability of affected structure, system, or component. Example damage includes: deformation due to heat or impact, denting, penetration, rupture, cracking, paint blistering. Surface blemishes (e.g., paint chipping, scratches) should not be included.

VITAL AREA: (site-specific) Typically, any area, normally within the PROTECTED AREA, which contains equipment, systems, components, or material, the failure, destruction, or release of which could directly or indirectly endanger the public health and safety by exposure to radiation.

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 Radioactivity to the Environment that Exceeds Two Times the Off-site Dose Calculation Manual 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 Off-site Dose Calculation Manual for 15 Minutes or Longer. *Op. Modes: All*	**AS1**	Off-site 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**	Off-site 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 Rise in Plant Radiation. *Op. Modes: All*	**AA3**	Release of Radioactive Material or Rise 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 Off-site Dose Calculation Manual 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.

AP1000

Plant Vent	VFS-RICA-103	[TBD]
Turbine Island Vent	TDS-JE-RE001	[TBD]
Gaseous Radwaste Discharge	WGS-RICA-017	[TBD]
Liquid Radwaste discharge	WLS-RIA-229	[TBD]
Wastewater Discharge	WWS-JE-RE021	[TBD]

ESBWR

Plant Stack	D11-PRM-RMS-13	[TBD]
Liquid Radwaste Discharge	D11-PRM-RMS-11	[TBD]
Isolation Condenser Vent Exhaust	D11-PRM-RMS-19	[TBD]

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

AP1000

Steam Generator Blowdown	BDS-RE-010	[TBD]
	BDS-RE-011	[TBD]
Main Steam Line	SGS-RIA-026, RIA-027	[TBD]
Service Water Blowdown	SWS-RIA-008	[TBD]
Containment Air Filtration Exhaust	VFS-MA-02A, MA-02B	[TBD]

ESBWR

Main Steamline	D11-PRM-RMS-01	[TBD]
Containment Purge Exhaust	D11-PRM-RMS-23	[TBD]
Drywell Sump LCW/HCW Discharge	D11-PRM-RMS-16	[TBD]
Turbine Bldg. Combined Ventilation Exhaust	D11-PRM-RMS-10	[TBD]
Radwaste Bldg. Ventilation Exhaust	D11-PRM-RMS-17	[TBD]

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

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 Off-site Dose Calculation Manual (ODCM).*] 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 ODCM 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 off-site 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 ODCM 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. Indexing the EAL threshold to the ODCM setpoints in this manner ensures that the EAL threshold will never be less than the setpoint established by a specific discharge permit.]*

EAL #2 addresses effluent or accident radiation monitors on non-routine release pathways (i.e., for which a discharge permit would not normally be prepared). [*The setpoint will be based on radiation monitor readings to exceed two times the Technical Specification limit and releases are not terminated within 60 minutes. 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, 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 ODCM 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.

AP1000 References:

VFS-M3C-101
WGS-M3C-101
WLS-M3C-101
WWS-M3C-100
BDS-M3C-101
SGS-M3C-101
SWS-M3C-101
RMS-J7-001

ESBWR References:

DCD Tier 2, Figure 11.5-1, Rev. 3
DCD Tier 2, Section 5.5.1, Rev. 3

Initiating Condition -- NOTIFICATION OF UNUSUAL EVENT

Unexpected Rise in Plant Radiation.

Operating Mode Applicability: All

Example Emergency Action Levels: (1 or 2)

1. a. Uncontrolled water level drop in any of the following with all irradiated fuel assemblies remaining covered by water.

AP1000
Spent Fuel Pool Low-Low Alarm 22.75 ft. on SFS-LICA-19A/B/C

ESBWR

Rx Well Cavity	G21-FAPCS-LS-N020-Low [TBD]
Buffer Pool	G21-FAPCS-LS-N019-Low [TBD]
Upper Fuel Transfer Pool	G21-FAPCS-LS-N018-Low [TBD]
Skimmer Surge Tank A/B Level	G21-FAPCS-LS-R621-Low, [TBD] LS-R622-Low-Low [23 feet]
Spent Fuel Storage Pool	G21-FAPCS-LS-R634 Low, [TBD] LI-R632, LI-R633
Lower Fuel Transfer Pool	G21-FAPCS-LS-N026 – Low [TBD]

AND

b. Unplanned VALID (site-specific) Direct Area Radiation Monitor reading rise in any of the following:

AP1000

Fuel Handling Area Exhaust Radiation Monitor	VAS-RE 001
Containment High Range	PXS-RICA-160, 161, 162, 163
Refueling Bridge Portable Monitor	[site specific]

ESBWR

Refueling Floor Area #1, EL 34000 (Reactor Building)	D21-ARM-RMS-01
Refueling Floor Area #2, EL 34000 (Reactor Building)	D21-ARM-RMS-02
New Fuel Buffer Pool, EL 27000 (Reactor Building)	D21-ARM-RMS-03
New Fuel Buffer Pool, EL 27000 (Reactor Building)	D21-ARM-RMS-04
Fuel Handling Machine (IFTS), EL 34000 (Reactor Building)	D21-ARM-RMS-40
Spent Fuel Floor, EL 4650 (Fuel Building)	D21-ARM-RMS-01
Fuel Handling Machine, EL 4650, (Fuel Building)	D21-ARM-RMS-02
Fuel Transfer Cask Area, EL 4650 (Fuel Building)	D21-ARM-RMS-03
IFTS Fuel Building Isolation Valve Room (Inside), EL 4600	D21-ARM-RMS-12

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

AP1000

Primary Sampling Room:	RMS-JE-RE008 [TBD]
Containment Area Personnel Hatch:	RMS-JE-RE009 [TBD]

Main Control Room:	RMS-JE-RE010 [TBD]
Chemistry Laboratory	RMS-JE-RE011 [TBD]
Fuel Handling Area 1:	RMS-JE-RE012 [TBD]
Rail Car Bay:	RMS-JE-RE013 [TBD]
Liquid and Gaseous Radwaste Area:	RMS-JE-RE014 [TBD]
Technical Support Center:	RMS-JE-RE016 [TBD]
Radwaste Building Mobile Systems:	RMS-JE-RE017 [TBD]
Hot Machine Shop:	RMS-JE-RE018 [TBD]
Annex Staging/Storage Area	RMS-JE-RE019 [TBD]
Fuel Handling Area 2:	RMS-JE-RE020 [TBD]

*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 rise 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, 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.

[*The ESBWR fuel pool cooling function is also provided in the event that a recently unloaded fuel batch requires continued cooling during the post-accident period. The spent fuel pool contains sufficient inventory to ensure no operator action is required during the first 72 hours. After that period, either makeup water must be supplied to the spent fuel pool or the FAPCS must be initiated. The FAPCS equipment is environmentally qualified, so access is not required and redundancy is included in system components.*]

EAL #2 addresses UNPLANNED rise in in-plant radiation levels encountered during operation of plant processes that represent a degradation in the control of radioactive material, and represent a potential degradation in the level of safety of the plant. This EAL excludes in-plant radiation levels that may result from use of radiographic sources. This event escalates to an Alert per IC AA3 if the increase in dose rates impedes personnel access necessary for safe operation.

AP1000 References:	SFS-M3C-101
	RCS-M3C-101

VAS-M3C-101
PXS-M3C-101
RMS-J7-001

ESBWR References

DCD Tier 2, Table 3.3.5.1-1, Rev. 3
DCD Tier 2, Table 12.3-2, Rev. 3
DCD Tier, Sec. 9.1.3
NEDO-33319

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 Off-site Dose Calculation Manual 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.

AP1000		
Plant Vent	VFS-RICA-103	[TBD]
Turbine Island Vent	TDS-JE-RE001	[TBD]
Gaseous Radwaste Discharge	WGS-RICA-017	[TBD]
Liquid Radwaste discharge	WLS-RIA-229	[TBD]
Wastewater Discharge	WWS-JE-RE021	[TBD]
ESBWR		
Plant Stack	D11-PRM-RMS-13	[TBD]
Liquid Radwaste Discharge	D11-PRM-RMS-11	[TBD]
Isolation Condenser Vent Exhaust	D11-PRM-RMS-19	[TBD]

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

AP1000		
Steam Generator Blowdown	BDS-RE-011	[TBD]
	BDS-RE-010	[TBD]
Main Steam Line	SGS-RIA-026, RIA-027	[TBD]
Service Water Blowdown	SWS-RIA-008	[TBD]
Containment Air Filtration Exhaust	VFS-MA-02A, MA-02B	[TBD]
ESBWR		
Main Steamline	D11-PRM-RMS-01	[TBD]
Containment Purge Exhaust	D11-PRM-RMS-23	[TBD]
Drywell Sump LCW/HCW Discharge	D11-PRM-RMS-16	[TBD]
Turbine Bldg. Combined Ventilation Exhaust	D11-PRM-RMS-10	[TBD]
Radwaste Bldg. Ventilation Exhaust	D11-PRM-RMS-17	[TBD]

3. Confirmed sample analyses for gaseous or liquid releases indicates concentrations or release rates in excess of 200 times {site specific} ODCM with a release duration of 15 minutes or longer.

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 Off-site Dose Calculation Manual (ODCM).*] The occurrence of extended, uncontrolled radioactive releases to the environment is indicative of a degradation in the features and/or controls established to prevent unintentional releases, or control and monitor intentional releases. [*Some sites may find it advantageous to address gaseous and liquid releases with separate initiating conditions and EALs.*]

The ODCM 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 off-site 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. Indexing the EAL threshold to the ODCM setpoints in this manner ensures that the EAL threshold will never be less than the setpoint established by a specific discharge permit.*]

EAL #2 addresses effluent or accident radiation monitors on non-routine release pathways (i.e., for which a discharge permit would not normally be prepared). *[To ensure a realistic near-linear escalation path, a setpoint should be selected roughly half-way between the AU1 EAL #2 value and the value calculated for AS1 rad monitor value. The setpoint will be based on radiation monitor readings to exceed two hundred times the Technical Specification limit and releases are not terminated within 60 minutes. 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, 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 ODCM 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.*]

AP1000 References:

VFS-M3C-101
WGS-M3C-101
WLS-M3C-101
WWS-M3C-100
BDS-M3C-101
SGS-M3C-101
SWS-M3C-101
RMS-J7-001

ESBWR References:

DCD Tier 2, Figure 11.5-1, Rev. 3
DCD Tier 2, Sec. 5.5.1, Rev. 3

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 alarm or elevated reading on one or more of the following radiation monitors due to irradiated fuel uncovery or damage

AP1000

Fuel Handling Area Exhaust Radiation Monitor	VAS-RE 001
Containment High Range	PXS-RICA-160, 161, 162, 163
Refueling Bridge Portable Monitor	[site specific]

ESBWR

Refueling Floor Area #1, EL 34000 (Reactor Building)	D21-ARM-RMS-01
Refueling Floor Area #2, EL34000 (Reactor Building)	D21-ARM-RMS-02
New Fuel Buffer Pool, EL 27000 (Reactor Building)	D21-RMS-ARM-03
New Fuel Buffer Pool, EL 27000 (Reactor Building)	D21-RMS-ARM-04
Fuel Handling Machine (IFTS), EL 34000 (Reactor Building)	D21-ARM-RMS-40
Spent Fuel Floor, EL 4650 (Fuel Building)	D21-ARM-RMS-01
Fuel Handling Machine, EL 4650 (Fuel Building)	D21-ARM-RMS-02
Fuel Transfer Cask Area, EL 4650 (Fuel Building)	D21-ARM-RMS-03
IFTS Fuel Building Isolation Valve Room (Inside), EL 4650	D21-ARM-RMS-12

2. A water level drop in the reactor refueling cavity, spent fuel pool(s) or fuel transfer path that will result in irradiated fuel becoming uncovered.

AP1000

Spent Fuel Pool Low-Low Alarm XXXX ft.	SFS-LICA-19A/B/C

ESBWR

Rx Well Cavity	G21-FAPCS-LS-N020-Low [TBD]
Buffer Pool	G21-FAPCS-LS-N019-Low [TBD]
Upper Fuel Transfer Pool	G21- FAPCS -LS-N018-Low [TBD]
Skimmer Surge Tank A/B Level	G21-FAPCS-LS-R621-Low, [TBD] LS-R622-Low-Low [23 feet]
Spent Fuel Storage Pool	G21-FAPCS-LS-R634Low [TBD], LI-R632, LI-R633 [TBD]
Lower Fuel Transfer Pool	G21-FAPCS-LS-N026-Low [TBD]

Basis:

This IC addresses specific events that have resulted, or may result, in unexpected rise 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 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.*].

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.

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, 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.*]

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

AP1000 References:

SFS-M3C-101
VAS-M3C-101
PXS-M3C-101
RMS-J7-001

ESBWR References:

DCD Tier 2, Table 3.3.5.1-1, Rev. 3
DCD Tier 2, Table 12.3-2, Rev. 3
DCD Tier, Sec. 9.1.3
NEDO-33319

AA3

Initiating Condition -- ALERT

Release of Radioactive Material or Rise 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. VALID radiation monitor readings greater than 15 mR/hr in areas requiring continuous occupancy to maintain plant safety functions:

AP1000

Main Control Room Area Monitor	RMS-JE-RE010
Technical Support Center Area Monitor	RMS-JE-RE016
Central Alarm Station	RMS-JE-RE009

ESBWR

Main Control Room	D11-PRM-RMS-04A, B
Technical Support Center	D11-PRM-RMS-20
Central Alarm Station	D11-PRM-RMS-TBD
Secondary Alarm Station	D11-PRM-RMS-TBD

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 rise in the containment 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 rise due to planned events (e.g., 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 staffed continuously. 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.*]

[*The AP1000 Containment Area–Personnel Hatch radiation monitor, RMS-JE-RE009, monitors the area in immediate proximity to Rooms 12451, 12452 and 12454. This monitor would be used to alert Security personnel associated with the Central Alarm Station (CAS).*]

AP1000 References:	ESBWR References
RMS-J7-001	DCD Tier 2, Figure 11.5-1, Rev. 3

AS1

Initiating Condition -- SITE AREA EMERGENCY

Off-site 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:

AP1000

Plant Vent (Mid Range Gas)	VFS-RIA-104A	[Setpoint TBD]
Plant Vent (High Range Gas)	VFS-RIA-104B	[Setpoint TBD]
Gaseous Radwaste discharge	WGS-RICA-017	[Setpoint TBD]

ESBWR

Plant Stack	D11-PRM-RMS-13	[Setpoint TBD]
Isolation Condenser Vent Exhaust	D11-PRM-RMS-19	[Setpoint TBD]

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 of 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 used should be the same as those used for determining the monitor reading EALs in ICs AU1 and AA1. The same source term (noble gases, particulates, and halogens) may also be used as long as it maintains a realistic and near linear escalation 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.*]

If proper escalations do not result from the use of the same source term, if the calculated values are unrealistically high, or if correlation between the values and dose assessment values does not exist, then consider using an accident source term for AS1 and AG1 calculations.

[*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.*]

AP1000 References:

VFS-M3C-101
WGS-M3C-101
RMS-J7-001

ESBWR References:

DCD Tier 2, Table 11.5-1, Rev. 3

AG1

Initiating Condition -- GENERAL EMERGENCY

Off-site 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 is expected to exceed the reading shown for 15 minutes or longer:

AP1000		
Plant Vent (Mid Range Gas)	VFS-RIA-104A	[Setpoint TBD]
Plant Vent (High Range Gas)	VFS-RIA-104B	[Setpoint TBD]
Gaseous Radwaste discharge	WGS-RICA-017	[Setpoint TBD]
ESBWR		
Plant Stack	D11-PRM-RMS-13	[Setpoint TBD]
Isolation Condenser Vent Exhaust	D11-PRM-RMS-19	[Setpoint TBD]

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 of 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. 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.*]

AP1000 References:

VFS-M3C-101
WGS-M3C-101
RMS-J7-001

ESBWR References:

DCD Tier 2, Table 11.5-1, Rev. 3

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

NOUE	ALERT	SITE AREA EMERGENCY	GENERAL EMERGENCY
CU1 RCS Leakage. (ESBWR) *Op. Mode: Cold Shutdown*	**CA1** Loss of RCS/RPV Inventory with Irradiated Fuel in the RPV. *Op. Modes: Cold Shutdown, Refueling*	**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 with CONTAINMENT CLOSURE/REACTOR BUILDING ISOLATION <u>NOT</u> Established. *Op. Modes: Cold Shutdown, Refueling*
CU2 UNPLANNED Loss of RCS Inventory with Irradiated Fuel in the RPV *Op. Mode: 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 Off-site and All On-site Power to PIP Busses for Greater Than 30 Minutes. *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*		
CU6 UNPLANNED Loss of All On-site or Off-site Communications Capabilities. *Op. Modes: Cold Shutdown, Refueling, Defueled*			
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*			

Initiating Condition -- NOTIFICATION OF UNUSUAL EVENT

RCS Leakage.

Operating Mode Applicability: Cold Shutdown

Example Emergency Action Levels:

AP1000

1. Not applicable

ESBWR

1. Unable to maintain or restore RPV level greater than Level 2 setpoint [338.5 inches (8597 mm)] RPV Water Level B21-NBS-LI R604A-D Wide Range due to RCS leakage for greater than 15 minutes.

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 inability to establish and maintain level for 15 minutes is indicative of loss of RCS inventory. Prolonged loss of RCS Inventory may result in escalation to the Alert level via either IC CA1 (Loss of RCS/RPV Inventory with Irradiated Fuel in the RPV) or CA4 (Inability to Maintain Plant in Cold Shutdown with Irradiated Fuel in the RPV).

[*For AP1000, this IC and associated EALs are deleted, as the IC and EALs for CA1 adequately address the precursor events intended by CU1 for the AP1000 when in Cold Shutdown, and because of the significant design differences between the AP1000 and current pressurized water reactors (PWRs) that form the original basis for CU1. The AP1000 design does not include "containment bypass" as a credible scenario in the Cold Shutdown mode, and the passive Emergency Core Cooling System (ECCS) and passive Residual Heat Removal (RHR) System are still available in Mode 5. The large amount or water inventory maintained in the passive ECCS and in the passive RHR System would be sufficient for much larger RCS leakage rates than for current PWRs. Because of these design differences, the AP1000 design does not include Technical Specifications for RCS leakage limits in Mode 5. The availability of the passive ECCS and RHR System for makeup, and the lack of a credible threat to the environment due to containment bypass or RCS leakage in the AP1000 design, preclude the need for monitoring of the RCS inventory by leakage rate in Mode 5. RCS leakage of a much larger magnitude than that of current PWRs is required to affect decay heat removal, and initiating conditions that indicate a precursor to loss of decay heat removal based on loss of RCS inventory are adequately addressed in IC and EALs for CA1. Waiting until the CA1 IC is met provides sufficient time for operator to take necessary actions to prevent loss of decay heat removal, and placing lower limits on RCS leakage for notification is not necessary as a precursor initiating condition because of this long operator response time involved. Therefore, this IC is not applicable to AP1000, and should be deleted.*]

AP1000 References:

RCS-M3-001
PXS-M3-001
RNS-M3-001
GW-GL-022
Tech Spec 3.4.7
Tech Spec 3.5

ESBWR References:

DCD Tier 2, Chap 16, Sec. 3.4.2 Rev. 3
DCD Tier 2, Chap. 5, Sec. 5.2.5.1.1, Rev. 3

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)

AP1000

1. UNPLANNED RCS level drop below the top of the RPV flange for greater than 15 minutes either visually or as indicated by RCS Hot Leg level at 9.7% and lowering as indicated on RCS-LT-160A or -160B.

2. a. RCS level cannot be monitored.

   AND

   b. Loss of RCS inventory as indicated by visual observations inside containment or by an unexplained rise in Containment sump level on WLS-LICR-034, -035, or -036.

ESBWR

1. UNPLANNED RPV level drop below the RPV flange for greater than 15 minutes

2. a. RPV level cannot be determined

   AND

   b. Unexplained Drywell Equipment or Floor Drain Sumps level rise on Drywell K10-HCW Sump LE-TBD OR Drywell K10-LCW Sump LE-TBD

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 CA1 (Loss of RCS/RPV Inventory with Irradiated Fuel in the RPV) or CA4 (Inability to Maintain Plant in Cold Shutdown with Irradiated Fuel in the RPV).

[*In the refueling mode, normal means of core temperature indication and RCS level indication may not be available. Redundant means of RPV level indication are permanently 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 rise 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 RCS heatup via CA1.*]

[*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. If RPV level continues to decrease then escalation to CA1 would be appropriate.*]

AP1000 References:

RCS-M3C-101
WLS-M3C-101
WLS-M3-001
RCS-M3-001
PXS-M3-001

ESBWR References:

DCD Tier 2, Chap. 7, Sect. 7.3.3.2
DCD Tier 2, Chap. 7, Table 7.3-5
NEDO-33319

Initiating Condition -- **NOTIFICATION OF UNUSUAL EVENT**

Loss of All Off-site and All On-site AC Power to PIP Busses for Greater Than 30 Minutes.

Operating Mode Applicability: Cold Shutdown
Refueling
Defueled

Example Emergency Action Level:

AP1000

1. Loss of all AC power capability to Busses ECS-ES-1 and ECS-ES-2 busses for greater than 30 minutes.

ESBWR

1. Loss of all AC power capability to PIP busses 1000A3, 2000A3, 1000B3, AND 2000B3 for greater than 30 minutes.

Basis:

The off-site AC power system supplies power for the unit in cold shutdown, refueling, and defueled conditions. Both the normal off-site and standby on-site AC power systems are non-Class 1E with no Technical Specification requirements. All safety-related functions associated with the unit in cold shutdown and refueling are provided by the safety-related on-site Class 1E DC power systems. [*The Passive ALWRs do not have safety-related standby diesel generators. Storage batteries are the standby power source for Class 1E electric power.*]

[*In cold shutdown, the decay heat available to raise RCS temperature during a loss of RCS water inventory or loss of decay 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. Technical Specification 3.9 requires the reactor to be subcritical for greater than {100 hours – AP1000}{24 hours ESBWR} prior to the movement of irradiated fuel. 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. The heatup threat could be lower for cold shutdown conditions if the entry into cold shutdown was following a refueling.*]

[*AP1000 - The loss of normal off-site AC power and standby on-site AC power systems de-energizes the RNS pumps. However, the on-site safety-related Class 1E DC power systems are rated for 24 hours and 72 hours of service based on the most-limiting post-accident electrical load requirements for powering the passive, safety-related systems, and thus remain available for a significant time following a loss of all off-site AC power and on-site AC power. Therefore, the progression of events after a loss of RNS cooling at mid-loop caused by a loss of AC power results in a heatup to saturation, a boiling off of coolant to the IRWST, reduction of hot leg level, and actuation of passive IRWST injection. This restores RCS water inventory using only the passive cooling systems and the on-site safety-related Class 1E DC power systems.*]

[*ESBWR The loss of normal off-site AC power and standby AC power systems de-energizes the RWCU/SDC pumps. The on-site safety related DC power system is rated for 72 hours of service based on the instrumentation and control power for systems required for safe shutdown, and thus remains available for a significant time following a loss of all offsite AC power and on-site. Beyond 72 hours the Fire Protection System (FPS) is available to provide makeup water to the upper pools, Passive Containment Cooling,* *Isolation Condenser, and Spent Fuel pools. The Fire Protection System enables the upper pools to be filled with water from FPS, which provides makeup water to extend the cooling period from 72 hours to 7 days.]*

Loss of all AC power potentially compromises all non-safety related plant systems requiring electric power including non-safety related containment heat removal, spent fuel pool cooling, and unit service water systems. [*When in cold shutdown, refueling, or defueled mode the event can be classified as an Unusual Event, because of the significantly reduced decay heat and lower temperatures and pressures, increasing the time to restore one of the normal off-site AC power and standby on-site AC power systems. In addition, the passive design affords additional and redundant means to remove heat passively or restore power to active components. The selection of 30 minutes was arbitrary. It was chosen for allowing sufficient time for plant personnel to attempt to establish a viable diesel generator AC power supply to the PIP busses.*]

Escalation to an Alert, if appropriate, is by Abnormal Radiation Levels / Radiological Effluent, or Emergency Director Judgment ICs. Thirty minutes was selected as a threshold to exclude transient or momentary power losses, and is appropriate because of the passive cooling systems and the on-site safety-related Class 1E DC power systems.

AP1000 References:

APP-ECS-E8-001
APP-RCS-M3-001
APP-PXS-M3-001
APP-RNS-M3-001
APP-ZOS-E8-001
Technical Specification 3.9.7

ESBWR References:

DCD Tier 2, Chap. 19, Sec. 19.A.3 and Table 19.2-2 Rev. 1

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)

AP1000
1. An UNPLANNED event results in RCS temperature exceeding 200 F on RCS-TI-135A or -135B

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

ESBWR
1. An UNPLANNED event results in RCS temperature exceeding 200 F on C51-TC-TBD

2. Loss of all RCS temperature and RPV level indication for greater than 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 decay heat available to raise RCS temperature during a loss of RCS water inventory or loss of decay 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. Technical Specification 3.9 requires the reactor to be subcritical for greater than {100 hours –AP1000}{24 hours ESBWR} prior to the movement of irradiated fuel. 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.*] Monitoring RCS temperature and RPV level so that escalation to the alert level via CA4 or CA1 will occur if required.

[*AP1000 - Decay heat removal is normally performed by the non-safety related RNS pumps and heat exchangers. The progression of events after a loss of RNS cooling at mid-loop results in a heatup to saturation, a boiling off of coolant to the IRWST, reduction of hot leg level, and actuation of passive IRWST injection. This restores RCS water inventory using only the safety-related passive cooling systems. However, if an unplanned event causes the both normal decay heat removal and the passive cooling systems to be lost, then RCS temperature can exceed 200°F. In addition, even though RNS may be operating and initial RCS/RPV inventory is available, a loss of all RCS temperature and RPV level indication prevents the operator from ensuring adequate RNS decay heat removal is occurring.*]

[*ESBWR Decay heat removal is normally performed by both trains of the nonsafety-related RWCU/SDC, which transfers sensible heat and core decay heat load produced when the reactor is being shutdown, or is in the shutdown condition, to the Reactor Component Cooling Water System. In the PRA it is assumed that both trains of RWCU/SDC are running, because the time periods in which only one train is running occurs when the reactor well is flooded. Failure of one of the trains is not considered an initiating event.*]

As a backup to this IC and EALs, any reduction of RCS inventory to the predetermined setpoint will result in an NOUE based on CU2 or an Alert based on CA1 or CA4.

AP1000 References:

APP-RCS-M3-001
APP-PXS-M3-001
APP-RNS-M3-001
APP-GW-GL-022
Tech Spec 3.4.7
Tech Spec 3.5

ESBWR References: [TBD]

Initiating Condition -- **NOTIFICATION OF UNUSUAL EVENT**

UNPLANNED Loss of All On-site or Off-site Communications Capabilities.

Operating Mode Applicability: Cold Shutdown
Refueling
Defueled

Example Emergency Action Levels: (1 or 2)

1. Loss of all of the following on-site communications capability affecting the ability to perform routine operations:

   AP1000
   - EFS
   - TVS
   - (Site specific)

   ESBWR
   - Plant Page/party Line
   - PABX
   - Sound Powered Phones
   - Plant Radios
   - (Site specific)

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

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 off-site authorities. The loss of off-site 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 off-site communications is sufficient to inform state and local authorities of plant conditions. [*This EAL is to be used only when extraordinary means (e.g., relaying of information from radio transmissions, individuals being sent to off-site locations, etc.) are being utilized to make communications possible.*]

[*Site-specific list for on-site 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).*] EFS and TVS are comprised of the following:

- Wireless Telephone System
- Telephone-Page System
- Sound Powered System
- Security Communication System
- Closed Circuit Television System

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

AP1000 References:

EFS-E8-001
TVS-J7-001

ESBWR References: [TBD]

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:

AP1000

1. a. UNPLANNED Loss of Required UPS System Power based on [voltage indications TBD] for ALL of the following AC instrumentation and control busses:
   - Division A 24-Hour Bus IDSA-EA-1
   - Division B 24-Hour Bus IDSB-EA-1
   - Division B 72-Hour Bus IDSB-EA-3
   - Division C 24-Hour Bus IDSC-EA-1
   - Division C 72-Hour Bus IDSC-EA-3
   - Division D 24-Hour Bus IDSD-EA-1

   AND

   b. Failure to restore power to at least one required bus in less than 15 minutes from the time of loss.

ESBWR

1. a. Loss of All Vital DC Busses 11, 12, 21, 22, 31, 32, 41, AND 42 based on bus voltage less than 210 V for greater than 15 minutes.

   AND

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

Basis:

The purpose of this IC and its associated EALs is to recognize a loss of the Class 1E DC {AP1000 - and Uninterruptible Power Supply (UPS) System,} which provides electrical power for safety related and vital control and monitoring instrumentation loads. It also provides power for safe shutdown when all the on-site and off-site AC power sources are lost and cannot be recovered for 72 hours. [*Loss of the vital AC instrumentation and control busses potentially compromises 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 division related basis during shutdown periods. It is intended that the loss of the operating (operable) division 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.*]

Bus voltage of [TBD] VAC is the minimum bus voltage necessary for the operation of safety-related instrumentation and controls. This voltage value incorporates a margin significantly longer than the allowed 15 minutes of operation before the onset of inability to operate those loads.

AP1000 References: ESBWR References: [TBD]

IDS-E8-001

Initiating Condition -- NOTIFICATION OF UNUSUAL EVENT

Inadvertent Criticality.

Operating Mode Applicability: Cold Shutdown
Refueling

Example Emergency Action Levels:

AP1000
1. An UNPLANNED sustained positive startup rate.

ESBWR
1. An UNPLANNED SRNM sustained positive period.

Basis:

This IC addresses criticality events that occur in Cold Shutdown or Refueling modes 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 condition can be identified using period monitors/startup rate monitor. The term "sustained" 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. These short term positive periods/startup rates are the result of the increase in neutron population due to subcritical multiplication.*]

AP1000 Reference:

PMS-J4-020
PMS-J1-003

ESBWR References: [TBD] [TBD]

Initiating Condition -- **ALERT**

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

Operating Mode Applicability: Cold Shutdown
Refueling

Example Emergency Action Levels: (1 or 2)

AP1000

1. a. Pressurizer level at 12% and lowering on RCS-LT-200

   OR

   b. RCS Hot Leg level is at 9.7% and lowering as indicated on RCS-LT-160A OR -160B

2. a. RCS level cannot be monitored for greater than 30 minutes.

   AND

   b. Unexplained rise in Containment sump level on WLS-LICR-034, -035, OR -036.

ESBWR

1. RCS inventory reduced below Level 1 setpoint [218.4 inches (5547 mm) above TAF] on RPV Water Level B21-NBS-LI R604A-D Wide Range for greater than 15 minutes.

2. a. RCS/RPV level cannot be determined for greater than 30 minutes.

   AND

   b. Unexplained Drywell Equipment or Floor Drain Sumps level rise on Drywell K10-HCW Sump LE-TBD OR Drywell K10-LCW Sump LE-TBD

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 inability to restore and maintain level after reaching this setpoint would therefore be indicative of a failure of the RCS barrier.

{AP1000 - The RCS PZR level and Hot Leg level decreasing setpoints were chosen to indicate that actions must be taken to prevent reaching a level that would cause a loss of RNS cooling. The inability to restore and maintain level after reaching this setpoint would therefore be indicative of a failure of the RCS barrier. The pressurizer level setpoint is 12%, which is the pressurizer level low-2 setpoint. This provides CMT actuation for Core Heat Removal. The hot leg level setpoint is 9.7%, which is the hot leg level low-2 setpoint. This activates ADS 4 and IRWST injection for Core Heat Removal.}

{ESBWR – The Level 1 actuation setpoint was chosen to indicate that those makeup efforts are failing. 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. Technical Specification 3.9 requires the reactor to be subcritical for greater than {100 hours –AP1000}{24 hours ESBWR} prior to the movement of irradiated fuel.. 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*].

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 rise 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 30-minute duration for the loss of level indication was chosen to allow CA1 to be an effective precursor to CS1. This provides time to increase makeup and isolate leakage prior to core uncovery. Whether or not the actions in progress will be effective should be apparent within 30 minutes. [*When in Cold Shutdown or Refueling the event can be classified as an Alert due to the significantly reduced decay heat and lower temperature and pressure. This increases the time available to resolve the problem. Significant fuel damage is not expected to occur until after core uncovery has occurred as addressed IC CS1. Therefore this EAL meets the definition for an Alert emergency.*]

[*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 CG1 basis. Therefore this EAL meets the definition for an Alert emergency.*]

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

AP1000 References:

RCS-M3 -101
WLS-M3C-101
WLS-M3-001
RCS-M3-001
PXS-M3-001

ESBWR References: [TBD]

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)

AP1000

1. An UNPLANNED event results in RCS Temperature greater than 200°F as indicated on RCS-TI-135A OR -135B

   AND

   CONTAINMENT CLOSURE NOT established

   AND

   RCS Open

Note: *If an RCS heat removal system is in operation within this time frame and RCS temperature is being reduced then Threshold Values 2 and 3 are not applicable.*

2. An UNPLANNED event results in RCS Temperature greater than 200 °F for greater than 20 Minutes (Note) as indicated on RCS-TI-135A OR RCS-TI-135B.

   AND

   CONTAINMENT CLOSURE Established

   AND EITHER of the following conditions:

   a. RCS Open

      OR

   b. RCS Water Level lower than 3 feet below the reactor vessel flange as indicated on RCS RCS-LI-200.

3. WITH RCS Intact an UNPLANNED event

   a. Results in RCS Temperature greater than 200°F for greater than 60 Minutes (Note) as indicated on RCS-TI-135A OR RCS-TI-135B

      OR

   b. RCS Pressure Increase greater than 10 psig as indicated on RCS-PIC-140A, RCS-PIC-140B, RCS-PIC-140C, OR RCS-PIC-140D

ESBWR

1. An UNPLANNED event results in RCS temperature exceeding 200 degrees F as indicated by any of the following:
   - Core Inlet Temperature, C51-TC-TBD,
   - RWCU Bottom Head Suction Temperature G31-RWCU-SDC-TT-N005, -N006, A-1,B-1 through A-4, B-4
   - RWCU Suction Temperature G31-RWCU-SDC-TT-N001, -N002, A-1, B-1 through A-4, B-4

   AND

   REACTOR BUILDING ISOLATION NOT established

   AND

   RCS Open

Note: *If an RCS heat removal system is in operation within this time frame and RCS temperature is being reduced then Threshold Values 2 and 3 are not applicable.*

2. An UNPLANNED event results in RCS temperature exceeding 200 degrees F for greater than 20 minutes (Note) as indicated by any of the following:
   - Core Inlet Temperature, C51-TC-TBD
   - RWCU Bottom Head Suction Temperature G31-RWCU-SDC-TT-N005, -N006, A-1, B-1 through A-4, B-4
   - RWCU Suction Temperature G31-RWCU-SDC-TT-N001, -N002, A-1, B-1 through A-4, B-4

   AND

   REACTOR BUILDING ISOLATION established

   AND One of the following:

   a. RCS Open

      OR

   b. RCS inventory reduced below Level 1 setpoint [218.4 inches (5547 mm) above TAF] on RPV Water Level B21-NBS-LI R604A-D Wide Range.

3. WITH RCS Intact an UNPLANNED event

   a. Results in RCS temperature exceeding 200 degrees F for greater than 60 minutes (Note) as indicated by any of the following:
      - Core Inlet Temperature, C51-TC-TBD,
      - RWCU Bottom Head Suction Temperature G31-RWCU-SDC-TT-N005, -N006, A-1, B-1 through A-4, B-4
      - RWCU Suction Temperature G31-RWCU-SDC-TT-N001, -N002, A-1, B-1 through A-4, B-4

      OR

b. An RCS pressure rise of greater than 10 psig as indicated by either B21-NBS-PI-N030A-D OR B21-NBS-PI-R620A-D.

Basis:

CONTAINMENT CLOSURE/REACTOR BUILDING ISOLATION: the site specific procedurally defined action taken to secure primary or secondary containment (ESBWR) and its associated structures, systems, and components as a functional barrier to fission product release under existing plant conditions.

EAL 1 addresses complete loss of functions required for core cooling during refueling and cold shutdown modes when neither CONTAINMENT CLOSURE/ REACTOR BUILDING ISOLATION 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 REACTOR BUILDING ISOLATION is established but RCS integrity is not established or RCS inventory is reduced. [*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 greater than 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 condition for the cold shutdown mode of operation (e.g., no freeze seals or nozzle dams). The status of CONTAINMENT CLOSURE/ REACTOR BUILDING ISOLATION 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 10 psig 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 of 10 psig was chosen because it is the lowest pressure that can read on Control Board instrumentation.*] 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 Emergency would be via CS1 or CS2 should boiling result in significant RPV level loss leading to core uncovery.

{AP1000 - This IC and the associated EALs are based on concerns raised by Generic Letter 88-17, "Loss of Decay Heat". The concern was based on an event involving loss of decay heat removal while there is still substantial core decay heat. This may pose a significant likelihood of a release. Evaluation of plant data has shown that a large number of events have occurred. Many of these events involve the loss of RNS for one or more hours. Failure to recognize the seriousness of the situation and lack of clear guidance can lead to significant delay in obtaining resources.}

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 degrees 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.

AP1000 References:

RCS-M3C-101
RCS-M3-001
PXS-M3-001
RNS-M3-001

ESBWR References: [TBD]

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)

AP1000

1. WITH CONTAINMENT CLOSURE NOT established:

   a. RPV level less than Lo-2 (3 inches above the inside surface of the bottom of the Hot Leg) on RCS LT-160A or -160B

   OR

   b. RPV level cannot be monitored for greater than 60 minutes with a loss of RPV inventory as indicated by unexplained containment sump level rise on WLS-LICR-034, -035, OR -036.

2. [With CONTAINMENT CLOSURE established

   a. RCS LT-160A or -160B Offscale low

   OR

   b. RPV level cannot be monitored for greater than 60 minutes with a loss of RPV inventory as indicated by either:
      - Unexplained containment sump level rise on WLS-LICR-034, -035, OR -036
      - TBD]

ESBWR

1. WITH REACTOR BUILDING ISOLATION NOT established:

    a. RPV level less than Level 0.5 Setpoint [39.4 inches (1000 mm) above TAF] on B21-NBS-LI-R615A-D

    OR

    b. RPV level cannot be determined for greater than 60 minutes with a loss of RPV inventory as indicated by either:
        - Unexplained Drywell Equipment or Floor Drain Sumps level rise on Drywell K10-HCW Sump LE-TBD OR Drywell K10-LCW Sump LE-TBD
        - Erratic Source Range Monitor Indication

2. With REACTOR BUILDING ISOLATION established

    a. RPV level less than Level 0 Setpoint [0 inches (0 mm)] on B21-NBS-LI-R615A-D

    OR

    b. RPV level cannot be monitored for greater than 60 minutes with a loss of RPV inventory as indicated by either:
        - Unexplained Drywell Equipment or Floor Drain Sumps level rise on Drywell K10-HCW Sump LE-TBD OR Drywell K10-LCW Sump LE-TBD
        - Erratic Source Range Monitor Indication

Basis:

CONTAINMENT CLOSURE/REACTOR BUILDING ISOLATION: the site specific procedurally defined action taken to secure primary or secondary containment (ESBWR) and its associated structures, systems, and components as a functional barrier to fission product release under existing plant conditions.

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. Technical Specification 3.9 requires the reactor to be subcritical for greater than {100 hours –AP1000}{24 hours ESBWR} prior to the movement of irradiated fuel. 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).*]

{AP1000 – For 1.a, the lowest observable level is used. ESBWR – For 1.a, the lowest level above the fuel is used.}

The 60-minute duration allows sufficient time for actions to be performed to recover needed cooling equipment and is considered to be conservative. {AP1000 - the effluent release is not expected with closure established. ESBWR - releases would be monitored and escalation would be via Category A ICs if required.}

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 (Off-site 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).

AP1000 References:

APP-RCS-M3C-101
Tech Specs 3.4.12, 3.4.13, 3.5.3, 3.5.5 and 3.5.7

ESBWR References: [TBD]

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:

AP1000

1. WITH CONTAINMENT CLOSURE NOT established:

   a. RPV level less than Lo-2 (3 inches above the inside surface of the bottom of the Hot Leg) RCS LT-160A or LT-160B

   OR

   b. RPV level cannot be monitored with indication of core uncovery as evidenced by one or more of the following:
      - PXS-RICA-160, -161, -162, or -163 reading greater than the [TBD] (Hi-1 setpoint)
      - Unexplained containment sump level rise on WLS-LICR-034, -035, -036.

2. [With CONTAINMENT CLOSURE established

   a. RPV level on RCS LT-160A or LT-160B Offscale Low

   OR

   b. RPV level cannot be monitored with Indication of core uncovery as evidenced by one or more of the following:
      - PXS-RICA-160, -161, -162, or -163 reading greater than the [TBD] (Hi-1 setpoint)
      - Unexplained containment sump level rise on WLS-LICR-034, -035, -036. TBD]

ESBWR

1. <u>WITH</u> REACTOR BUILDING ISOLATION <u>NOT</u> established:

   a. RPV level less than Level 0.5 Setpoint [39.4 inches (1000 mm)] above TAF on B21-LI-R615A-D Post Accident Monitor Fuel Zone Range

   <u>OR</u>

   b. RPV level cannot be determined with Indication of core uncovery as evidenced by one or more of the following:
      - Drywell Radiation Monitors T62-RMS-RDT-TBD reading greater than {site-specific} setpoint.
      - Erratic Source Range Monitor Indication
      - Unexplained Drywell Equipment or Floor Drain Sumps level rise on Drywell K10-HCW Sump LE-TBD <u>OR</u> Drywell K10-LCW Sump LE-TBD

2. With CONTAINMENT CLOSURE established

   a. RPV level less than Level 0 Setpoint [0 inches (0 mm)] on B21-NBS-LI-R615A-D

   <u>OR</u>

   b. RPV level cannot be monitored with Indication of core uncovery as evidenced by one or more of the following:
      - Drywell Radiation Monitors T62-RMS-RDT-TBD reading greater than {site-specific} setpoint.
      - Erratic Source Range Monitor Indication
      - Unexplained Drywell Equipment or Floor Drain Sumps level rise on Drywell K10-HCW Sump LE-TBD <u>OR</u> Drywell K10-LCW Sump LE-TBD

Basis:

CONTAINMENT CLOSURE/REACTOR BUILDING ISOLATION: the site specific procedurally defined action taken to secure primary or secondary containment (ESBWR) and its associated structures, systems, and components as a functional barrier to fission product release under existing plant conditions.

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 the ESBWR has penetrations below the setpoint, continued level decrease may be indicative of pressure RPV 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. Technical Specification 3.9 requires the reactor to be subcritical for greater than {100 hours –AP1000} {24 hours ESBWR} prior to the movement of irradiated fuel. 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).*]

{AP1000 – For 1.a, the lowest observable level is used. ESBWR – For 1.a, the lowest level above the fuel is used.}

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 {site-specific} monitor indication and possible alarm. [*EAL 1.b and EAL 2.b should conservatively estimate a site-specific dose rate setpoint indicative of core uncovery (ie, level at TOAF).*]

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.

{AP1000 the effluent release is not expected with closure established. ESBWR - releases would be monitored and escalation would be via Category A ICs if required.}

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 (Off-site 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).

AP1000 References:

APP-RCS-M3C-101
APP-PXS-M3C-101
APP-PXS-M3-001
Tech Specs 3.4.13 and 3.5.7

ESBWR References: [TBD]

SYSTEM MALFUNCTION

CG1

Initiating Condition -- **GENERAL EMERGENCY**

Loss of RPV Inventory Affecting Fuel Clad Integrity with Containment Challenged with Irradiated Fuel in the RPV with CONTAINMENT CLOSURE/REACTOR BUILDING ISOLATION NOT Established.

Operating Mode Applicability: Cold Shutdown, Refueling

Example Emergency Action Level:

AP1000

1. Unexplained containment sump level rise on WLS-LICR-034, -035, OR -036

2. RPV Level:

   a. RCS LT-160A or LT-160B Offscale low for greater than 30 minutes

   OR

   b. CANNOT be monitored with indication of core uncovery for greater than 30 minutes as indicated by one or more of the following:
      - PXS-JE-RE160, -161, -162, -163 radiation monitor reading greater than [TBD] (Hi2 setpoint).
      - Core Exit Thermocouple temperature equal to or greater than 700°F on [TBD].
      - Erratic Source Range Monitor Indication

3. CONTAINMENT challenged as indicated by one or more of the following:
   - Explosive mixture inside containment
   - Pressure above [TBD] psig value
   - CONTAINMENT CLOSURE not established

ESBWR

1. Unexplained Drywell Equipment or Floor Drain Sumps level rise on Drywell K10-HCW Sump LE-TBD OR Drywell K10-LCW Sump LE-TBD

2. RPV Level:
   a. Less than Level 0 Setpoint [0 inches (0 mm)] on B21-NBS-LI-R615A-D for greater than 30 minutes.

   OR

   b. CANNOT be determined with indication of core uncovery for greater than 30 minutes as evidenced by one or more of the following:
      - Drywell Radiation Monitors T62-RMS-RDT-TBD reading greater than {site-specific} high setpoint
      - Unexplained Drywell Equipment or Floor Drain Sumps level rise on Drywell K10-HCW Sump LE-TBD OR Drywell K10-LCW Sump LE-TBD
      - Erratic Source Range Monitor Indication

3. CONTAINMENT challenged as indicated by one or more of the following:
   - Explosive mixture inside containment
   - Pressure above {TBD value}
   - REACTOR BUILDING ISOLATION not established
   - Secondary Containment radiation monitors above {TBD value}

Basis:

CONTAINMENT CLOSURE/REACTOR BUILDING ISOLATION: the site specific procedurally defined action taken to secure primary or secondary containment (ESBWR) and its associated structures, systems, and components as a functional barrier to fission product release under existing plant conditions.

[*In the cold shutdown mode, normal RCS level and RPV level instrumentation systems will normally be available to detect inventory loss. 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 other site-specific indications.*]

These conditions represent 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 conditions 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.

[*In the cold shutdown mode, normal RCS level and RPV level instrumentation systems will normally be available to detect decreasing RPV water level. 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.*]

[*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 rise 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.

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 radiation 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.

[*CONTAINMENT CLOSURE/REACTOR BUILDING ISOLATION 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/REACTOR BUILDING ISOLATION should not be confused with refueling containment integrity as defined in technical specifications. Site shutdown contingency plans typically provide for re-establishing CONTAINMENT CLOSURE/REACTOR BUILDING ISOLATION following a loss of heat removal or RCS inventory functions.*] If CONTAINMENT CLOSURE/REACTOR BUILDING ISOLATION 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.

AP1000 References:

APP-PXS-M3C-101
APP-PXS-M3-001
Tech Specs 3.4.12, 3.4.13, 3.5.3, 3.5.5, 3.5.7 and 3.5.8

ESBWR References: [TBD]

DCD Tier 2, Chapter 7, Sect. 7.3.3.2, Table 7.3-5 Rev. 3
DCD Tier 2, Chapter 16, Sections 3.1.2, 3.3.1.6, 3.4.3, 3.6.3.1
DCD Tier 2, Chapter 16, Sect. B.3.6.1.1, Rev. 3

Table 5-F-1

Recognition Category F

Fission Product Barrier Degradation

INITIATING CONDITION MATRIX

See Table 5-F-2 for BWR Example EALs
See Table 5-F-3 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, Safe/Stable Shutdown*	**FA1**	ANY Loss or ANY Potential Loss of EITHER Fuel Clad <u>OR</u> RCS *Op. Modes: Power Operation, Hot Standby, Startup, Safe/Stable Shutdown*	**FS1**	Loss or Potential Loss of ANY Two Barriers *Op. Modes: Power Operation, Hot Standby, Startup, Safe/Stable Shutdown*	**FG1**	Loss of ANY Two Barriers <u>AND</u> Loss or Potential Loss of Third Barrier *Op. Modes: Power Operation, Hot Standby, Startup, Safe/Stable 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 off-site 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.

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. 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 Loss or 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**
<u>1. Primary Coolant Activity Level</u> Primary coolant activity greater than 300 uCi/gm	Not Applicable	<u>1. Primary Containment Conditions</u> Drywell pressure greater than 1.85 psig on T62-CMS-PI-TDB-A-D due to RCS leakage	Not Applicable	<u>1. Primary Containment Pressure</u> Primary containment pressure rise followed by a rapid unexplained drop in primary containment pressure **<u>OR</u>** Primary containment pressure response not consistent with LOCA conditions	Primary containment pressure 45 psig on T62-CMS-PI-TBD-A-D and rising **<u>OR</u>** H_2 greater than 6% <u>AND</u> O_2 greater than 5% **<u>OR</u>** RPV pressure <u>AND</u> suppression pool temperature cannot be maintained below the HCTL
OR		OR		OR	
<u>2. RPV Level</u> RPV water level cannot be restored and maintained above Post Accident Monitor Fuel Zone Range 0 inches (0 mm) B21-LI-R615A-D	RPV water level cannot be restored and maintained above Level 0.5 Setpoint Post Accident Monitor Fuel Zone Range 39.4 inches (1000 mm) B21- LI-R615A-D	<u>2. RPV</u> RPV water level cannot be restored and maintained above Level 0.5 Setpoint Post Accident Monitor Fuel Zone Range 39.4 inches (1000 mm) B21- LI-R615A-D	Not Applicable	<u>2. RPV Level</u> Not Applicable	Primary Containment Flooding is required.
		OR		OR	
<u>3. Not Applicable</u> Not applicable		<u>3. RCS Leak Rate</u> Unisolable Main Steamline Break as indicated by: Failure of both valves in any one line to close **<u>AND</u>** a. Steamline High Flow greater than 140% rated **<u>OR</u>** b. Main Steam Line Low Pressure less than 750 psig **<u>OR</u>** c. Main Steam Tunnel Ambient Temperature greater than [TBD] **<u>OR</u>** Automatic Depressurization System automatically <u>OR</u> manually initiated.	RCS leak greater than 100 gpm in the drywell. **<u>OR</u>** Unisolable primary system leakage outside primary containment as indicated by: Area temperature or area radiation greater than Max Normal values Table TBD	<u>3. Containment Isolation Failure or Bypass</u> Failure of both valves in any one line to close <u>AND</u> direct downstream pathway to the environment exists after a primary containment isolation signal **<u>OR</u>** Intentional venting per EOPs for pressure control **<u>OR</u>** Unisolable primary system leakage outside Containment as indicated by area temperature or area radiation greater than Max Safe Operating values Table TBD	Feedline break [TBD]

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. 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 Loss or 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. Primary Containment Radiation Monitoring		**4. Primary Containment Radiation Monitoring**		**4. Significant Radioactive Inventory in Primary Containment**	
Primary containment radiation monitor reading greater than (TBD 5% clad failure dispersed in the drywell) R/hr	Not Applicable	Primary containment radiation monitor reading greater than (TBD normal operating chemistry dispersed in the drywell) R/hr on [TBD]	Not Applicable	Not applicable	Primary containment radiation monitor reading greater than (TBD 20% clad failure dispersed in the drywell) R/hr on [TBD]
OR		OR		OR	
5. Other (Site-Specific) Indications		**5. Other (Site-Specific) Indications**		**5. Other (site-specific) Indications**	
[MSL Rad Monitors Drywell Fission Product Monitor – TBD]	(Site specific) as applicable	(Site specific) as applicable	(Site specific) as applicable	(Site specific) as applicable	(Site specific) as applicable
OR		OR		OR	
6. Emergency Director Judgment		**6. Emergency Director Judgment**		**6. Emergency Director Judgment**	
Any condition in the judgment of the Emergency Director that indicates Loss or Potential Loss of the Fuel Clad Barrier		Any condition in the judgment of the Emergency Director that indicates Loss or Potential Loss of the RCS Barrier		Any condition in the judgment of the Emergency Director that indicates Loss or Potential Loss of the Containment barrier	

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

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

1. Primary Coolant Activity Level

This (site-specific) value corresponds to 300 μCi/gm I-131 equivalents. 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 potential loss associated with this condition.

2. Reactor Vessel Water Level

The "Loss" value is the top of active fuel which is used in EOPs to indicate challenge of core cooling. This is the minimum value to assure core cooling without further degradation of the clad.

Level 0.5 corresponds to a water level above the top of the active fuel. [*The "Potential Loss" EAL is the same as the RCS barrier "Loss" EAL #2.*] *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. Not applicable

4. Primary 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 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 greater 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 associated with this condition.

5. Other (Site-Specific) Indications

Main Steam Line monitors and the Drywell Fission Product Monitor at the specified values are indicative of fuel clad failure.

6. 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 Off-site Power and Prolonged Loss of All On-site 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. Primary Containment Conditions

1.85 psig drywell pressure is based on the drywell high pressure set point which indicates a LOCA.

There is no potential loss associated with this condition.

2. Reactor Vessel Water Level

[*This "Loss" EAL is the same as "Potential Loss" Fuel Clad Barrier EAL #2. The water level corresponds to the level which is used in EOPs to indicate challenge of core cooling.*] Level 0.5 corresponds to a water level above the top of the 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 associated with this condition.

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. Automatic Depressurization System automatically or manually initiated is a breach of the RCS.

The potential loss of RCS based on leakage is set at a level indicative of a breach of the RCS but which is well within the makeup capability of the CRD high pressure injection. Core uncovery is not a significant concern for a 100 gpm leak, however, break propagation leading to significantly larger loss of inventory is possible.

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 plant 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. Primary Containment 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 #4. 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 #4, fuel damage would also be indicated.*]

There is no potential loss associated with this condition.

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 Off-site Power and Prolonged Loss of All On-site 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. Primary Containment 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 operator's 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 45 psig for potential loss of containment is based on the primary containment design pressure. Existence of an explosive mixture means hydrogen and oxygen concentration of at least the lower deflagration limit curve exists.

2. Reactor Vessel Water Level

There is no loss associated with this condition.

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 TAF 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.*]

3. Containment Isolation Failure or Bypass

This EAL addresses the inability to isolate the containment when containment isolation is required. Also, an intentional venting of primary containment for pressure control per EOPs to the environment is considered a loss of containment. Containment venting for temperature or pressure when not in an accident situation should not be considered. 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 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.*]

[Check on feedwater line break and failure f isolation valves for potential loss -TBD]

4. Significant Radioactive Inventory in Containment

There is no loss associated with this condition.

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. A major release of radioactivity requiring off-site 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%.*]

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. The Containment Barrier should not be declared lost or potentially lost based on exceeding Technical Specification action statement criteria, unless there is an event in progress requiring mitigation by the Containment barrier. When no event is in progress (Loss or Potential Loss of either Fuel Clad and/or RCS) the Containment Barrier status is addressed by Technical Specifications. (See also IC SG1, "Prolonged Loss of All Off-site Power and Prolonged Loss of All On-site AC Power", for additional information.)

TABLE 5-F-3

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, multiple events could occur which result in the conclusion that exceeding the loss or Potential loss thresholds is IMMINENT. 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 Loss or 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**	
Dose Equivalent 300 μCi/gm I-131 OR 280 μCi/gm XE-133] as indicated on [Instrument TBD]	Not Applicable	RCS leak rate greater than available makeup capacity as indicated by RCS subcooling less than 30 degrees on [TBD]	RCS leak rate greater than 135 gpm on [TBD]	A containment pressure rise followed by a rapid unexplained drop in containment pressure. **OR** Containment pressure or sump level response not consistent with LOCA or MSL break conditions	59 psig and rising on PCS-PI-012, 013 or 014 **OR** 4% H_2 on VLS-AE001, 002 or 003 **OR** Containment Pressure Hi/Hi Alarm on PCS-P005, 006 or 007 AND PCS does NOT actuate.
OR		OR		OR	
3. Core Exit Thermocouple Readings		**3. Not Applicable**		**3. Core Exit Themocouple Reading**	
Greater than 1200°F degrees F	Greater than 700 degrees F	Not applicable	Not applicable	Not applicable	Core exit thermocouples in excess of 1200 degrees AND Restoration procedures not effective within 15 minutes AND Stage 4 ADS actuated.
OR		OR		OR	
4. Reactor Vessel Water Level		**4. SG Tube Rupture**		**4. SG Secondary Side Release with P-to-S Leakage**	
Not Applicable	RCS Hot Leg Level LESS than 9.7% on RCS-LT-160A or 160B. **OR** Inventory CSF - Yellow	SGTR that results in a CMT/PRHR Actuation	Not Applicable	RUPTURED S/G is also FAULTED outside of containment **OR** Primary-to-Secondary leakrate greater than 10 gpm as indicated by [TBD] with nonisolable steam release from affected S/G to the environment	Not applicable

TABLE 5-F-3

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, multiple events could occur which result in the conclusion that exceeding the loss or Potential loss thresholds is IMMINENT. 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 Loss or 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	
5. Containment Radiation Monitoring		**5. Containment Radiation Monitoring**		**5. CNMT Isolation Valves Status After CNMT Isolation**	
Containment radiation monitor reading greater than [TBD] rad/hr on PXS-JE-RE-160, -161, -162, OR -163	Not Applicable	Containment radiation monitor reading greater than 2 rad/hr on PXS-JE-RE-160, -161, -162, OR -163	Not Applicable	Valve(s) not closed AND direct downstream pathway to the environment exists after CTMT isolation signal	Not Applicable
OR		OR		OR	
6. Not Applicable		**6. Not Applicable**		**6. Significant Radioactive Inventory in Containment**	
Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Containment radiation monitor reading GREATER THAN [TBD] rad/hr on PXS-JE-RE-160, -161, -162, OR -163
OR		OR		OR	
7 Other (Site-Specific) Indications		**7. 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	
8. Emergency Director Judgment		**8. Emergency Director Judgment**		**8. Emergency Director Judgment**	
Any condition in the judgment of the Emergency Director that indicates Loss or Potential Loss of the Fuel Clad Barrier		Any condition in the judgment of the Emergency Director that indicate Loss or Potential Loss of the RCS Barrier		Any condition in the judgment 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 EALs: (1 or 2 or 3 or 4 or 5 or 6 or 7 or 8)

1. Critical Safety Function Status

   These EALs serve as precursors to a loss of fuel clad. Core cooling orange path indicates subcooling has been lost and that some clad damage may occur. Core cooling red path indicated significant superheating and core uncovery and is considered to indicate a loss of the fuel clad. Heat Sink RED indicates the steam generator heat sink function is under extreme challenge and provides the potential for loss of the fuel clad.

2. Primary Coolant Activity Level

   This is a site specific value corresponding to 300 μCi/gm I-131 equivalent or 280 μCi/gm Xe-133. This amount of radioactivity indicates significant clad damage and the fuel barrier is considered lost.

   There is no equivalent Potential Loss for this item.

3. Core Exit Thermocouple Readings

   The core exit thermocouples (CETs) provide an adequate measure of core temperatures to estimate temperatures at which potential cladding damage and core over temperature may be occurring. CETs with readings greater than 700 °F indicate the onset of inadequate core cooling. Continued operation in this state can lead to a core damage sequence if Emergency Operating Procedures are not effective in restoring core cooling.

   CETs with readings above 1200 °F indicate significant clad heating and the loss of the fuel clad barrier. Core exit thermocouples are included in addition to the Critical Safety Functions to include conditions when the status trees may not be in use. A Core Cooling ORANGE path indicates subcooling has been lost and that some clad damage may occur. A Core Cooling RED path indicated significant superheating and core uncovery and is considered to indicate a loss of the Fuel Clad barrier.

4. Reactor Vessel Water Level

   The potential loss corresponds to a level 3 inches above the bottom of the Hot Leg. This is defined by the CSFSTs as an Inventory YELLOW path.

   There is no Loss EAL corresponding to this item because it is better covered by the other Fuel Clad Barrier Loss EALs. The value for the Potential Loss EAL corresponds to the 3 inches above the bottom of the Hot Leg. This Potential Loss EAL is defined by the Inventory YELLOW path.

5. Containment Radiation Monitoring

   The reading of 100 rad/hr on PXS-JE-RE160, RE161, RE162 or RE163 is a value which indicates the release of reactor coolant, with elevated activity indicative of fuel damage, into the containment. Use of a confirmed radiation monitoring reading can lead to an earlier Alert classification. A reactivity excursion or mechanical damage may cause fuel damage that is first detected by radiation monitors.

   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.

   There is no Potential Loss EAL associated with this item.

6. Not Applicable

7. Other (Site-Specific) Indications – Not Applicable

8. Emergency Director Judgment

The Emergency Director can declare an Alert based on the judgment that conditions exist which indicate the Loss or Potential Loss of the Fuel Cladding barrier. This can take any other factors into consideration including the inability to monitor the barrier.

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

1. Critical Safety Function Status

   There is no Loss EAL associated with this item.

   These EALs serve as precursors to a loss of fuel clad. Heat Sink RED indicates the steam generator heat sink function is under extreme challenge and provides the potential for loss of the fuel clad. An Integrity RED path indicates an extreme challenge to the safety function and a potential loss of the RCS barrier.

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 is based on the inability to maintain normal liquid inventory within the reactor coolant system by the Chemical and Volume Control System (CVS). Where leakage is greater than available inventory control a loss of subcooling can occur.

3. Not Applicable

4. Steam Generator Tube Rupture (SGTR)

   A SGTR is based on the inability to maintain normal liquid inventory within the RCS by normal operation of the CVS system. The loss of the RCS barrier is based on leakage large enough to cause CMT/PRHR actuation.

   There is no Potential Loss EAL for this condition.

5. Containment Radiation Monitoring

   The reading of 100 rad/hr on PXS-JE-RE160, RE161, RE162 or RE163 is a value which indicates the release of reactor coolant to the containment. 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.

   There is no Potential Loss EAL associated with this item.

6. Not Applicable

7. Other (Site-Specific) Indications – Not Applicable

8. Emergency Director Judgment

   The Emergency Director can declare an Alert based on the judgment that conditions exist which indicate the Loss or Potential Loss of the RCS Barrier. This can take any other factors into consideration including the inability to monitor the barrier.

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

1. Critical Safety Function Status

   There is no Loss EAL associated with this item.

   A Containment 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.

2. Containment Pressure

A rapid unexplained loss of pressure following an initial pressure rise indicates a loss of containment integrity. Containment pressure should increase as a result of mass and energy release into the containment. In addition, containment pressure or sump level response not consistent with design basis accident conditions can also be an indicator of a Loss of containment integrity.

Existence of an explosive mixture of hydrogen means there is potential for damage to containment. This could cause a Potential Loss of the containment barrier. Containment pressure at 6.2 psig or greater indicates the pressure has reached the PCS actuation setpoint. Should the PCS system not actuate at this point, this condition would represent a Potential Loss of Containment. This represents a challenge to containment that requires operation of the containment isolation and pressure suppression systems.

3. Core Exit Thermocouples (CETs)

The Core Cooling RED path represents an imminent core melt sequence, which if not corrected, could lead to RPV failure and an increased potential for containment failure. It is appropriate to allow 15 minutes for functional restoration procedures to address the core melt sequence. Whether or not the procedures will be effective should be apparent in 15 minutes. In addition, if the CETs continue to be at or greater than 1200°F for 15 minutes after the ADS Valves have actuated, 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. If the Emergency Operating Procedures have been ineffective in restoring reactor vessel level above the RCS and Fuel Clad barriers, there is not a success path and a core melt sequence is in progress.

4. SG Secondary Side Release With Primary To Secondary Leakage

Steam generator tube leakage can represent the bypass of containment and the loss of the RCS barrier. This recognizes the non-isolable release path directly to the environment. The first Loss EAL addresses the condition in which a RUPTURED steam generator is also FAULTED.

The second loss EAL addresses SG tube leaks that exceed 10 gpm in conjunction with a non-isolable release path to the environment.

5. Containment Isolation Valve Status After Containment Isolation

The failure of the isolation of a containment penetration allows a direct path to the environment and represents failure of the Containment barrier. The Containment barrier must be considered breached if isolation fails.

6. Significant Radioactive Inventory In Containment

There is no Loss EAL associated with this item.

The 100 rad/hr 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. A major release of radioactivity requiring off-site 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%.

7. Other (Site-Specific) Indications – Not Applicable

8. Emergency Director Judgment

The Emergency Director can declare an Alert based on the judgment that conditions exist which indicate the Loss or Potential Loss of the Containment Barrier. This can take any other factors into consideration including the inability to monitor the barrier. The Containment Barrier should not be declared lost or potentially lost based on exceeding Technical Specification action statement criteria, unless there is an event in progress requiring mitigation by the Containment barrier. When no event is in progress (Loss or Potential Loss of either Fuel Clad and/or RCS) the Containment Barrier status is addressed by Technical Specifications.

TABLE 5-H-1

Recognition Category H

HAZARDS or OTHER Conditions Affecting Plant Safety

INITIATING CONDITION MATRIX

NOUE	ALERT	SITE AREA EMERGENCY	GENERAL EMERGENCY
HU1 Natural or Destructive Phenomena Affecting the PROTECTED AREA. *Op. Modes: All*	**HA1** Natural or Destructive Phenomena Affecting the Plant VITAL AREA. *Op. Modes: All*		
HU2 FIRE Within PROTECTED AREA Boundary Not Extinguished In Less Than 15 Minutes of Detection <u>OR</u> Explosion within the Protected Area Boundary *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, Corrosive, Asphyxiant, or Flammable Gases Deemed Detrimental to NORMAL PLANT OPERATIONS. *Op. Modes: All*	**HA3** Required Access To a VITAL AREA Is Prohibited Due To Release of Toxic, Corrosive, Asphyxiant or Flammable Gases *Op. Modes: All*		
HU4 Confirmed Security Event Which Indicates a Potential Degradation in the Level of Safety of the Plant. *Op. Modes: All*			**HG1** HOSTILE ACTION 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*	
	HA7 Notification of an Airborne Attack Threat *Op. Modes: All*	**HS4** Site Attack (Notification of HOSTILE ACTION within the Protected Area) *Op. Modes: All*	
	HA8 Notification of HOSTILE ACTION within the OCA *Op. Modes: All*		

HU1

Initiating Condition -- NOTIFICATION OF UNUSUAL EVENT

Natural or 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)

1. Seismic event identified by any **TWO** of the following:
   - Earthquake felt in plant.
   - Seismic event confirmed by [site-specific indication or method TBD].
   - National Earthquake Center.

2. Report by plant personnel of tornado or high wind gust greater than (TBD mph AP1000 JE-MES-TBD) {ESBWR – TBD} striking within PROTECTED AREA boundary.

3. Vehicle crash into plant systems required for safe shutdown of the plant, or structures containing those systems.
   - Containment Building
   - Shield Building (AP1000)
   - Aux Building (AP1000)
   - Reactor Building (ESBWR)
   - Control Building (ESBWR)
   - Electrical building (ESBWR)

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

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

Basis:

These EALs are categorized on the basis of the occurrence of an event of sufficient magnitude to be of concern to plant operators. [*Areas identified 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.*]

[*The AP1000 is designed for a safe shutdown earthquake (SSE) defined by a peak ground acceleration of 0.30g. Operating Basis Earthquake (OBE) is not considered in the design basis. For the purpose of shutdown criteria the operating basis earthquake is considered to be one-third of the safe shutdown earthquake. The seismic equipment is designed to remain functional after a SSE. The time-history analyzer receives input from the triaxial acceleration sensors. It provides for initiation of audible and visual alarms in the main Control Room. Alarms are initiated when a seismic event exceeds a predetermined value or the calculated cumulative absolute velocity (CAV).*]

[*The ESBWR peak ground acceleration (PGA) of the SSE at the foundation level is 0.3g in the horizontal direction. The PGA in the vertical direction is equal to the horizontal PGA. The Operating Basis Earthquake (OBE) is not an ESBWR design requirement. Consistent with the Appendix S to 10 CFR 50, the design requirements associated with the OBE, when the level of OBE ground motion is chosen to be one-third of the SSE ground motion, are satisfied without performing explicit response or design analyses. The ESBWR OBE ground motion is one-third of the SSE ground motion.*]

The National Earthquake Center can confirm or deny that an earthquake has occurred in the area of the plant.

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 should be based on site-specific FSAR design basis or the highest reading available for wind speed.*] If such damage is confirmed visually or by other in-plant indications, the event may be escalated to Alert.

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

EAL #4 addresses 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 projectiles generated by the failure. These events would be classified by the radiological ICs or Fission Product Barrier ICs.

EAL #5 is other site-specific phenomena [*such as hurricane, flood, or seiche*] that 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.).*]

AP1000 References:

APP-SJS-J7-001
APP-RCS-M3-001
APP-CNS-M3-001

ESBWR References:

DCD Tier 2 Table 3G.1-2, Rev. 3

HAZARDS OR OTHER CONDITIONS AFFECTING PLANT SAFETY

HU2

Initiating Condition -- NOTIFICATION OF UNUSUAL EVENT

FIRE Within the PROTECTED AREA Boundary Not Extinguished Within 15 Minutes of Detection OR EXPLOSION within the PROTECTED AREA Boundary.

Operating Mode Applicability: All

Example Emergency Action Level:

1. FIRE in any of the following areas not extinguished in less than 15 minutes of Control Room notification or receipt of a Control Room FIRE alarm:

   AP1000
   - Containment
   - Shield Building
   - Aux Building
   - Annex Building
   - Turbine Building
   - Radwaste Building

   ESBWR
   - Containment
   - Reactor Building
   - Fuel Building
   - Control Building
   - Turbine Building
   - Electrical Building
   - Radwaste Building

2. Report by plant personnel of an unanticipated EXPLOSION affecting systems required for safe shutdown of the plant, or structures containing those systems.

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. Validation 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 validated 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.*]

[*Only the protected area is considered. All safety-related structures, systems, and components are located on the nuclear island. The nuclear island includes the containment building, shield building, and auxiliary building. This site specific list is limited to buildings and areas contiguous to plant vital areas or other significant buildings or areas.*]

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*]. Fires inside the protected area, located near equipment, that last greater than 15 minutes can result in a challenge to the site fire brigade. This represents a degradation in plant operational status. [*Immediately adjacent implies that the area immediately adjacent contains or may contain equipment or cabling that could impact equipment located in the vital area or the fire could damage equipment inside the vital area or that precludes access to vital areas.*]

For EAL #2 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 is sufficient for declaration.*] The Emergency director also needs to consider any security aspects of the EXPLOSION, if applicable.

Escalation to a higher emergency class is by IC HA2, "FIRE Affecting the Operability of Plant Safety Systems Required for the Current Operating Mode".

AP1000 References:

FPS-M3-001
CNS-M3-001
Technical Specification 5.4

ESBWR References: [TBD]

DCD Tier 2 Chap 9, Sect. 9.5.1 Rev. 3, FPS – U43
DCD Tier 2 Chap. 16, Sect. 5.4.1

HU3

Initiating Condition – NOTIFICATION OF UNUSUAL EVENT

Release of Toxic, Corrosive, Asphyxiant, or Flammable Gases Deemed Detrimental to NORMAL PLANT OPERATIONS.

Operating Mode Applicability: All

Example Emergency Action Levels: (1 or 2)

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

2. Report by Local, County or State Officials for evacuation or sheltering of site personnel based on an off-site 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, corrosive, asphyxiant 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.*] The fact that SCBA may be worn does not eliminate the need to declare the event.

[*An Asphyxiant is a gas capable of reducing the level of oxygen in the body to dangerous levels. Most commonly, asphyxiants work by merely displacing air in an enclosed environment. This reduces the concentration of oxygen below the normal level of around 19%, which can lead to breathing difficulties, unconsciousness or even death.*]

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

AP1000 References: ESBWR References: [TBD]

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. A security event that does NOT constitute a HOSTILE ACTION as reported by the (site-specific) security shift supervision.

2. A credible site specific security threat notification.

3. A validated notification from NRC providing information of an aircraft threat.

Basis:

[*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 Safeguards Contingency Plan.*]

This EAL 1 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.*] Security events assessed as HOSTILE ACTIONS are classifiable under HA8, HS4 and HG1.

[*Consideration should be given to the following types of events which may not degrade the level of safety of the plant when evaluating an event against the criteria of the site specific Security Contingency Plan: CIVIL DISTURBANCE and STRIKE ACTION.*]

EAL 2 is to ensure that appropriate notifications for the security threat are made in a timely manner. This includes information of a credible threat. [*Only the plant to which the specific threat is made need declare the Notification of an Unusual Event.*]

EAL 3 is to ensure that notifications for the security threat are made in a timely manner and that Off-site Response Organizations and plant personnel are at a state of heightened awareness regarding the credible threat. [*Only the plant to which the specific threat is made need declare the Notification of Unusual Event. This EAL is met when a plant receives information regarding an aircraft threat from NRC. Validation is performed by calling the NRC or by other approved methods of authentication. Should the threat involve an airliner (airliner is meant to be a large aircraft with the potential for causing significant damage to the plant) then escalation to Alert via HA7 would be appropriate if the airliner is less than 30 minutes away from the plant .The NRC Headquarters Operations Officer (HOO) will communicate to the licensee if the threat involves an airliner. The status of the plane may be provided by NORAD through the NRC. It is not the intent of this EAL to replace existing non-hostile related EALs involving aircraft.*]

[The determination of "credible" is made through use of information found in the (site-specific) Safeguards Contingency Plan.]

A higher initial classification could be made based upon the nature and timing of the threat and potential consequences. *[The licensee shall consider upgrading the emergency response status and emergency classification in accordance with the [site security specific] Safeguards Contingency Plan and Emergency Plans.]*

AP1000 References:

ESBWR References: [TBD]

HAZARDS OR 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 or indicate a security threat to facility protection has been initiated. No releases of radioactive material requiring off-site response or monitoring are expected unless further degradation of safety systems occurs.

Basis:

This EAL addresses 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.*]

AP1000 References:

ESBWR References: [TBD]

HA1

Initiating Condition -- ALERT

Natural or 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. Seismic event greater than Operating Basis Earthquake (OBE) {AP1000 - 0.10g} as indicated by the time history analyzer initiation of the Control Room alarm. {ESBWR – 0.10g} as indicated by seismic instrumentation {site-specific OBE limit}.

   AND

   Confirmed by **EITHER**:
   - Earthquake felt in plant
   - National Earthquake Center

2. Tornado or high winds greater than (maximum wind speed readable in the MCR) {AP1000 – TBD} {ESBWR – TBD} mph within PROTECTED AREA boundary resulting in VISIBLE DAMAGE to any safety structure, system, or component in the following plant structures / equipment or Control Room indication of degraded performance of those systems.

AP1000
- Containment Building
- Shield Building
- Aux Building

ESBWR
- Containment Building
- Reactor Building
- Control Building
- Electrical Building

3. Vehicle crash within PROTECTED AREA boundary and resulting in VISIBLE DAMAGE to any safety structure, system, or component in the following plant structures or Control Room indication of degraded performance of those safety systems:

AP1000
- Containment
- Shield Building
- Aux Building

ESBWR
- Containment
- Reactor building
- Fuel Building
- Control Building
- Turbine Building

- Electrical Building
- Radwaste Building

4. (ESBWR) Turbine failure-generated projectiles result in any VISIBLE DAMAGE to or penetration of the Electrical Building.

   (AP1000) Not applicable

5. Uncontrolled flooding in areas of the plant that creates an 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:

These EALs escalate from 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 System Malfunctions.

[*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, and 4 should specify site-specific safety structure, system, or component and functions required for safe shutdown of the plant.*]

[*EAL #3 addresses crashes of vehicle types large enough to cause significant damage to safety structure, system, or component containing functions and systems required for safe shutdown of the plant.*]

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

EAL #5 addresses the effect of internal flooding that has created industrial safety hazards (e.g., electrical shock) that preclude necessary access to operate or monitor safety equipment.

EAL #6 is other site-specific phenomena [*such as hurricane, flood, or seiche*] that 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.).*]

AP1000 References:	ESBWR References: [TBD]
APP-SJS-J7-001	DCD Tier 2 Chapter 3, Sect. 3.7, Rev. 3
APP-RCS-M3-001	DCD Tier 2 3.7.1.1, Rev. 3
APP-CNS-M3-001	DCD Tier 2 Table 3G.1-2, Rev. 3

Initiating Condition -- ALERT

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

Operating Mode Applicability: All

Example Emergency Action Level:

1. FIRE or EXPLOSION in any of the following areas:

AP1000
- Containment
- Shield Building
- Aux Building

ESBWR
- Containment
- Reactor building
- Fuel Building
- Control Building
- Turbine Building
- Electrical Building
- Radwaste Building

AND

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

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.*]

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.*]

[*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.

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.

AP1000 References:

APP-RCS-M3-001
APP-CNS-M3-001
APP-FPS-M3-001
APP-GW-GJP-305

ESBWR References: [TBD]

DCD Tier 2 Chapter 9, Section 9.5.1, Rev. 3

HA3

Initiating Condition -- ALERT

Required Access to a VITAL AREA Is Prohibited Due To Release of Toxic, Corrosive, Asphyxiant or Flammable Gases.

Operating Mode Applicability: All

Example Emergency Action Levels:

1. Required access to a VITAL AREA is prohibited due to report or detection of toxic, corrosive, asphyxiant or flammable gases.

Basis:

This IC addresses gas releases 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.

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.

The fact that SCBA may be worn does not eliminate the need to declare the event

An Asphyxiant is a gas capable of reducing the level of oxygen in the body to dangerous levels. Most commonly, asphyxiants work by merely displacing air in an enclosed environment. This reduces the concentration of oxygen below the normal level of around 19%, which can lead to breathing difficulties, unconsciousness or even death.

[*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.

AP1000 References: ESBWR References: [TBD]

HAZARDS OR OTHER CONDITIONS AFFECTING PLANT SAFETY

HA5

Initiating Condition -- ALERT

Control Room Evacuation Has Been Initiated.

Operating Mode Applicability: All

Example Emergency Action Level:

AP1000

1. Entry into GW-GJP-306, Evacuation of Control Room.

ESBWR

1. Entry into Abnormal Operating Procedure (TBD) Forced 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.

AP1000 References:

APP-GW-GJP-306

ESBWR References: AOP-TBD

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 potential substantial degradation of the level of safety of the plant or a security event that involves probable life threatening risk to site personnel or damage to site equipment because of HOSTILE ACTION. Any releases are expected to be limited to small fractions of the EPA Protective Action Guideline exposure levels.

Basis:

This EAL addresses 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.

AP1000 References: ESBWR References: [TBD]

HAZARDS OR OTHER CONDITIONS AFFECTING PLANT SAFETY

HA7

Initiating Condition -- ALERT

Notification of an Airborne Attack Threat.

Operating Mode Applicability: All

Example Emergency Action Level:

1. A validated notification from NRC of an airliner attack threat less than 30 minutes away.

Basis:

The intent of this EAL is to ensure that notifications for the airliner attack threat are made in a timely manner and that Off-site Response Organizations and plant personnel are at a state of heightened awareness regarding the credible threat. Validation is performed by calling the NRC or by other approved methods of authentication. [*Only the plant to which the specific threat is made need declare the Alert.*] This EAL is met when a plant receives information regarding an airliner attack threat from NRC and the airliner is less than 30 minutes away from the plant.

This EAL addresses the contingency of a very rapid progression of events due to an airborne hostile attack such as that experienced on September 11, 2001. This EAL is not premised solely on the potential for a radiological release. Rather the issue includes the need for assistance due to the possibility for significant and indeterminate damage from such an attack. Validation is confirmed by a call from or to the NRC. [*Although vulnerability analyses show nuclear plants to be robust, it is appropriate for Off-site Response Organizations to be notified and encouraged to activate (if they do not normally) to be better prepared should it be necessary to consider further actions. Airliner is meant to be a large aircraft with the potential for causing significant damage to the plant. The status and size of the plane may be provided by NORAD through the NRC.*]

AP1000 References:

ESBWR References: [TBD]

HAZARDS OR OTHER CONDITIONS AFFECTING PLANT SAFETY

HA8

Initiating Condition -- ALERT

Notification of HOSTILE ACTION within the OCA

Operating Mode Applicability: All

Example Emergency Action Level:

1. A notification from the site security force that a HOSTILE ACTION is occurring or has occurred within the OCA.

Basis:

This EAL addresses the potential for a very rapid progression of events due to a HOSTILE ACTION.

[*This EAL is not intended to address incidents that are accidental or acts of civil disobedience, such as hunters or physical disputes between employees within the OCA or PA. That initiating condition is adequately addressed by other EALs.*]

This EAL addresses the contingency for a very rapid progression of events due to an airborne hostile attack such as that experienced on September 11, 2001 and the possibility for additional attacking aircraft. It is not intended to address accidental aircraft impact as that initiating condition is adequately addressed by other EALs. This EAL is not premised solely on the potential for a radiological release. Rather the issue includes the need for assistance due to the possibility for significant and indeterminate damage from additional air, land or water attack elements. [*Although vulnerability analyses show nuclear plants to be robust, it is appropriate for Off-site Response Organizations to be notified and to activate in order to be better prepared to respond should protective actions become necessary. If not previously notified by NRC that the aircraft impact was intentional, then it would be expected, although not certain, that notification by an appropriate Federal agency would follow. In this case, appropriate federal agency is intended to be NORAD, FBI, FAA or NRC. However, the declaration should not be unduly delayed awaiting Federal notification. Airliner is meant to be a large aircraft with the potential for causing significant damage to the plant. The status and size of the plane may be provided by NORAD through the NRC.*]

This IC/EAL addresses the immediacy of an expected threat arrival or impact on the site within a relatively short time. The fact that the site is an identified attack target with minimal time available for further preparation requires a heightened state of readiness and implementation of protective measures that can be effective (on-site evacuation, dispersal or sheltering) before arrival or impact.

This EAL is not premised solely on adverse health effects caused by a radiological release. Rather the issue is the immediate need for assistance due to the nature of the event and the potential for significant and indeterminate damage. [*Although nuclear plant security officers are well trained and prepared to protect against HOSTILE ACTION, it is appropriate for Off-site Response Organizations to be notified and encouraged to begin activation (if they do not normally) to be better prepared should it be necessary to consider further actions.*]

AP1000 References:

ESBWR References: [TBD]

HAZARDS OR 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:

AP1000

1. Control room evacuation has been initiated.

   AND

   Control of the plant cannot be established per [procedure TBD] in less than [TBD] minutes.

ESBWR

1. Control room evacuation has been initiated.

   AND

   Control of the plant cannot be established per [procedure TBD] in less than [TBD] 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 [TBD] 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. 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 ESBWR. The equivalent functions for AP1000 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.

AP1000 References:

APP-GW-GJP-306

ESBWR References: [TBD]

HAZARDS OR OTHER CONDITIONS AFFECTING PLANT SAFETY

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 or HOSTILE ACTION that results in intentional damage or malicious acts; (1) toward site personnel or equipment that could lead to the likely failure of or; (2) that prevent effective access to equipment needed for the 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 addresses 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.

AP1000 References: ESBWR References: [TBD]

Initiating Condition – - SITE AREA EMERGENCY

Site Attack (Notification of HOSTILE ACTION within the Protected Area)

Operating Mode Applicability: All

Example Emergency Action Level:

1. A notification from the site security force that a HOSTILE ACTION is occurring or has occurred within the PROTECTED AREA.

Basis:

This condition represents an escalated threat to plant safety above that contained in the Alert IC in that a HOSTILE FORCE has progressed from the Owner Controlled Area to the PROTECTED AREA.

[*Although nuclear plant security officers are well trained and prepared to protect against HOSTILE ACTION, it is appropriate for Off-site Response Organizations to be notified and encouraged to begin preparations for public protective actions (if they do not normally) to be better prepared should it be necessary to consider further actions.*]

This EAL addresses the potential for a very rapid progression of events due to a dedicated attack. It is not intended to address incidents that are accidental or acts of civil disobedience [*, such as hunters or physical disputes between employees within the OCA or PA*]. [*That initiating condition is adequately addressed by other EALs.*]

This EAL addresses the contingency for a very rapid progression of events due to an airborne hostile attack such as that experienced on September 11, 2001 and the possibility for additional attacking aircraft. It is not intended to address accidental aircraft impact as that initiating condition is adequately addressed by other EALs. This EAL is not premised solely on the potential for a radiological release. Rather the issue includes the need for assistance due to the possibility for significant and indeterminate damage from additional attack elements. [*Although vulnerability analyses show nuclear plants to be robust, it is appropriate for Off-site Response Organizations to be notified and to activate in order to be better prepared to respond should protective actions become necessary. If not previously notified by NRC that the aircraft impact was intentional, then it would be expected, although not certain, that notification by an appropriate Federal agency would follow. In this case, appropriate federal agency is intended to be NORAD, FBI, FAA or NRC. However, the declaration should not be unduly delayed awaiting Federal notification. Airliner is meant to be a large aircraft with the potential for causing significant damage to the plant. The status and size of the plane may be provided by NORAD through the NRC.*]

This EAL addresses the immediacy of a threat to impact site VITAL AREAS within a relatively short time. The fact that the site is under serious attack with minimal time available for additional assistance to arrive requires ORO readiness and preparation for the implementation of protective measures.

Licensees should consider upgrading the classification to a General Emergency based on actual plant status after impact or progression of attack.

AP1000 References:

ESBWR References: [TBD]

HG1

Initiating Condition – GENERAL EMERGENCY

HOSTILE ACTION Resulting in Loss of Physical Control of the Facility.

Operating Mode Applicability: All

Example Emergency Action Level: (1 or 2)

1. A HOSTILE ACTION has occurred such that plant personnel are unable to operate equipment required to maintain safety functions.

2. A HOSTILE ACTION has caused failure of Spent Fuel Cooling Systems and IMMINENT fuel damage is likely for a freshly off-loaded reactor core in pool.

Basis:

This IC encompasses conditions under which a HOSTILE ACTION has resulted in a loss of 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.

[*The ESBWR fuel pool cooling function is also provided in the event that a recently unloaded fuel batch requires continued cooling during the post-accident period. The spent fuel pool contains sufficient inventory to ensure no operator action is required during the first 72 hours. After that period, either makeup water must be supplied to the spent fuel pool or the FAPCS must be initiated. The FAPCS equipment is environmentally qualified, so access is not required and redundancy is included in system components.*]

This EAL also addresses failure of spent fuel cooling systems as a result of HOSTILE ACTION if IMMINENT fuel damage is likely[*(e.g., freshly off-loaded reactor core in pool). "Freshly" is defined by site-specific requirements.*]

[*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. 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.*]

AP1000 References: ESBWR References: [TBD]

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 or HOSTILE ACTION that results in an actual loss of physical control of the facility. Releases can be reasonably expected to exceed EPA Protective Action Guideline exposure levels off-site for more than the immediate site area.

Basis:

This EAL addresses 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.

AP1000 References:

ESBWR References: [TBD]

TABLE 5-S-1

Recognition Category S

System Malfunction

INITIATING CONDITION MATRIX

NOUE	ALERT	SITE AREA EMERGENCY	GENERAL EMERGENCY
SU1 Loss of All Off-site AC Power for Greater Than 30 Minutes. *Op. Modes: Power Operation, Startup, Hot Standby, Safe/Stable Shutdown*	**SA1** Loss of all Off-site and On-site AC power capability for greater than 60 minutes *Op. Modes: Power Operation, Startup, Hot Standby, Safe/Stable Shutdown*	**SS1** Loss of All Off-site and On-site AC Power for greater than 24 hours *Op. Modes: Power Operation, Startup, Hot Standby, Safe/Stable Shutdown*	**SG1** Prolonged Loss of All Off-site and On-site AC Power for greater than 72 hours. *Op. Modes: Power Operation, Startup, Hot Standby, Safe/Stable Shutdown*
SU9 Failure of the Reactor Protection System, Automatic OR Manual and Subcriticality Was Achieved. *Op Modes: Power Operation, Startup*	**SA2** Failure of Reactor Protection System, Automatic OR Manual to establish the reactor subcritical. *Op. Modes: Power Operation, Startup*	**SS2** Failure of Reactor Protection System, Automatic AND Manual to reduce power below Safety System Design Limit *Op. Modes: Power Operation, Startup*	**SG2** Failure of the Reactor Protection System, Automatic AND Manual and Indication of an Extreme Challenge to the Ability to Cool the Core. *Op. Modes: Power Operation, Startup*
SU2 Inability to Reach Required Shutdown Mode Within Technical Specification Limits. *Op. Modes: Power Operation, Startup, Hot Standby, Safe/Stable Shutdown*			
	SA4 UNPLANNED Loss of Indicating and Monitoring Functions *Op. Modes: Power Operation, Startup, Hot Standby, Safe/Stable Shutdown*	**SS6** Inability to Monitor a SIGNIFICANT TRANSIENT in Progress. *Op. Modes: Power Operation, Startup, Hot Standby, Safe/Stable Shutdown*	

Recognition Category S

System Malfunction

INITIATING CONDITION MATRIX

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

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

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

SU6 UNPLANNED Loss of All On-site OR Off-site Communications Capabilities.
Op. Modes: Power Operation, Startup, Hot Standby, Safe/Stable Shutdown

SU8 Inadvertent Criticality.
Op Modes: Hot Standby, Safe/Stable Shutdown

SU1

Initiating Condition -- **NOTIFICATION OF UNUSUAL EVENT**

Loss of All Off-site AC Power for Greater Than 30 Minutes.

Operating Mode Applicability:

Power Operation
Startup
Hot Standby
Safe/Stable Shutdown

Example Emergency Action Level:

AP1000

1. Loss of off-site AC power to Busses ECS-ES-1 and ECS-ES-2 for greater than 30 minutes.

   AND

   Any On-site Standby Diesel Generator supplying on-site AC power to EITHER Bus ECS-ES-1 OR Bus ECS-ES-2.

ESBWR

1. Loss of all off-site AC power for greater than 30 minutes.

   AND

   Any Diesel generator supplying power to EITHER of the following PIP busses.
   - 1000A3(B3)
   - 2000A3(B3)

Basis:

A loss of off-site 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 all AC Power [*e.g., Station Blackout*]. 30 minutes was selected as a threshold to exclude transient or momentary losses of off-site power.

[*The Passive ALWRs do not need/have safety-related standby diesel generators. Storage batteries are the standby power source for Class 1E electric power.*]

AP1000 References:

APP-ECS-E8-001
APP-ZOS-E8-001
Technical Specification 3.8

ESBWR References: [TBD]

DCD Tier 2 Chapter 8, Sect. 8.1.5.1 Rev 3
DCD Tier 2 Chapter 8, Sect. 8.1.5.2 Rev. 3
DCD Tier 2 Chapter 16, Sect. 3.8 Rev. 3

SU2

Initiating Condition -- **NOTIFICATION OF UNUSUAL EVENT**

Inability to Reach Required Shutdown Mode Within Technical Specification Limits.

Operating Mode Applicability:

Power Operation
Startup
Hot Standby
Safe/Stable Shutdown

Example Emergency Action Level:

1. Plant is not brought to required operating mode within 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 four 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.*]

AP1000 Reference:

Technical Specification 3.0.3

ESBWR References: [TBD]

Initiating Condition -- **NOTIFICATION OF UNUSUAL EVENT**

Fuel Clad Degradation.

Operating Mode Applicability: Power Operation
Startup
Hot Standby

Example Emergency Action Levels: (1 or 2)

AP1000

1. Liquid Sample Radiation Monitor PSS-RICA-050 High Alarm Setpoint [TBD] µCi/cc indicating fuel clad degradation greater than Technical Specification 3.4.10 allowable limits.

OR

2. Dose equivalent I-131 greater than 60 µCi/gm OR dose equivalent Xe-133 greater than 280 µCi/gm for more than 6 hours from sampling and analysis.

ESBWR

1. (TBD) radiation monitor readings indicating fuel clad degradation greater than Technical Specification 3.4.3 allowable limits.

2. (TBD) coolant sample activity value indicating fuel clad degradation greater than Technical Specification 3.4.3 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.

[AP1000 - PSS-RICA-050, provides early indication of significant increase in radioactivity of the reactor coolant, indicating a possible fuel cladding breach. On high alarm, the primary sampling system liquid sample radiation monitor isolates the sample flow by closing the outside containment isolation valve (PSS-PL-V011) and initiates an alarm in the main Control Room and locally to alert the operator. At that time, sampling and analysis would be performed to verify compliance with the Technical Specification 3.4.10 RCS Specific Activity limits.

Technical Specification 3.4.10 limits the allowable concentration of iodines and noble gases, such as xenon, in the reactor coolant. Limiting Condition for Operation (LCO) limits are established to be consistent with fuel defect level of 0.25 percent and to ensure that plant operation remains within conditions assumed for shielding and DBA release analyses.

Technical Specification Surveillance Requirement (SR) 3.4.10.1 requires performing a measure of the noble gas specific activity of the reactor coolant once every 7 days, which provides an indication of any increase in *the release of noble gas activity from fuel rods containing cladding defects. SR 3.4.10.2 requires performing a measure of the iodine specific activity of the reactor coolant once every 14 days, and between 2 to 6 hours after a reactor power increase of greater than or equal to 15% of Rated Thermal Power within a 1 hour period. Trending the results of these surveillances allows proper remedial action to be taken PRIOR to reaching the LCO upper limits under normal operating conditions.*]

AP1000 References:

APP-PSS-M3C-101
Tech Spec 3.4.10

ESBWR References: [TBD]

NEDO-33319
DCD Tier 2, Chapter 16, Sect. 3.4.3 Rev. 3

SU5

Initiating Condition -- **NOTIFICATION OF UNUSUAL EVENT**

RCS Leakage.

Operating Mode Applicability:	Power Operation Startup Hot Standby Safe/Stable Shutdown
Example Emergency Action Levels:	(1 or 2)

AP1000

1. Unidentified leakage greater than 5 gpm.

2. Identified leakage greater than 25 gpm.

ESBWR

1. Unidentified or pressure boundary leakage greater than 50 gpm.

2. Total leakage greater than 75 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 value for the unidentified leakage (including the pressure boundary) was selected as it is observable with normal Control Room indications and is 10 times the Technical Specification limit. Lesser values must generally be determined through time-consuming surveillance tests (e.g., mass balances).

Relief valve normal operation should be excluded from this IC. However, a relief valve that operates and fails to close per design should be considered applicable to this IC if the relief valve cannot be isolated.

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 and is 2.5 times the Technical Specification limit. In either case, escalation of this IC to the Alert level is via Fission Product Barrier Degradation ICs.

AP1000 References:

Technical Specification 3.4.7

ESBWR References: [TBD]

SU6

Initiating Condition -- **NOTIFICATION OF UNUSUAL EVENT**

UNPLANNED Loss of All On-site or Off-site Communications Capabilities.

Operating Mode Applicability: Power Operation
Startup
Hot Standby
Safe/Stable Shutdown

Example Emergency Action Levels: (1 or 2)

1. Loss of all on-site communications capability affecting the ability to perform routine operations.

AP1000
- EFS
- TVS
- (Site specific)

ESBWR
- Plant Page/Party Line
- PABX
- Sound Powered Phones
- Plant Radios
- (Site specific)

2. Loss of all (site-specific) off-site 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 off-site authorities. The loss of off-site 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 off-site communications is sufficient to inform state and local authorities of plant conditions. [*This EAL is to be used only when extraordinary means (e.g., relaying of information from radio transmissions, individuals being sent to off-site locations, etc.) are being utilized to make communications possible.*] EFS and TVS are comprised of the following:
- Wireless Telephone System
- Telephone-Page System
- Sound Powered System
- Security Communication System
- Closed Circuit Television System

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

AP1000 References:

APP-EFS-J7-001
APP-TVS-J7-001

ESBWR References: [TBD]

SU8

Initiating Condition -- **NOTIFICATION OF UNUSUAL EVENT**

Inadvertent Criticality.

OPERATING MODE APPLICABILITY — Hot Standby; Safe/Stable Shutdown

Example Emergency Action Level:

AP1000
1. An UNPLANNED sustained positive startup rate.

ESBWR
1. An UNPLANNED SRNM Short Period Alarm.

Basis:

This IC addresses inadvertent criticality 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). The Cold Shutdown/Refueling IC is CU8*].

[*This condition can be identified using period monitors/startup rate monitor. The term "sustained" 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. 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.

AP1000 References:

APP-PMS-J1-003

ESBWR References: [TBD]

SU9

Initiating Condition – NOTIFICATION OF UNUSUAL EVENT

Failure of the Reactor Protection System, Automatic OR Manual and Subcriticality Was Achieved.

Operating Mode Applicability: Power Operation
Startup

Example Emergency Action Level: (1 or 2)

AP1000

1. An Automatic PMS Trip setpoint was exceeded and an automatic trip was not successful and a successful manual trip from the Control Room control panels resulted in the reactor being subcritical below Intermediate Range 1.0E-8 amps on channels RXS-NE-002A, -002B, -002C, and -002D.

2. Manual PMS Trip was actuated and a trip was not successful and either an Automatic PMS Trip OR DAS or PLS manual actions from the Control Room control panels resulted in the reactor being subcritical below Intermediate Range 1.0E-8 amps on channels RXS-NE-002A, -002B, -002C, and -002D.

ESBWR

1. An Automatic Reactor Protection System setpoint was exceeded and an automatic scram was not successful and a successful manual scram via Manual Scram Pushbuttons, Mode Switch in Shutdown, or ARI resulted in the reactor being subcritical below [0.25% power].

2. Manual Scram Pushbuttons and Mode Switch in Shutdown were actuated and a scram was not successful and either an Automatic scram OR ARI from the Control Room control panels resulted in the reactor being subcritical below [0.25% power].

Basis:

This condition indicates failure of the Reactor Protection System (either automatic or manual) to initiate a reactor trip/scram; however the reactor was able to be successfully shutdown utilizing other portions of the Reactor Protection System (automatic or manual) or other means from the reactor control panels in a timely manner. [*An NOUE is warranted as this condition is a potential degradation of a safety system in that a portion of the front line protection system did not function in response to a plant transient or initial operator action and thus the plant safety may have been compromised.*]

Failure of the Manual portion of the Reactor Protection System addresses a failure of all applicable manual reactor trip pushbuttons/switches from the Control Room control panels.

A manual trip/scram is any set of actions by the reactor operator(s) at the Control Room control panels which causes control rods to be rapidly inserted into the core and brings the reactor subcritical [*e.g., reactor trip button, Alternate Rod Insertion*].

This condition indicates alternative actions functioned to reduce power to below the point of adding heat (POAH).

Failure the Reactor Protection System and the inability by other means from the Control Room control panels to complete a reactor scram/trip would escalate the event to an Alert or Site Area Emergency based on reactor power levels.

AP1000 References:

ESBWR References: [TBD]

APP-PMS-J7-001
APP-DAS-J7-001
APP-PLS-J7-001
APP-RCS-M3-001
Technical Specification 3.3.1

SA1

Initiating Condition -- **ALERT**

Loss Of All Off-site And On-site AC Power Capability to PIP Busses For Greater Than 60 Minutes.

Operating Mode Applicability:

Power Operation
Startup
Hot Standby
Safe/Stable Shutdown

Example Emergency Action Level:

AP1000

1. Loss of all AC power capability to Busses ECS-ES-1 and ECS-ES-2 busses for greater than 60 minutes.

ESBWR

1. Loss of all AC power capability to PIP busses 1000A3, 2000A3, 1000B3, AND 2000B3 busses for greater than 60 minutes.

Basis:

This IC and the associated EALs are intended to provide an escalation from IC SU1. The condition indicated by this IC is the degradation of the off-site and on-site power systems. Loss of all AC power compromises all plant systems requiring AC power.

[*There are no safety-related functions with respect to Off-site or On-site AC power in the AP1000 plant design that are required for the protection of any of the fission product barriers. All electrical power requirements that are necessary to protect the health and safety of the public and the fission product barriers are part of the DC power system design which is completely independent of the off-site or on-site AC power systems.*]

AP1000 References:

APP-ECS-E8-001
APP-EDS-E8-001
APP-IDS-E8-001
Tech Spec 3.8

ESBWR References: [TBD]

SYSTEM MALFUNCTION

SA2

Initiating Condition -- **ALERT**

Failure of the Reactor Protection System, Automatic AND Manual to Establish The Reactor Subcritical.

Operating Mode Applicability: Power Operation
Startup

Example Emergency Action Level: (1 or 2)(AP1000)

AP1000

1. An Automatic PMS Trip setpoint was exceeded

   AND

   The reactor is critical with reactor power greater than Intermediate Range Nuclear Instrumentation 1.0E-8 amps.

2. A Manual PMS, PLS or DAS reactor trip was initiated from the control room control panels.

   AND

   The reactor is critical with reactor power greater than Intermediate Range Nuclear Instrumentation 1.0E-8 amps.

ESBWR

1. An Automatic Reactor Protection System setpoint was exceeded AND a Manual reactor scram was initiated.

   AND

   The reactor is critical with reactor power greater than [0.25% power].

Basis:

This condition indicates failure of the Reactor Protection System to reduce power to below the point of adding heat (POAH). This condition is more than a potential degradation of a safety system in that a front line protection system did not function in response to a plant transient or initial operator action and thus the plant safety has been compromised. An Alert is indicated because conditions exist that may lead to potential loss of fuel clad or RCS.

A manual scram/trip is any set of actions by the reactor operator(s) at the Control Room control panels which causes control rods to be rapidly inserted into the core and brings the reactor subcritical (e.g., reactor trip/scram button, Mode Switch in Shutdown, Alternate Rod Insertion).

Failure of the Reactor Protection System to scram/trip the reactor with power greater than the Safety System Design Limit would escalate the event to a Site Area Emergency.

AP1000 References: APP-PMS-J7-001
APP-DAS-J7-001

APP-PLS-J7-001
APP-RCS-M3-001
Technical Specification 3.3.1

ESBWR References: [TBD]

SA4

Initiating Condition -- ALERT

UNPLANNED Loss of Indicating and Monitoring Functions.

Operating Mode Applicability:	Power Operation Startup Hot Standby Safe/Stable Shutdown

Example Emergency Action Level:

AP1000

1. UNPLANNED Loss of All PLS and PMS Indicating and Monitoring Functions.

ESBWR

1. UNPLANNED Loss of any three Q-DCIS Indicating and Monitoring Functions.

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 control and indication systems during a transient.

[*The Protection and Safety Monitoring System (PMS) provides the functions necessary to protect the plant during normal operations, to shutdown the plant, and to maintain the plant in a safe shutdown condition. The Plant Control System (PLS) includes the control functions that provide for the control of the nuclear process, conversion of nuclear energy into heat energy, and transport of the heat energy from the nuclear reactor to the main steam turbine.*]

[ESBWR TBD]

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

AP1000 References:

APP-PMS-J7-001
APP-DAS-J7-001
APP-PLS-J7-001
APP-DDS-J7-001

ESBWR References: [TBD]

Initiating Condition -- SITE AREA EMERGENCY

Loss of All Off-site AND On-site AC Power for Greater Than 24 Hours.

Operating Mode Applicability:

Power Operation
Startup
Hot Standby
Safe/Stable Shutdown

Example Emergency Action Level:

AP1000

1. Loss of AC power capability to Busses ECS-ES-1 and ECS-ES-2 busses for greater than 24 hours.

ESBWR

1. Loss of AC power capability to 1000A3(B3) AND 2000A3(B3) busses for greater than 24 hours.

Basis:

Loss of all AC power compromises all plant systems requiring AC electric power.

[*There are no safety-related functions with respect to Off-site or On-site AC power in the Passive ALWR plant designs that are required for the protection of any of the fission product barriers. All electrical power requirements that are necessary to protect the health and safety of the public and the fission product barriers are part of the DC power system design which is completely independent of the off-site or on-site AC power systems.*]

Escalation to General Emergency is via Fission Product Barrier Degradation or IC SG1, "Prolonged Loss of All Off-site and On-site AC Power for greater than 72 hours."

AP1000 References:

APP-ECS-E8-001
APP-EDS-E8-001
APP-IDS-E8-001
Tech Spec 3.8

ESBWR References: [TBD]

Initiating Condition -- **SITE AREA EMERGENCY**

Failure of Reactor Protection System, Automatic OR Manual to Reduce Power Below Safety System Design Limit.

Operating Mode Applicability: Power Operation
Startup

Example Emergency Action Level:

AP1000

1. a. An Automatic PMS Trip setpoint was exceeded

OR

b. A Manual PMS, PLS or DAS reactor trip was initiated from the control room control panels..

AND

Reactor power is greater than {Safety System Design Limit} [8%] power.

ESBWR

1. a. An Automatic Reactor Protection System setpoint was exceeded

OR

b. A Manual reactor trip was initiated.

AND

Reactor power is greater than {Safety System Design Limit} [6%] power.

Basis:

A manual trip/scram initiation is not considered successful if action away from the Control Room control panels was required to trip/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 [*typically 3 to 8% power*]. 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.*]

A manual trip/scram is any set of actions by the reactor operator(s) at the Control Room control panels which causes control rods to be rapidly inserted into the core and brings the reactor subcritical[*(e.g., reactor trip button, Alternate Rod Insertion)*].

Escalation of this event to a General Emergency would be due to a prolonged condition leading to challenges in maintaining core-cooling or heat sink.

AP1000 References:

APP-PMS-J7-001
APP-DAS-J7-001

ESBWR References: [TBD]

Initiating Condition -- **SITE AREA EMERGENCY**

Loss of All Vital DC Power.

Operating Mode Applicability:	Power Operation Startup Hot Standby Safe/Stable Shutdown

Example Emergency Action Level:

AP1000

1. Loss of all of the following IE DC Busses based on bus voltage less than {TBD} for greater than 15 minutes.

IDSA-EA-1	IDSC-EA-1
IDSA-EA-2	IDSC-EA-2
IDSB-EA-1	IDSC-EA-3
IDSB-EA-2	IDSD-EA-1
IDSB-EA-3	IDSD-EA-2

ESBWR

1. Loss of All Vital DC Busses 11, 12, 21, 22, 31, 32, 41, and 42 based on bus voltage less than 210V 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. Fifteen minutes for the initiating condition was selected as a threshold to exclude transient or momentary power losses.

[*(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.*]

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.

AP1000 References:

APP-ECS-E8-001
APP-EDS-E8-001
APP-IDS-E8-001
Tech Spec 3.8

ESBWR References: [TBD]

Initiating Condition -- **SITE AREA EMERGENCY**

Inability to Monitor a SIGNIFICANT TRANSIENT in Progress.

Operating Mode Applicability: Power Operation
Startup
Hot Standby
Safe/Stable Shutdown

Example Emergency Action Level:

AP1000

1. Loss of all PLS, PMS and DAS Indication and Monitoring capability

   AND

   A SIGNIFICANT TRANSIENT in progress.

ESBWR

1. UNPLANNED Loss of all Q-DCIS Indicating and Monitoring Functions

   AND

   A 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.

AP1000 References:

APP-PMS-J7-001
APP-DAS-J7-001
APP-PLS-J7-001
APP-DDS-J7-001

ESBWR References: [TBD]

Initiating Condition -- **GENERAL EMERGENCY**

Prolonged Loss Of All Off-site And On-site AC Power For Greater Than 72 Hours.

Operating Mode Applicability: Power Operation
Startup
Hot Standby
Safe/Stable Shutdown

Example Emergency Action Level:

AP1000

1. Loss of AC power capability to PIP busses ECS-ES-1 and ECS-ES-2 busses for greater than 72 hours.

ESBWR

1. Loss of AC power capability to PIP busses 1000A3, 2000A3, 1000B3, AND 2000B3 busses for greater than 72 hours.

Basis:

[*There are no safety-related functions with respect to off-site or on-site AC power in the Passive ALWRs plant design that are required for the protection of any of the fission product barriers. However, a Loss of all AC power compromises the ability to charge the IE batteries and the ability to recover from an accident condition. Prolonged loss of all AC power and other failures could lead to loss of fuel clad, RCS, and containment. The 72 hours to restore AC power is based on Technical Specification Bases B 3.8. Appropriate allowance for off-site 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.*]

If all off-site and on-site plant AC Power has been lost for greater than 72 hours, then power for maintaining the reactor shutdown and safe is being supplied by gravity and natural circulation. This increases the risk for a reduction of the fission product barrier protection for the plant to being dependent on the non-safety related ancillary diesels to ensure safety, creating a potential threat to all three fission product barriers. As the batteries would be beyond their design capability, operators would also be dependent upon indications powered by the ancillary diesels for monitoring plant status and functions.

[ESBWR equivalent – TBD]

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 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 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?

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.

AP1000 References:

APP-ECS-E8-001
APP-EDS-E8-001
APP-IDS-E8-001
Tech Spec 3.8
Tech Spec Basis B 3.8.1

ESBWR References: [TBD]

SG2

Initiating Condition -- **GENERAL EMERGENCY**

Failure of the Reactor Protection System, Automatic AND Manual and Indication of an Extreme Challenge to the Ability to Cool the Core.

Operating Mode Applicability: Power Operation, Startup

Example Emergency Action Level:

AP1000

1. Failure of PLS, PMS and DAS to complete a Reactor Trip

   AND

   EITHER of the following exists or has occurred due to continued power generation:

   a. Core Cooling CSF - RED.

   OR

   b. Heat Sink CSF - RED.

ESBWR

1. An Automatic Reactor Protection System setpoint was exceeded OR a Manual reactor scram was initiated.

   AND

   EITHER of the following exists or has occurred due to continued power generation:

   a. RPV level less than Level 0 Setpoint [0 inches (0 mm)] on B21-NBS-LI-R615A-D

   OR

   b. RPV pressure and suppression pool temperature cannot be maintained below the Heat Capacity Temperature Limit (HCTL) Curve

Basis:

A manual trip/scram is not considered successful if action away from the Control Room control panels was required to trip/scram the reactor.

Under the conditions of this EAL, efforts to bring the reactor subcritical to the extent that the reactor is producing more heat than the maximum decay heat load for which the safety systems were designed are not successful. [*Although there are capabilities away from the reactor control console the continuing temperature rise indicates that these capabilities are not effective. For plants using CSFSTs, this equates to a Subcriticality RED condition (an entry into function restoration procedure FR-S.1).*] 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 combined with a Subcriticality RED condition. 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 the Top of Active Fuel (TAF) 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 combined with a Subcriticality RED condition. For BWRs, considerations include inability to remove heat via the main condenser, or via the suppression pool.]

In the event either of these challenges exists at a time that the reactor has not been brought below the power associated with the Safety System Design {*typically 3 to 6% 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 off-site intervention time.

AP1000 References:

APP-PMS-J4-020
APP-PMS-J7-001
APP-DAS-J7-001
APP-PLS-J7-001

ESBWR References:

DCD Tier 2, Sec 15.5 (Rev 3)

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.

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 Off-site 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 off-site 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-established classification thresholds match those that are present at the time of the incident.

Section 3.3 of NEI 99-01 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 NEI 99-01 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 NEI 99-01. The IC and the fundamental basis for the ultimate classification for the four classifications are:

General (AG1)	Off-site 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)	Off-site 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 Off-site Dose Calculation Manual for 15 Minutes or Longer.
NOUE (AU1)	Any UNPLANNED Release of Gaseous or Liquid Radioactivity to the Environment that Exceeds Two Times Off-site Dose Calculation Manual 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.

- Off-site 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 off-site dose or dose rate but, rather, on the loss of plant control implied by a radiological release that exceeds a specified multiple of the ODCM release limits for a specified period of time.
- The ODCM multiples are specified only to distinguish AU1 and AA1 from non-emergency conditions and from each other. While these multiples obviously correspond to an off-site 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 off-site dose rates as **symptoms** that the ODCM limits may be exceeded, the IC, and the classification, are **NOT** concerned with the particular value of off-site 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 off-site 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, NEI 99-01 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:

- Effluent Monitor Readings: These EALs are pre-calculated values that correspond to the condition identified in the IC for a given set of assumptions.
- Field Survey Results: These example EALs are included to provide a means to address classifications based on results from field surveys.
- Perimeter Monitor Indications: For sites having them, perimeter monitors can provide a direct indication of the off-site consequences of a release.
- Dose Assessment Results: 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.

AS1 and AG1

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.

AU1 and AA1

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 Technical Specifications. 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 X/Q. Since the meteorology data is pre-defined, there is a direct correlation between the monitor setpoints and the ODCM limits. Although the actual X/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 off-site 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 ODCM release limits for an extended period and that the ODCM provides the methodology for showing compliance with these limits.

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 ODCM 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 ODCM 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 ODCM 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 ODCM limit 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 ODCM limits. Alarm response procedures call for an assessment of the alarm to determine whether or not these limits 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 ODCM limits will not create a need for off-site 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

AS1 and AG1

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 rather 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.

AU1 and AA1

As discussed previously, the threshold in these ICs is based on exceeding a multiple of the ODCM for an extended period. The applicable ODCM 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 ODCM 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 ODCM limits 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 ODCM. 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 ODCM controls 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, 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.

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 NEI 99-01 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 X/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 X/Q value. The site X/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 X/Q values is used in accident analyses.
- For routine release situations, annual average X/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 X/Q value for the most restrictive receptor at or beyond the site boundary is used. The sector annual average X/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 X/Qs that are 10-20 times higher than the calculated annual average for the sector.

In developing the effluent EALs, the NEI 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 X/Qs, may be too conservative. For some sites, the difference between the accident X/Q and the annual average X/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 is based in part on annual average X/Q (non-normalized). ODCMs already provide alarm setpoints based on annual average X/Q that could be used for AU1 and AA1.
- Use of a X/Q more restrictive than the X/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 X/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 off-site 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 ODCM.

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, or an accident source term if deemed appropriate. This guidance is provided to promote proper escalations, use realistic values, and correlation between rad monitor values and dose assessment results. This guidance is provided to avoid potential overlaps between effluent monitor EALs for AA1 and AS1. Other source terms may be appropriate to achieve these goals. 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.