WATERFORD 3 EAL BASIS DOCUMENT

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General Notes on Basis Document Use

Plant Operating Mode Usage for Waterford 3 EALs:

Mode 1 = Power Operations – Reactor Power > 5%, Keff $\geq$ 0.99

Mode 2 = Startup – Reactor Power $\leq$ 5%, Keff $\geq$ .99

Mode 3 = Hot Standby – RCS $\geq$ 350° F, Keff < .99

Mode 4 = Hot Shutdown – 200° F< RCS <350° F, Keff < .99

Mode 5 = Cold Shutdown – RCS < 200° F, Keff < .99

Mode 6 = Refueling – RCS < 140° F, Keff < .95, Fuel in the reactor vessel with the vessel head closure bolts less than fully tensioned or with the head removed

Defueled (D) – All reactor fuel removed from reactor pressure vessel (full core offload during refueling or extended outage). This is not an operating mode designation by Technical Specifications.

This basis document serves two basic functions:

- It provides background and explanatory information based on NEI 99-01 to present a basis for the origination of the Waterford 3 EALs for reviewers and users.
- The second function this basis document may provide is an aid to decision makers when making a determination to classify an emergency event. It is intended that decision makers have all the information in Attachment 7.1 of this procedure that they need to make a sound classification decision. Information that may be useful to a decision maker in classifying emergency events is indicated in red font in the Basis section for each IC in the Basis Document.

The expectation is that emergency classifications are to be made as soon as conditions are present and recognizable for the classification, but within 15 minutes or less in all cases of conditions present. A decision maker's use of this Basis Document for assistance is not intended to delay the classification.

DEFINITIONS

The following definitions are taken from NEI 99-01 and applicable to the Waterford 3 emergency classification system:

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

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

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

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

CIVIL DISTURBANCE: is a group of persons violently protesting station operations at the site.

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

CONTAINMENT CLOSURE: Those actions taken by procedure within acceptable times as specified by procedure to close containment when in modes 5 or 6. Reference OP-901-131, Shutdown Cooling Malfunction, Attachment 7.1.

CONTAINMENT INTEGRITY: refers to that condition of the containment described in Technical Specifications definition 1.7.

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

DEFINITIONS

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

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

EXCLUSION AREA BOUNDARY (EAB): For Waterford 3 EALs, the Emergency Plan Exclusion Area Boundary is the site boundary. The term "Exclusion Area Boundary" or "EAB" is used throughout the Waterford 3 EALs as the site boundary. The Emergency Plan defines the Exclusion Area Boundary (EAB) as "The border of the EXCLUSION AREA or an area corresponding to a distance of 914 meters from the Waterford 3 reactor."

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

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

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

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

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

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

DEFINITIONS

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

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.

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

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

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 offnormal or emergency operating procedures, or deviation from normal security or radiological controls posture, is a departure from NORMAL PLANT OPERATIONS.

PROTECTED AREA: The area encompassed by physical barriers (the security fence) and to which access is controlled into the VITAL AREAS of the plant.

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

SABOTAGE: is deliberate damage, mis-alignment, or mis-operation of plant equipment with the intent to render the equipment inoperable. Equipment found tampered with or damaged due to malicious mischief may NOT meet the definition of SABOTAGE until this determination is made by security supervision.

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

DEFINITIONS

STRIKE ACTION: is a work stoppage within the PROTECTED AREA by a body of workers to enforce compliance with demands made on Entergy or its affiliates. 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: is 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 safety 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: is 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.

ABNORMAL RADIATION LEVELS/RADIOLOGICAL EFFLUENTS

ABNORMAL RADIATION LEVELS/RADIOLOGICAL EFFLUENTS

AU1

Initiating Condition – NOTIFICATION OF UNUSUAL EVENT

Any UNPLANNED release of gaseous or liquid radioactivity to the environment that exceeds 2 times the radiological effluent ODCM limits for ≥ 60 minutes.

Operating Mode Applicability: All

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

1. VALID reading on any effluent monitor that exceeds 2 times the alarm setpoint established by a current radioactivity discharge permit for ≥ 60 minutes.

OR

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

MONITOR	CONC.	EFFLUENT RATE
CONDENSER EXHAUST WRGM PRM-IRE-0002, RE0002-4		1.51E+05 uCi/sec
FUEL HANDLING BUILDING EXHAUST PIG, GAS CHANNEL , PRM-IRE-5107A or B, RE5107A-1 or RE5107B-1	1.61E-02 uCi/cc	
FUEL HANDLING BUILDING EXHAUST WRGM, PRM-IRE-3032, RE3032-4		2.25E+05 uCi/sec
PLANT STACK PIG GAS CHANNEL PRM-IRE-0100.1S or 2S, RE0100.1-1 or RE0100.2-1	3.45E-03 uCi/cc	
PLANT STACK WRGM PRM-IRE-0110, RE0110-4		1.51E+05 uCi/sec
[1]DRY COOLING TOWER SUMPS MONITOR, PRM-IRE-6775 or PRM-IRE-6776, RE6775-1 or RE6776-1	8.49E-04 uCi/ml	
[1]TURBINE BUILDING INDUSTRIAL WASTE SUMP MONITOR, PRM-IRE-6778, RE6778-1	8.49E-04 uCi/ml	

[1]Monitor reading not applicable if sump discharge is aligned to circulating water discharge.

OR

ABNORMAL RADIATION LEVELS/RADIOLOGICAL EFFLUENTS

AU1

3. Confirmed grab sample analyses for gaseous or liquid releases indicates concentrations or release rates, with a release duration of ≥ 60 minutes, in excess of 2 times ODCM based limits from the Technical Requirements Manual (TRM) (Table A1).

Table A1
TRM Limits

	ALERT	UE
Gaseous Release		
Noble Gases: ≤ 500 mrem/yr whole body	1.00E+05	1000
Noble Gases: ≤ 3000 mrem/yr skin	6.00E+05	6000
I-131, I-133, H-3 and particulates with half-lives > 8 days: ≤ 1500 mrem/year to any organ	3.00E+05	3000
Liquid Release		
Whole body: < 1.50 mrem/quarter	300	3
< 3 mrem/yr	600	6
Any Organ: < 5 mrem/quarter	1000	10
< 10 mrem/yr	2000	20

Basis:

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. Waterford 3 SES incorporates features intended to control the release of radioactive effluents to the environment. Further, there are administrative controls established to prevent unintentional releases, or control and monitor intentional releases. These controls are located in the Offsite Dose Calculation Manual (ODCM). The occurrence of extended, uncontrolled radioactive releases to the environment is indicative of a degradation in these features and/or controls.

The ODCM multiples are specified in AU1 (and AA1) only to distinguish between non-emergency conditions, and from each other. While these multiples obviously correspond to an offsite dose or dose rate, the emphasis in classifying these events is the degradation in the level of safety of the plant, NOT the magnitude of the associated dose or dose rate.

ABNORMAL RADIATION LEVELS/RADIOLOGICAL EFFLUENTS

AU1

The ODCM contains the specific release limits and appropriate surveillance requirements which normally monitor these limits. Releases should not be prorated or averaged over 60 minutes. For example, a release exceeding 4 times ODCM limits for 30 minutes does not meet the threshold for this event classification. The one-hour time period allows sufficient time to isolate any release after exceeding ODCM limits. Releases continuing for more than one hour represent inability to isolate or control the release. The Emergency Coordinator 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, then the Emergency Coordinator should, in the absence of data to the contrary, assume that the release has exceeded 60 minutes and make the emergency declaration.

UNPLANNED, as used in this context, includes any release for which a liquid waste release or a gaseous waste release discharge permit was not prepared, or a release that exceeds the conditions (e.g., minimum dilution flow, maximum discharge flow, alarm set points, etc.) on the applicable package permit. Unplanned releases in excess of two times of the technical specification limit that continue for 60 minutes or longer represent an uncontrolled situation and a potential degradation in the level of safety. It is not intended that the release be averaged over 60 minutes. The event should be declared as soon as it is determined that the release duration has or will likely exceed one hour.

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. In all cases, the applicable monitor is expected to be in **high alarm**, but AU1 and AA1 EAL #1 are based on the reading on the monitor and not its alarm status. The emergency classification is not made simply on the basis that the monitor has been in high alarm for 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. 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.

ABNORMAL RADIATION LEVELS/RADIOLOGICAL EFFLUENTS

AU1

EAL #2 is similar to EAL #1, but is intended to address effluent or accident radiation monitors on release pathways for which a discharge permit would not be prepared for a non-routine release. The ODCM establishes a methodology for determining effluent radiation monitor setpoints. The ODCM specifies default source terms from the UFSAR 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 have been determined using this methodology. The values used on the Dry Cooling Tower and Turbine Building sump discharge are based on the release pathway being aligned to the Storm Water System or Discharge Canal vice the circulating water system and are not applicable if the pathway is aligned to the circulating water system. Grab sample analysis of the circulation water discharge, IAW EAL #3, would be necessary to determine the appropriate action.

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

Calculation HP-CALC-2005-002, "Emergency Action Levels (EALs) Abnormal Rad Levels and Radiological Effluent Based on Power Uprate Source Terms" and HP-CALC-2005-012, " Emergency Action Levels (EALs) (Fuel Handling Building Accident) Based on Power Uprate Source Terms" provide the basis for the radiation monitor readings selected for AU1, AA1, AS1 and AG1. The guidance from NEI 99-01 (Basis for Radiological Effluent Initiating Conditions) and Appendix A were used for these calculations. The calculations assume the same meteorology (annual average meteorology) and source term (Offsite Dose Calculation Manual – ODCM default source term) for all four emergency classifications. The back calculation methodology for the Site Area and General Emergency values utilizes the dose assessment method used by responders in emergency facilities to determine offsite doses and its corresponding dose factors and iodine to noble gas ratios. The NEI 99-01 Appendix A caution regarding overly conservative iodine to noble gas ratios was also considered in the calculation with an appropriate ratio correction factor selected.

ABNORMAL RADIATION LEVELS/RADIOLOGICAL EFFLUENTS

AU2

Initiating Condition – NOTIFICATION OF UNUSUAL EVENT

Unexpected rise in plant radiation.

Operating Mode Applicability: All

Emergency Action Level(s): (1 or 2)

1. a. VALID 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.

   - Level drop may be indicated by personnel observation, spent fuel pool level below level plate, refueling crew report, indication on area security camera, RWSP level drop due to makeup demands.

AND

   b. Unplanned VALID Area Radiation Monitor rise on any of the following:

   - CONTAINMENT AREA RADIATION MONITORS (PURGE ISOLATION), (ARM-IRE-5024S, 5025S, 5026S OR 5027S, RE5024-1, RE5025-1, RE5026-1 OR RE5027-1)
   - CONTAINMENT +46 STAIRS MONITORS, (ARM-IRE-5014 OR 5015, RE5014-1 OR RE5015-1)
   - REFUELING BRIDGE AREA RADIATION MONITOR (ARM-IRE-5013, RE5013-1)
   - FHB AREA RADIATION MONITORS (ISOLATION), (ARM-IRE-0300.1S, .2S, .3S OR .4S, RE0300.1-1, RE0300.2-1, RE0300.3-1, OR RE0300.4-1)

OR

2. Unplanned VALID Area Radiation Monitor readings indicate a rise in plant radiation levels by a factor of 1000 over normal levels (highest reading in the past 24 hours excluding the current peak value).

Basis:

This IC addresses increased radiation levels as a result of water level decreases above the reactor vessel 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.

ABNORMAL RADIATION LEVELS/RADIOLOGICAL EFFLUENTS

AU2

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 an Unusual Event is warranted as a precursor to a more serious event.

Specific indications may include instrumentation such as water level and local area radiation monitors, and personnel (e.g., refueling crew) reports. Depending on available level instrumentation, the declaration may be based on indications of water makeup rate or decrease in Refueling Water Storage Pool level. Video cameras (Security or outage-related) may allow remote observation of level. Credit should not be taken for inventory additions to maintain level above the threshold.

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 refuel mast. Generally, increased radiation monitor indications will need to be combined with another indicator (or personnel report) of water loss. For refueling events where the water level drops below the reactor vessel flange, classification would be via CU2. This event escalates to an Alert per AA2 if irradiated fuel outside the reactor vessel is uncovered. For events involving irradiated fuel in the reactor vessel, escalation would be via the Fission Product Barrier Matrix for events in operating modes 1-4.

EAL #2 addresses UNPLANNED increases in in-plant radiation levels that represent a degradation in the control of radioactive material, and represent a potential degradation in the level of safety of the plant. Normal levels can be considered as the HIGHEST reading in the past twenty-four hours excluding the current peak value.

This event escalates to an Alert in accordance with AA3 if the increase in dose rates impedes personnel access necessary for safe operations.

ABNORMAL RADIATION LEVELS/RADIOLOGICAL EFFLUENTS

AA1

Initiating Condition – ALERT

Any UNPLANNED release of gaseous or liquid radioactivity to the environment that exceeds 200 times the radiological effluent ODCM limits for ≥ 15 minutes.

Operating Mode Applicability: All

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

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

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

   - CONDENSER EXHAUST WRGM (PRM-IRE-0002, RE0002-4) indicates release rate > 1.51E+07 uCi/sec.
   - FUEL HANDLING BUILDING EXHAUST WRGM (PRM-IRE-3032, RE3032-4) indicates > 2.25E+07 uCi/sec.
   - PLANT STACK WRGM (PRM-IRE-0110, RE0110-4) indicates > 1.51E+07 uCi/sec.

OR

ABNORMAL RADIATION LEVELS/RADIOLOGICAL EFFLUENTS

AA1

3. Confirmed grab sample analyses for gaseous or liquid releases indicates concentrations or release rates, with a release duration of ≥ 15 minutes, in excess of 200 times ODCM based limits from the Technical Requirements Manual (TRM) (Table A1).

Table A1
TRM Limits

	ALERT	UE
Gaseous Release		
Noble Gases: ≤ 500 mrem/yr whole body	1.00E+05	1000
Noble Gases: ≤ 3000 mrem/yr	6.00E+5	6000
I-131, I-133, H-3 and particulates with half-lives > 8 days: ≤ 1500 mrem/year to any organ	3.00E+05	3000
Liquid Release		
Whole body: < 1.50 mrem/quarter	300	3
< 3 mrem/yr	600	6
Any Organ: < 5 mrem/quarter	1000	10
< 10 mrem/yr	2000	20

Basis:

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. Waterford 3 SES incorporates 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 ODCM. The occurrence of extended, uncontrolled radioactive releases to the environment is indicative of degradation in these features and/or controls.

The ODCM multiples are specified in AA1 (and AU1) only to distinguish between non-emergency conditions, and from each other. While these multiples obviously correspond to an offsite dose or dose rate, the emphasis in classifying these events is the degradation in the level of safety of the plant, NOT the magnitude of the associated dose or dose rate.

Releases should not be prorated or averaged. For example. a release exceeding 100 times ODCM limits for 30 minutes does not meet the threshold for this event classification.

ABNORMAL RADIATION LEVELS/RADIOLOGICAL EFFLUENTS

AA1

UNPLANNED, as used in this context, includes any release for which a liquid waste release or a gaseous waste release discharge permit was not prepared, or a release that exceeds the conditions (e.g., minimum dilution flow, maximum discharge flow, alarm set points, etc.) on the applicable package permit. The Emergency Coordinator/EOF 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, then the Emergency Coordinator/EOF Director should, in the absence of data to the contrary, assume that the release has exceeded 15 minutes and make the emergency declaration.

EAL #1 addresses radioactivity releases that for whatever reason cause effluent radiation monitor readings that exceed 200 times the alarm setpoint established by the radioactivity discharge permit. In all cases, the applicable monitor is expected to be in **alarm**, but AU1 and AA1 EAL #1 are based on the reading on the monitor and not its alarm status. The emergency classification is not made simply on the basis that the monitor has been in high alarm for 15 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. Indexing the EAL threshold to the ODCM setpoints in this manner insures that the EAL threshold will never be less than the setpoint established by a specific discharge permit.

EAL #2 is similar to EAL #1, but is intended to address effluent or accident radiation monitors on release pathways for which a discharge permit would not be prepared for a non-routine release. The ODCM establishes a methodology for determining effluent radiation monitor setpoints. The ODCM specifies default source terms from the UFSAR and, for gaseous releases, prescribes the use of predetermined annual average meteorology in the most limiting downwind sector for showing compliance with the regulatory commitments. These monitor reading EALs have been 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, leakage into Mississippi river water system, etc.

ABNORMAL RADIATION LEVELS/RADIOLOGICAL EFFLUENTS

AA1

Calculation HP-CALC-2005-002, "Emergency Action Levels (EALs) Abnormal Rad Levels and Radiological Effluent Based on Power Uprate Source Terms" and HP-CALC-2005-012, " Emergency Action Levels (EALs) (Fuel Handling Building Accident) Based on Power Uprate Source Terms" provide the basis for the radiation monitor readings selected for AU1, AA1, AS1 and AG1. The guidance from NEI 99-01 (Basis for Radiological Effluent Initiating Conditions) and Appendix A were used for these calculations. The calculations assume the same meteorology (annual average meteorology) and source term (Offsite Dose Calculation Manual – ODCM default source term) for all four emergency classifications. The back calculation methodology for the Site Area and General Emergency values utilizes the dose assessment method used by responders in emergency facilities to determine offsite doses and its corresponding dose factors and iodine to noble gas ratios. The NEI 99-01 Appendix A caution regarding overly conservative iodine to noble gas ratios was also considered in the calculation with an appropriate ratio correction factor selected.

ABNORMAL RADIATION LEVELS/RADIOLOGICAL EFFLUENTS

AA2

Initiating Condition – ALERT

Damage to irradiated fuel or loss of water level that has or will result in uncovering of irradiated fuel outside the reactor vessel.

Operating Mode Applicability: All

Emergency Action Level(s): (1 or 2)

1. VALID alarm or reading ≥ HIGH alarm limits on one or more of the following radiation monitors:

   - CONTAINMENT AREA RADIATION MONITORS (PURGE ISOLATION), (ARM-IRE-5024S, 5025S, 5026S OR 5027S, RE5024-1, RE5025-1, RE5026-1 OR RE5027-1) ≥ HIGH alarm

   - CONTAINMENT +46 STAIRS MONITORS, (ARM-IRE-5014 OR 5015, RE5014-1 OR RE5015-1) ≥ HIGH alarm

   - REFUELING BRIDGE AREA RADIATION MONITOR (ARM-IRE-5013, RE5013-1) ≥ HIGH alarm

   - FHB AREA RADIATION MONITORS (ISOLATION), (ARM-IRE-0300.1S, .2S, 3S OR .4S, RE0300.1-1, RE0300.2-1, RE0300.3-1, OR RE0300.4-1) ≥ 1000 mR/hr

   - FUEL HANDLING BUILDING EXHAUST PIG, GAS CHANNEL , PRM-IRE-5107A OR B, RE5107A-1 OR RE5107B-1 ≥ HIGH alarm

OR

2. Valid indication of uncontrolled water level drop in the reactor refueling cavity, spent fuel pool or fuel transfer canal that will result in irradiated fuel uncovering.

Basis:

This IC addresses specific events that have resulted, or may result, in unexpected increases in radiation dose rates within plant buildings, and may be a precursor to a radioactivity release to the environment. These events represent a loss of control over radioactive material and represent degradation in the level of safety of the plant. These events escalate from AU2 in that fuel activity has been released, or is anticipated due to fuel heatup.

ABNORMAL RADIATION LEVELS/RADIOLOGICAL EFFLUENTS

AA2

Uncontrolled water level decrease may be detected by visual observation, increased radiation levels or various other symptoms that are considered valid indicators of the event. Fuel uncovery may be expected based on abnormal radiation levels, visual observation, or best judgment of the Emergency Coordinator/EOF Director based on present and past trends.

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, indications may include instrumentation such as water level and local area radiation monitors, and personnel (e.g., refueling crew) reports. Depending on available level indication, the declaration may be based on indications of water makeup rate or decrease in Refueling Water Storage Pool level. Video cameras (Security or outage-related) may allow remote observation of level.

Escalation, if appropriate, would occur via AS1 or AG1 or Emergency Coordinator/EOF Director Judgment.

ABNORMAL RADIATION LEVELS/RADIOLOGICAL EFFLUENTS

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

Emergency Action Level(s): (1 or 2)

1. VALID radiation level > 15 mR/hr in areas requiring continuous occupancy to maintain plant safety functions.

   - Main Control Room Area Radiation Monitor (ARM-IRE- 5001, RE5001-1) > 15 mR/hr
   - Radiation level in CAS >15 mR/hr

OR

2. VALID radiation level > Table A2 value in plant vital areas requiring infrequent access to maintain plant safety functions (Table A2).

Table A2
Radiation Levels in Areas Requiring Infrequent Access

VCT Room – 10 R/hr	Safeguards Rooms – 10 R/hr
VALUE FOR ALL AREAS BELOW IS 2.5 R/hr:	
+46 Chiller Area	BAM Tank Rooms
MSIV Areas	Relay Room
Electrical Penetration Area	Remote Shutdown Room
EDG Rooms	Battery Rooms
Valve Bay	Wing Areas
CVC-507 Valve Area	CCW Heat Exchanger Rooms
CCW Pump Rooms	

ABNORMAL RADIATION LEVELS/RADIOLOGICAL EFFLUENTS

AA3

Basis:
The radiation levels in the EALs for this IC may be identified by a radiation monitor value or direct survey.

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 Coordinator/EOF Director must consider the source or cause of the increased radiation levels and determine if any other IC may be involved. For example, a 15 mR/hr dose rate in the control room or a high radiation monitor reading 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 EALs.

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 EALs. 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.).

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 value of 2.5 R/hr was selected for those areas that are not already high radiation areas because it is a value with a specific action for Radiation Protection Superintendent approval addressed in RP-105, Radiation Work Permits that would result in exposure control measures intended to maintain doses within normal occupational guidelines and limits (i.e., 10CFR20), and in doing so, will impede necessary access. The 10 R/hr value is selected for those areas that are already high radiation areas because some greater amount of radiological control is already in place as a baseline condition for these areas (such as the requirement to notify Radiation Protection and get a briefing) prior to entry. In selecting both the 2.5 R/hr value and the 10 R/hr value, consideration was given to preclude unnecessary EAL entry for radiological conditions that may fluctuate during normal plant operations (e.g., incore detector movement, radwaste container movement, depleted resin transfers, etc.). 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. The list of plant areas was selected from a review of the 10 CFR 50 Appendix R analysis.

ABNORMAL RADIATION LEVELS/RADIOLOGICAL EFFLUENTS

AS1

Initiating Condition – SITE AREA EMERGENCY

Offsite dose resulting from an actual or imminent release of gaseous radioactivity exceeds 100 mR TEDE or 500 mR CDE Thyroid for the actual or projected duration of the release.

Operating Mode Applicability: All

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

Note: *If dose assessment results are available at the time of declaration, then 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:

   - CONDENSER EXHAUST WRGM (PRM-IRE-0002, RE0002-4) indicates release rate > 2.69E+08 µCi/sec

   - FUEL HANDLING BUILDING EXHAUST WRGM (PRM-IRE-3032, RE3032-4) indicates release rate > 1.75E+08 µCi/sec

   - PLANT STACK WRGM (PRM-IRE-0110, RE0110-4) indicates release rate > 2.55E+08 µCi/sec

OR

2. Dose assessment using actual meteorology indicates doses > 100 mR TEDE or > 500 mR CDE Thyroid at or beyond the EAB.

OR

3. Field survey results indicate closed window dose rates >100 mR/hr expected to continue for > one hour; or analyses of field survey samples indicate CDE Thyroid ≥ 500 mR for one hour of inhalation, at or beyond the EAB.

ABNORMAL RADIATION LEVELS/RADIOLOGICAL EFFLUENTS

AS1

Basis:

This IC addresses radioactivity releases that result in doses at or beyond the EAB 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 may be 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 actual or projected dose of 100 mR TEDE is set at 10% of the EPA Protective Action Guide (PAG) values given in EPA-400-R-92-001, while the 500 mR CDE thyroid was established in consideration of the 1:5 ratio of the EPA PAG for TEDE and thyroid CDE. The TEDE integrated dose value also provides a desirable gradient between the Alert, Site Area Emergency and General Emergency classes.

The Emergency Coordinator/EOF 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 monitor list in EAL #1 includes monitors on the primary potential release pathways (Plant stack, Primary/Secondary leak, Fuel Handling Accident) for Waterford 3. 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 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 in EPA-400R-92-001 provides for the use of adult thyroid dose conversion factors.

The monitor reading EALs were determined using a dose assessment method that back calculates from the dose values specified in the IC. Calculation HP-CALC-2005-002, "Emergency Action Levels (EALs) Abnormal Rad Levels and Radiological Effluent Based on Power Uprate Source Terms" and HP-CALC-2005-012, "Emergency Action Levels (EALs) (Fuel Handling Building Accident) Based on Power Uprate Source Terms" provide the basis for the radiation monitor readings selected for AU1, AA1, AS1 and AG1. The guidance from NEI 99-01 (Basis for Radiological Effluent Initiating Conditions) and Appendix A were used for these calculations. The calculations assume the same meteorology (annual average meteorology) and source term (Offsite Dose Calculation Manual – ODCM default source term) for all four emergency classifications. The back calculation methodology for the Site Area and General Emergency values utilizes the dose assessment method used by responders in emergency facilities to determine offsite doses and its corresponding dose factors and iodine to noble gas ratios. The NEI 99-01 Appendix A caution regarding overly conservative iodine to noble gas ratios was also considered in the calculation with an appropriate ratio correction factor selected.

ABNORMAL RADIATION LEVELS/RADIOLOGICAL EFFLUENTS

AS1

Since doses are generally not monitored in real-time, a release duration of one hour was assumed, and the EALs are based on a EAB (or beyond) dose of 100 mR/hour whole body or 500 mR/hour thyroid, whichever is more limiting (as was done for EALs #2 and #3). If 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 in EALs #2 and #3 is based on actual meteorology, whereas the monitor readings in EAL #1 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, decision makers should ensure performance of dose assessments using actual meteorology and release information are performed in a timely manner when release conditions are detected. If the results of these dose assessments are available when the classification is made (e.g., initiated at a lower classification level), then the dose assessment results override the monitor reading EALs. However, classification should not be delayed pending the results of these dose assessments. If dose assessment team calculations can not be completed in 15 minutes, then valid monitor readings should be used for emergency classification.

Field team surveys in EAL #3 are performed at or beyond the EAB and at the most accurate indicator of the condition. Field data are independent of release elevation and meteorology. The assumed release duration is one hour for the basis of the EAL. Expected post accident source terms would be dominated by noble gases providing the dose rate value. Sampling of radioiodine by adsorption on a charcoal cartridge should determine the iodine value.

ABNORMAL RADIATION LEVELS/RADIOLOGICAL EFFLUENTS

AG1

Initiating Condition – GENERAL EMERGENCY

Offsite dose resulting from an actual or imminent release of gaseous radioactivity exceeds 1000 mR TEDE or 5000 mR CDE Thyroid for the actual or projected duration of the release using actual meteorology.

Operating Mode Applicability: All

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

Note: *If dose assessment results are available at the time of declaration, then 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 more accurately characterize the nature of the release.*

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:

   - CONDENSER EXHAUST WRGM (PRM-IRE-0002, RE0002-4) indicates release rate > 2.69E+09 uCi/sec
   - FUEL HANDLING BUILDING EXHAUST WRGM (PRM-IRE-3032, RE3032-4) indicates release rate > 1.75E+09 uCi/sec
   - PLANT STACK WRGM (PRM-IRE-0110, RE0110-4) indicates release rate > 2.55E+09 uCi/sec

OR

2. Dose assessment using actual meteorology indicates doses > 1000 mR TEDE or > 5000 mR CDE Thyroid at or beyond the EAB.

OR

3. Field survey results indicate closed window dose rates >1000 mR/hr expected to continue for > one hour; or analyses of field survey samples indicate CDE Thyroid ≥ 5000 mR for one hour of inhalation, at or beyond the EAB.

ABNORMAL RADIATION LEVELS/RADIOLOGICAL EFFLUENTS

AG1

Basis:

This IC addresses radioactivity releases that result in doses at or beyond the EAB that exceed the EPA Protective Action Guides (PAGs). Public protective actions are required. 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 Coordinator/EOF 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 actual or projected dose of 1000 mR TEDE and 5000 mR CDE thyroid integrated doses are based on the EPA Protective Action Guide (PAG) values given in EPA-400-R-92-001, which indicates that public protective actions are indicated if doses exceed these values. This is consistent with the emergency class description of a General Emergency.

The monitor list in EAL #1 includes monitors on potential gaseous effluent release pathways (Plant stack, Primary/Secondary Leak, Fuel Handling Accident). 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 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 in EPA-400R-92-001 provides for the use of adult thyroid dose conversion factors.

The monitor reading EALs were determined using a dose assessment method that back calculates from the dose values specified in the IC.

ABNORMAL RADIATION LEVELS/RADIOLOGICAL EFFLUENTS

AG1

Calculation HP-CALC-2005-002, "Emergency Action Levels (EALs) Abnormal Rad Levels and Radiological Effluent Based on Power Uprate Source Terms" and HP-CALC-2005-012, "Emergency Action Levels (EALs) (Fuel Handling Building Accident) Based on Power Uprate Source Terms" provide the basis for the radiation monitor readings selected for AU1, AA1, AS1 and AG1. The guidance from NEI 99-01 (Basis for Radiological Effluent Initiating Conditions) and Appendix A were used for these calculations. The calculations assume the same meteorology (annual average meteorology) and source term (Offsite Dose Calculation Manual – ODCM default source term) for all four emergency classifications. The back calculation methodology for the Site Area and General Emergency values utilizes the dose assessment method used by responders in emergency facilities to determine offsite doses and its corresponding dose factors and iodine to noble gas ratios. The NEI 99-01 Appendix A caution regarding overly conservative iodine to noble gas ratios was also considered in the calculation with an appropriate ratio correction factor selected.

Since doses are generally not monitored in real-time, a release duration of one hour was assumed, and the EALs are based on a EAB (or beyond) dose of 1000 mR/hour whole body or 5000 mR/hour thyroid, whichever is more limiting (as was done for EALs #2 and #3). If 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 in EALs #2 and #3 is based on actual meteorology, whereas the monitor readings in EAL #1 are not, the results from these assessments may indicate that the classification is not warranted. For this reason, decision makers should ensure performance of dose assessments using actual meteorology and release information are performed in a timely manner when release conditions are detected. If the results of these dose assessments are available when the classification is made (e.g., initiated at a lower classification level), then the dose assessment results override the monitor reading EALs. However, classification should not be delayed pending the results of these dose assessments. If dose assessment team calculations can not be completed in 15 minutes, then valid monitor readings should be used for emergency classification.

Field team surveys in EAL #3 are performed at or beyond the EAB and at the most accurate indicator of the condition. Field data are independent of release elevation and meteorology. The assumed release duration is one hour for the basis of the EAL. Expected post accident source terms would be dominated by noble gases providing the dose rate value. Sampling of radioiodine by adsorption on a charcoal cartridge should determine the iodine value.

COLD SHUTDOWN/REFUELING SYSTEM MALFUNCTION

COLD SHUTDOWN/REFUELING SYSTEM MALFUNCTION

CU1

Initiating Condition – NOTIFICATION OF UNUSUAL EVENT

RCS leakage.

Operating Mode Applicability: **Cold Shutdown (Mode 5)**

Emergency Action Level(s): (1 or 2)

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

OR

2. Identified leakage > 25 gpm .

Basis:

This IC is included as a NOUE because it is considered to be a potential degradation of the level of safety of the plant. The 10 gpm value for the unidentified and pressure boundary leakage was selected as it is sufficiently large to be observable via normally installed instrumentation (e.g., Pressurizer level, RCS loop level instrumentation, etc.) or reduced inventory instrumentation such as level hose indication. Lesser values must generally be determined through time-consuming surveillance tests (e.g., mass balances). The EAL for identified leakage is set at a higher value due to the lesser significance of identified leakage in comparison to unidentified or pressure boundary leakage. Prolonged loss of RCS inventory may result in escalation to the Alert level via either CA1 or CA3.

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

COLD SHUTDOWN/REFUELING SYSTEM MALFUNCTION

CU2

Initiating Condition – NOTIFICATION OF UNUSUAL EVENT

UNPLANNED loss of RCS inventory with irradiated fuel in the reactor vessel.

Operating Mode Applicability: **Refueling (Mode 6)**

Emergency Action Level(s): (1 or 2)

1. UNPLANNED RCS level drop below the vessel flange for ≥ 15 minutes

OR

2. a. Loss of reactor vessel inventory as indicated by unexplained containment sump level or reactor drain tank level rise

AND

b. Reactor vessel 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 reactor vessel flange are carefully planned and procedurally controlled. An UNPLANNED event that results in water level decreasing below the reactor vessel flange warrants declaration of a NOUE due to the reduced 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 Inventory will result in escalation to the Alert level via either CA2 or CA3.

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 reactor vessel level and inventory are monitored by different means.

In the refueling mode, normal means of core temperature indication and RCS level indication may not be available. Redundant means of reactor vessel 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 inventory event, the operators would need to determine that reactor vessel inventory loss was occurring by observing containment sump and reactor drain tank level changes. Sump and tank level increases must be evaluated against other potential sources of leakage such as cooling water sources inside the containment to ensure they are indicative of RCS leakage. Escalation to Alert would be via either CA2 or RCS heatup via CA4.

EAL 1 involves a decrease in RCS level below the top of the reactor vessel 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 reactor vessel level continues to decrease and reaches the Bottom ID of the RCS Loop (12 ft. MSL for these ICs), then escalation to CA2 would be appropriate.

COLD SHUTDOWN/REFUELING SYSTEM MALFUNCTION

CU3

Initiating Condition – NOTIFICATION OF UNUSUAL EVENT

UNPLANNED loss of decay heat removal capability with irradiated fuel in the reactor vessel.

Operating Mode Applicability: **Cold Shutdown (Mode 5)**
Refueling (Mode 6)

Emergency Action Level(s): (1 or 2)

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

OR

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

Basis:

This IC is included as a NOUE because it may be a precursor of more serious conditions and, as a result, is considered to be a potential degradation of the level of safety of the plant. In cold shutdown, the ability to remove decay heat relies primarily on forced cooling flow. Operation of the systems that provide this forced cooling may be jeopardized due to the unlikely loss of electrical power or RCS inventory. Temporary instrumentation and jumpers are maintained in service such that the operators are able to monitor RCS temperature and reactor vessel level so that escalation to the alert level via CA3 or CA1 will occur if required.

Loss of forced decay heat removal at reduced inventory may result in more rapid increases in reactor coolant temperatures depending on the time since shutdown. Escalation to the Alert level via CA3 is provided dependent upon containment closure and RCS integrity conditions.

Redundant means of reactor vessel level indication are procedurally installed in accordance with OP-001-003, Reactor Coolant System Drain Down, 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 or 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 CA3 based on exceeding RCS temperature criteria. The Emergency Coordinator 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 Coordinator, an imminent situation is at hand, the classification should be made as if the threshold has been exceeded.

COLD SHUTDOWN/REFUELING SYSTEM MALFUNCTION

CU4

Initiating Condition – NOTIFICATION OF UNUSUAL EVENT

Fuel clad degradation.

Operating Mode Applicability: **Cold Shutdown (Mode 5)**

Emergency Action Level(s):

1. RCS sample activity value indicates fuel clad degradation > Technical Specification allowable limits.

   - >1.0 µCi/gm DEI

   OR

   - >100/$\bar{E}$ µCi/gm

Basis:

The condition noted in this EAL is considered to be a potential degradation in the level of safety of the plant and potential precursors of more serious problems. The EAL addresses coolant samples exceeding coolant technical specifications for iodine spike that are indicative of fuel clad integrity.

COLD SHUTDOWN/REFUELING SYSTEM MALFUNCTION

CU5

Initiating Condition – NOTIFICATION OF UNUSUAL EVENT

Loss of all offsite power to essential busses > 15 minutes.

Operating Mode Applicability: **Cold Shutdown (Mode 5)**
Refueling (Mode 6)

Emergency Action Level(s):

1. a. Loss of power to all unit auxiliary and startup transformers > 15 minutes.

AND

b. At least emergency diesel generator 'A' or 'B' is supplying power to emergency busses.

Basis:

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

Credit for Temporary Emergency Diesel Generators (TEDs) may **NOT** be taken because they are not a credited power source in the Technical Specifications for modes 5 and 6.

COLD SHUTDOWN/REFUELING SYSTEM MALFUNCTION

CU6

Initiating Condition – NOTIFICATION OF UNUSUAL EVENT

UNPLANNED loss of required DC power > 15 minutes.

Operating Mode Applicability: **Cold Shutdown (Mode 5)**
Refueling (Mode 6)

Emergency Action Level:

1. a. UNPLANNED loss of vital DC power to required DC busses based on bus voltage indication < 108 volts.

AND

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

Basis:

This IC refers to loss of vital DC power from the 3A-DC, 3B-DC or 3AB-DC busses dependant upon designated protected train operability status. The purpose of this IC and its associated EALs is to recognize a loss of DC power 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 EAL to preclude the declaration of an emergency as a result of planned maintenance activities. Routinely, Waterford 3 performs 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, then the escalation to an Alert will be in accordance with CA3.

The minimum voltage necessary, based on plant design, is 105 volts; however, the lowest battery voltage attained on a loss of off site power at the end of the 4 hour period is 107.4 volts on the 'B' battery bank. 108 volts is used for the EAL indication because the Control Room instrumentation reads in 2 volt increments. Reference calculations ECE91-058, "Battery 3A-S "A Train" Calculation for Station Blackout" and ECE91-059, "Battery 3B-S "B Train" Calculation for Station Blackout."

COLD SHUTDOWN/REFUELING SYSTEM MALFUNCTION

CU7

Initiating Condition – NOTIFICATION OF UNUSUAL EVENT

Inadvertent criticality.

Operating Mode Applicability: **Cold Shutdown (Mode 5)**
Refueling (Mode 6)

Emergency Action Level(s):

1. 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 misloading events and inadvertent dilution events. This IC indicates a potential degradation of the level of safety of the plant, warranting a NOUE classification. This IC excludes inadvertent criticalities that occur during planned reactivity changes associated with reactor startups (e.g., criticality earlier than estimated) which are addressed in the companion SU10.

This condition can be identified using the startup rate meter. If the startup rate meter is not in service in Mode 6, then the neutron count rate is used for this EAL. The term "sustained" is used in order to allow exclusion of expected short term positive startup rates from planned fuel bundle or control rod movements during core alteration. These short term positive startup rates are the result of the increase in neutron population due to subcritical multiplication.

Escalation would be by Emergency Coordinator Judgment.

COLD SHUTDOWN/REFUELING SYSTEM MALFUNCTION

CU8

Initiating Condition – NOTIFICATION OF UNUSUAL EVENT

UNPLANNED loss of all onsite or offsite communications capabilities.

Operating Mode Applicability: **Cold Shutdown (Mode 5)**
Refueling (Mode 6)

Emergency Action Level(s): (1 or 2)

1. Loss of all Table C1 onsite communications systems affecting the ability to perform routine operations.

OR

2. Loss of all Table C2 offsite communications systems.

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 to offsite authorities. The loss of offsite communications ability is expected to be significantly more comprehensive than the condition addressed by 10 CFR 50.72. The availability of one method of ordinary offsite communications is sufficient to inform state and local authorities of plant problems. This EAL is intended to be used only when extraordinary means (e.g., relaying of information from radio transmissions, individuals being sent to offsite locations, etc.) are being utilized to make communications possible.

Table C1 Onsite Communications Equipment
Plant radio system
Plant paging system
In-plant telephones
Sound powered phones

Table C2 Offsite Communications Equipment
All telephone lines (commercial and microwave)
Industrial Hot Line
ENS
Civil Defense Radios
Operational Hotline

COLD SHUTDOWN/REFUELING SYSTEM MALFUNCTION

CA1

Initiating Condition – ALERT

Loss of RCS inventory.

Operating Mode Applicability: **Cold Shutdown (Mode 5)**

Emergency Action Level(s): (1 or 2)

1. Loss of RCS inventory as indicated by RVLMS upper plenum level ≤ 20%.

OR

2. a. Loss of RCS inventory as indicated by unexplained containment sump level or reactor drain tank level rise

AND

b. RCS level cannot be monitored > 15 minutes

Basis:

These 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 reactor vessel level decrease and potential core uncovery. This condition will result in a minimum classification of Alert. The Reactor Vessel Level Monitoring System (RVLMS) provides a reading in percentage level remaining in the upper plenum. Procedure OP-001-003, Reactor Coolant System Drain Down, Attachment 11.4 lists the RVLMS sensing element elevations. The area corresponding to 20 % level is at 11.80 ft. MSL (bottom ID of RCS loop determined to be 11.625 ft. MSL from basis for CA2). Therefore a level equal to or below 20% indicates that level has dropped to an area at (or below) the low point of the RCS 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 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 reactor vessel (note that the heatup threat could be lower for cold shutdown conditions if the entry into cold shutdown was following a refueling). The above forms the basis for needing both a cold shutdown specific IC (CA1) and a refueling specific IC (CA2).

COLD SHUTDOWN/REFUELING SYSTEM MALFUNCTION

CA1

In the cold shutdown mode, normal RCS level and reactor vessel 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 reactor vessel inventory loss was occurring by observing sump and tank level changes. Sump and tank level increases must be evaluated against other potential sources of leakage such as cooling water sources inside the containment to ensure they are indicative of RCS leakage. The 15-minute duration for the loss of level indication was chosen because it is half of the CS1 Site Area Emergency EAL duration. The 15-minute duration allows CA1 to be an effective precursor to CS1. Significant fuel damage is not expected to occur until the core has been uncovered for greater than 1 hour in accordance with the analysis referenced in the CS1 basis. Therefore this EAL meets the definition for an Alert emergency.

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

If reactor vessel level continues to decrease, then escalation to Site Area Emergency will be via CS1.

COLD SHUTDOWN/REFUELING SYSTEM MALFUNCTION

CA2

Initiating Condition – ALERT

Loss of reactor vessel inventory with irradiated fuel in the reactor vessel.

Operating Mode Applicability: **Refueling (Mode 6)**

Emergency Action Level(s): (1 or 2)

1. Loss of reactor vessel inventory as indicated by reactor vessel level at 12 ft.

OR

2. a. Loss of reactor vessel inventory as indicated by unexplained containment sump level or reactor drain tank level rise

AND

b. Reactor vessel level cannot be monitored > 15 minutes

Basis:

These EALs serve as precursors to a loss of heat removal. The magnitude of this loss of water indicates that makeup systems have not been effective and may not be capable of preventing further reactor vessel level decrease and potential core uncovery. The bottom ID of the RCS Loop is chosen for this IC because at this level remote RCS level indication is lost and loss of normal suction for the shutdown cooling system will occur below this point. RVLMS is not used as an indicator for this EAL because it is not expected to be in service in Mode 6. The bottom ID of the RCS loop is determined to be at 11.625 ft. MSL by the following: The centerline elevation of the RCS hot leg is 13.375' MSL (from drawing 1564-G146), the hot leg piping inside diameter is 42" (from UFSAR section 5.4.3.2), therefore 13.375' – 21" = bottom ID of RCS loop = elevation 11.625' MSL. Other reactor vessel level monitoring systems for mode 6 provide lowest indication in the Control Room at 12.0 ft. MSL (from RCS System Description SD-RCS). Thus the level corresponding to a loss of suction to decay heat removal systems (bottom ID of the RCS loop) for upgrade to an Alert is taken to be 12 ft. MSL for this IC. 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 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 reactor vessel (note that the heatup threat could be lower for cold shutdown conditions if the entry into cold shutdown was following a refueling). The above forms the basis for needing both a cold shutdown specific IC (CA1) and a refueling specific IC (CA2).

In the refueling mode, normal means of reactor vessel level indication may not be available. Redundant means of reactor vessel 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 reactor vessel inventory loss was occurring by observing sump and tank level changes. Sump and tank level increases must be evaluated against other potential sources of leakage such as cooling water sources inside the containment to ensure they are indicative of RCS leakage. The 15-minute duration for the loss of level indication was chosen because it is half of the CS2 Site Area Emergency EAL duration. The 15-minute duration allows CA2 to be an effective precursor to CS2. Significant fuel damage is not expected to occur until the core has been uncovered for greater than 1 hour in accordance with the analysis referenced in the CS2 basis. Therefore this EAL meets the definition for an Alert.

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

If reactor vessel level continues to decrease, then escalation to Site Area Emergency will be via CS2.

COLD SHUTDOWN/REFUELING SYSTEM MALFUNCTION

CA3

Initiating Condition – ALERT

Inability to maintain plant in Cold Shutdown with irradiated fuel in the reactor vessel.

Operating Mode Applicability: **Cold Shutdown (Mode 5)**
Refueling (Mode 6)

Emergency Action Level(s): (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.

OR

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 > 20 minutes[1].

OR

3. An UNPLANNED event results in RCS temperature exceeding the Technical Specification cold shutdown temperature limit for > 60 minutes[1] or results in an RCS pressure rise of > 10 psig.

*[1]Note: **If** shutdown cooling is in operation within this time frame **and** RCS temperature is being reduced **then** this EAL is **not** applicable.*

Basis:

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 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 the Technical Specification cold shutdown temperature limit when the heat removal function is available.

COLD SHUTDOWN/REFUELING SYSTEM MALFUNCTION

CA3

The Emergency Coordinator/EOF 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 Coordinator/EOF Director, an imminent situation is at hand, then the classification should be made as if the threshold has been exceeded.

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 to be pressurized (e.g., no freeze seals or nozzle dams). No delay time is allowed for EAL1 because the evaporated reactor coolant that may be released into the Containment during this heatup condition could also be directly released to the environment.

EAL 2 addresses the complete loss of functions required for core cooling for > 20 minutes during refueling and cold shutdown modes when CONTAINMENT CLOSURE is established **but** RCS integrity is **not** established **or** RCS inventory is reduced (e.g., mid loop operation). As in EAL 1, RCS integrity should be assumed to be in place when the RCS pressure boundary is in its normal condition to be pressurized (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" and is believed to be conservative given that a low pressure Containment barrier to fission product release is established. Note 1 indicates that EAL 2 is **not** applicable if actions are successful in restoring an RCS heat removal system to operation **and** RCS temperature is being reduced within the 20 minute time frame.

EAL 3 addresses complete loss of functions required for core cooling for > 60 minutes during refueling and cold shutdown modes when RCS integrity is established. As in EAL 1 and 2, RCS integrity should be considered to be in place when the RCS pressure boundary is in its normal condition to be pressurized (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 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 can be read on installed control board instrumentation. Note 1 indicates that EAL 3 is **not** applicable if actions are successful in restoring a shutdown cooling 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 10 psig.**

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

COLD SHUTDOWN/REFUELING SYSTEM MALFUNCTION

CA5

Initiating Condition – ALERT

Loss of all offsite power and loss of all onsite AC power to essential busses.

Operating Mode Applicability: **Cold Shutdown (Mode 5)**
Refueling (Mode 6)
Defueled

Emergency Action Level(s):

1. a. Loss of power to all unit auxiliary and startup transformers

AND

b. Failure of the 'A' and 'B' emergency diesel generators to supply power to emergency busses

AND

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

Basis:

Loss of all AC power compromises all plant safety systems requiring electric power including shutdown cooling, emergency core cooling, containment cooling, spent fuel pool cooling 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 and lower temperature and pressure which allow increasing the time to restore one of the emergency busses, relative to that specified for the Site Area Emergency EAL. Fifteen minutes was selected as a threshold to exclude transient or momentary power losses. Escalating to Site Area Emergency, if appropriate, is by Abnormal Radiation Levels / Radiological Effluents (AS1), or Emergency Coordinator/EOF Director Judgment EALs.

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

Credit for Temporary Emergency Diesel Generators (TEDs) may **NOT** be taken because they are not a credited power source in the Technical Specifications for modes 5 and 6.

COLD SHUTDOWN/REFUELING SYSTEM MALFUNCTION

CS1

Initiating Condition – SITE AREA EMERGENCY

Loss of reactor vessel inventory affecting core decay heat removal capability.

Operating Mode Applicability: **Cold Shutdown (Mode 5)**

Emergency Action Level(s): (1 or 2)

1. With CONTAINMENT CLOSURE not established:

   a. Reactor vessel inventory as indicated by RVLMS upper plenum level 0%.

OR

   b. Reactor vessel level cannot be monitored > 30 minutes with a loss of reactor vessel inventory as indicated by unexplained containment sump level or reactor drain tank level rise.

OR

2. With CONTAINMENT CLOSURE established:

   Reactor vessel level cannot be monitored > 30 minutes with a loss of reactor vessel inventory as indicated by either:
   - Unexplained containment sump or reactor drain tank level rise.
   - Erratic Source Range Monitor indication.

Basis:

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

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 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 reactor vessel (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).

COLD SHUTDOWN/REFUELING SYSTEM MALFUNCTION

CS1

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

These 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, (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.

The Reactor Vessel Level Monitoring System (RVLMS) provides a reading in percentage level remaining in the upper plenum. A 0% level is the first observable point below 6" below the bottom ID of the RCS loop penetration in the reactor vessel (NEI 99-01 guidance) but is at a point higher than the Top of Active Fuel (TOAF) at its location 12.6" above the fuel alignment plate (from RCS System Description SD-RCS). Procedure OP-001-003, Reactor Coolant System Drain Down, Attachment 11.4 lists the RVLMS sensing element elevations. The area corresponding to 0% level is at 10.10 ft. MSL (bottom ID of RCS loop determined to be 11.625 ft. MSL from basis for CA2 with 6" below that point at 11.125 ft. MSL). Therefore a 0% level indicates that level has dropped to an area at (or below) the low point of the RCS loop. The inability to restore and maintain level after reaching this setpoint would therefore be indicative of a failure of the RCS barrier.

The 30-minute duration allowed when CONTAINMENT CLOSURE is established allows sufficient time for actions to be performed to recover needed cooling equipment and is considered to be conservative given that level is being monitored via CS1 and CS2. Effluent release is not expected with closure established.

Escalation to a General Emergency is via CG1 or radiological effluent IC AG1.

COLD SHUTDOWN/REFUELING SYSTEM MALFUNCTION

CS2

Initiating Condition – SITE AREA EMERGENCY

Loss of reactor vessel inventory affecting core decay heat removal capability with irradiated fuel in the reactor vessel.

Operating Mode Applicability: **Refueling (Mode 6)**

Emergency Action Level(s):

1. Reactor vessel level cannot be monitored WITH indication of core uncovery as evidenced by one or more of the following:
- Containment High Range Radiation Monitor (ARM-IRE-5400AS or ARM-IRE-5400BS) $\geq$ 10R/hr
- Erratic Source Range Monitor indication
- Core Exit Thermocouples indicate superheat

Basis:

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

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 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 reactor vessel (note that the heatup threat could be lower for cold shutdown conditions if the entry into cold shutdown was following a refueling). The above forms the basis for needing both a cold shutdown specific IC (CS1) and a refueling specific IC (CS2).

These example EALs are based on concerns raised by Generic Letter 88-17, Loss of Decay Heat Removal, SECY 91-283, Evaluation of Shutdown and Low Power Risk Issues, NUREG-1449, Shutdown and Low-Power Operation at Commercial Nuclear Power Plants in the United States, and, NUMARC 91-06, Guidelines for Industry Actions to Assess Shutdown Management. A number of variables, (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.

COLD SHUTDOWN/REFUELING SYSTEM MALFUNCTION

CS2

Normal means of reactor vessel level indication may not be available. Redundant means of reactor vessel 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.

RVLMS is not used as an indicator for this EAL because it is not expected to be in service in Mode 6. Other reactor vessel level monitoring systems for mode 6 provide lowest indication at 12.0 ft. MSL which is slightly above the bottom ID of the RCS loop penetration to the reactor vessel. Therefore, an indication that the water level has dropped to any point below the bottom of the RCS loop penetration in the reactor vessel is not available in mode 6 and an EAL is selected that uses inability to monitor reactor vessel level.

As water level in the reactor vessel lowers, the dose rate above the core will increase. The dose rate due to this core shine should result in up-scaled Containment High Range Monitor indication and possible alarm. A reading of greater than or equal to 10 R/hr may be indicative of fuel damage. The basis for 10 R/hr is that it is sufficiently above the normal indication of 0.74 R/hr (nominal shutdown) to avoid an unnecessary entry into the EAL but substantially lower than the calculated values for RCS barrier failure (100 R/hr) and fuel clad barrier failure (1000 R/hr) for barrier losses in Section F(Fission Product Barrier) to give an early indication of vessel level lowering to the point of potential fuel damage. The 10 R/hr is also high enough to be indicative of potential fuel uncovery. 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.

Effluent release is not expected if containment closure is established.

Escalation to a General Emergency is via CG1 or radiological effluent IC AG1.

COLD SHUTDOWN/REFUELING SYSTEM MALFUNCTION

CG1

Initiating Condition – GENERAL EMERGENCY

Loss of reactor vessel inventory affecting fuel clad integrity with containment challenged and irradiated fuel in the reactor vessel.

Operating Mode Applicability: **Cold Shutdown (Mode 5)**
Refueling (Mode 6)

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

1. Loss of reactor vessel inventory as indicated by unexplained containment sump level or reactor drain tank level rise

AND

2. Reactor vessel level cannot be monitored with indication of core uncovery > 30 minutes as evidenced by one or more of the following:
   - Containment High Range Radiation Monitor (ARM-IRE-5400AS or ARM-IRE-5400BS) ≥ 10R/hr
   - Erratic Source Range Monitor indication
   - Core Exit Thermocouples indicate superheat

AND

3. Indication of CONTAINMENT challenged as indicated by one or more of the following:
   - Explosive mixture inside containment
   - Containment pressure > 50 PSIA
   - CONTAINMENT CLOSURE not established

COLD SHUTDOWN/REFUELING SYSTEM MALFUNCTION

CG1

Basis:

During an outage, installed RCS level and REACTOR VESSEL level instrumentation systems will normally be available when the RCS is filled and redundant means of REACTOR VESSEL 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 when the RCS is not filled. EAL #1 assumes, if all level indication were to be lost during a loss of RCS inventory event, the operators would need to determine that REACTOR VESSEL 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.

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

These 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, (e.g., mid-loop, reduced level/flange level, head in place, or cavity flooded, RCS venting strategy, decay heat removal system design, vortexing pre-disposition, steam generator U-tube draining) can have a significant impact on heat removal capability challenging the fuel clad barrier. Analysis in the above references indicates that core damage may occur within an hour following continued core uncovery therefore, conservatively, 30 minutes was chosen.

As water level in the reactor vessel lowers, the dose rate above the core will increase. The dose rate due to this core shine should result in up-scaled Containment High Range Monitor indication. The basis for 10 R/hr is that it is sufficiently above the normal indication of 0.74 R/hr (nominal shutdown) to avoid an unnecessary entry into the EAL but substantially lower than the calculated values for RCS barrier failure (100 R/hr) and fuel clad barrier failure (1000 R/hr) for barrier losses in Section F (Fission Product Barrier) to give an early indication of vessel level lowering to the point of potential fuel damage. The 10 R/hr is also high enough to be indicative of potential fuel uncovery. 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.

COLD SHUTDOWN/REFUELING SYSTEM MALFUNCTION

CG1

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

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

The pressure at which CONTAINMENT is considered challenged is based on the condition of the CONTAINMENT. If the CONTAINMENT is fully intact, then the CONTAINMENT will be challenged at the design pressure of 44 psig (~59 psia). Because the EOPs use 50 psia as a safety function parameter following a LOCA, this is the value used in the EAL. This is consistent with the owner's groups Emergency Response Procedures. If CONTAINMENT CLOSURE is established, the EAL setpoint is based on an estimate of the pressure CONTAINMENT CLOSURE would be able to sustain. Waterford estimates this pressure to be the design pressure because of the closure actions taken.

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. Existence of an explosive mixture means a hydrogen and oxygen concentration of at least the lower deflagration limit curve exists.

FISSION PRODUCT BARRIER DEGRADATION

FISSION PRODUCT BARRIER DEGRADATION

FU1 – Initiating Condition – NOTIFICATION OF UNUSUAL EVENT

ANY loss or ANY Potential Loss of Containment.

Operating Mode Applicability:

Power Operations (Mode 1)
Startup (Mode 2)
Hot Standby (Mode 3)
Hot Shutdown (Mode 4)

FA1 – Initiating Condition – Alert

ANY loss or ANY Potential Loss of EITHER Fuel Clad or RCS

Operating Mode Applicability:

Power Operations (Mode 1)
Startup (Mode 2)
Hot Standby (Mode 3)
Hot Shutdown (Mode 4)

FS1 – Initiating Condition – Site Area Emergency

Loss or Potential Loss of ANY two Barriers

Operating Mode Applicability:

Power Operations (Mode 1)
Startup (Mode 2)
Hot Standby (Mode 3)
Hot Shutdown (Mode 4)

FG1 – Initiating Condition – General Emergency

Loss of ANY two Barriers AND Loss or Potential Loss of Third barrier

Operating Mode Applicability:

Power Operations (Mode 1)
Startup (Mode 2)
Hot Standby (Mode 3)
Hot Shutdown (Mode 4)

FISSION PRODUCT BARRIER DEGRADATION

General Bases:

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. Unusual Event ICs associated with RCS and Fuel Clad Barriers are addressed under System Malfunction (S) ICs.

- At the Site Area Emergency level, there must be some ability to dynamically assess how far present conditions are from the threshold for a General Emergency. For example, if Fuel Clad and RCS Barrier "Loss" EALs existed, that, in addition to offsite dose assessments, would require continual assessments of radioactive inventory and containment integrity. Alternatively, if both Fuel Clad and RCS "Potential Loss" EALs existed, the Emergency Coordinator/EOF 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.

    a. Fission Product Barrier ICs must be capable of addressing event dynamics. Thus, the Note associated with the ICs in the EAL Matrix provides guidance that imminent (i.e., within 1 to 2 hours) Loss or Potential Loss should result in a classification as if the affected threshold(s) are already exceeded, particularly for the higher emergency classes.

FISSION PRODUCT BARRIER DEGRADATION

Fuel Clad Barrier Emergency Action Levels:

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

Primary Coolant Activity Level (FCB1)

Loss: RCS Dose Equivalent Iodine > 300 µCi/gm as indicated by:

a. Dose Rate at one foot from Primary Sample Panel > 950 mR/hr

OR

b. -4 RAB RADIOCHEMISTRY LAB area radiation monitor (ARM-IRE-5020) > 125 mR/hr

OR

c. Chemistry sample results

Potential Loss: Not Applicable

Basis:

The radiation monitor values given are assumed valid when the primary sample panel valves are open receiving flow from the RCS.

The radiation monitor values were determined by calculating various coolant radionuclide concentrations postulated to result from a 10% gap inventory release at Waterford 3. This alternate method to PASS sampling of determining fuel degradation was developed in HP-CALC-2001-001, PASS Elimination and accepted by NRC when Waterford 3 eliminated the PASS. 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.

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

FISSION PRODUCT BARRIER DEGRADATION

Fuel Clad Barrier Emergency Action Levels:

Core Exit Thermocouple Readings (FCB2)

Loss: Core Exit Thermocouple readings ≥ 1200 degrees F

Potential Loss: Core Exit Thermocouple readings ≥ 700 degrees F

Basis:

The Loss EAL of ≥ 1200° F is consistent with the NEI 99-01. The elevated temperature corresponds to significant superheating of the coolant and is indicative of a loss of the Fuel Clad Barrier. Other references (EC-S98-001, "EOP Action Value Bases" and CE-NPSD-241, "Development of the Comprehensive Procedure Guideline for Core Damage Assessment," Task 467) indicate that clad rupture due to high temperature is not expected for CET temperature readings of less than 1200° F.

The Potential Loss setpoint of CET temperatures ≥ 700° F is consistent with Emergency Operating Procedures (EOPs) and is used as an indication of a loss of subcooling conditions in the RCS. It is consistent with the criteria developed in NEI 99-01. The elevated temperature corresponds to a loss of subcooling and is indicative of a Potential Loss of the Fuel Clad Barrier. This criteria is supplemented by further plant specific criteria for diagnosis of loss of subcooling given in Potential Loss EAL FCB3.

FISSION PRODUCT BARRIER DEGRADATION

Fuel Clad Barrier Emergency Action Levels:

Reactor Vessel Water Level (FCB3)

Loss: Not Applicable

Potential Loss: RVLMS upper plenum level 0%.

Basis:

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

As part of its Inadequate Core Cooling Instrumentation, Waterford 3 uses a Reactor Vessel Level Monitoring System (RVLMS) that is displayed to the operators and can measure water level from near the top of the active fuel. The lowest point where monitoring is provided in this system is 12.6" above the fuel alignment plate. This monitoring point is equal to 0% upper plenum RVLMS level. This is consistent with the EOPs as follows: The Waterford 3 EOPs, in OP-902-008, Functional Recovery, use an acceptance criteria for RCS and core heat removal of RVLMS upper plenum level $\geq$ 20%. If the level is below 20%, then contingency actions must be taken and the criterion is considered not met. The next discrete measurement point below 20 % upper plenum level is 0% level.

FISSION PRODUCT BARRIER DEGRADATION

Fuel Clad Barrier Emergency Action Levels:

Containment Radiation Monitoring (FCB4)

Loss: Containment High Range Radiation Monitor (ARM-IRE-5400AS or ARM-IRE-5400BS) > 1000 R/hr.

Potential Loss: Not Applicable

Basis:

This reading is a value which indicates the release of reactor coolant, with elevated activity indicative of fuel damage, into the containment. The reading is 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. Reference Waterford 3 Engineering Calculation EC-S03-008. Source documents are HP-CALC-93-005, "Containment Atmosphere Radiation Monitor Setpoint Calculation," NUREG 1228, "Source Term Estimation During Incident Response to Severe Nuclear Power Plant Accidents" and EC-S98-002, "Waterford 3 Chapter 15 Non-LOCA Dose Calculation." It assumes normal (NUREG 1228) gas gap fractions, leak into RCS and then into containment, and containment spray initiation impact. 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 radiation monitor value is higher than that specified for RCS barrier Loss EAL **RCB3**. Thus, this EAL indicates a loss of **both** the fuel clad barrier **and** a loss of the RCS barrier.

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