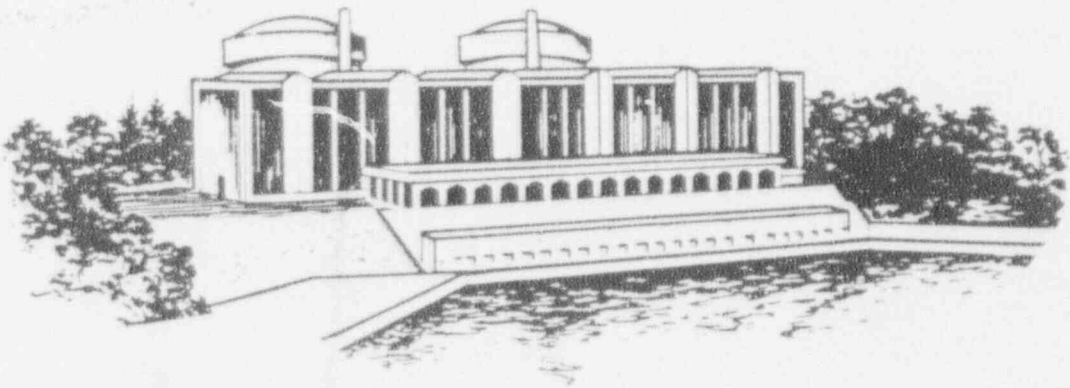
# EMERGENCY ACTION LEVELS

# TECHNICAL BASIS DOCUMENT



CALVERT CLIFFS

NUCLEAR POWER PLANT

REVISION 0

JUNE 15, 1993

BALTIMORE GAS AND ELECTRIC

# CALVERT CLIFFS NUCLEAR POWER PLANT UNITS 1 & 2

## EMERGENCY ACTION LEVELS TECHNICAL BASIS DOCUMENT

REVISION 0
June 15, 1993

| | | | |
|---|---|---|---|
| PREPARED BY: | John A. Fruto<br>Ogden Project Manager | DATE: | 6/16/93 |
| REVIEWED BY: | Edward A Rose<br>Emergency Planning - Emergency Planning Analyst | DATE: | 6/21/93 |
| REVIEWED BY: | Mike N<br>Plant Operations - Shift Supervisor | DATE: | 6/22/93 |
| REVIEWED BY: | Raymond A Hoffman<br>Operations Requalification Training - Instructor | DATE: | 6/23/93 |
| REVIEWED BY: | Chad Conatser<br>Chemistry Programs - Chemist | DATE: | 6-24-93 |
| REVIEWED BY: | Lawrence Smialek<br>Radiation Safety - Sr. Plant Health Physicist | DATE: | 6-23-93 |
| REVIEWED BY: | [illegible]<br>Nuclear Engineering - Engineer | DATE: | 6/29/93 |
| REVIEWED BY: | Marilyn K Newman<br>Security - Security Programs Specialist | DATE: | 6/23/93 |
| REVIEWED BY: | John M Osborne<br>Licensing - Nuclear Regulatory Analyst | DATE: | 6/22/93 |
| APPROVED BY: | [illegible]<br>Emergency Planning Unit - Supervisor | DATE: | 6.24.93 |
| REVIEWED BY: | [illegible] 93-51<br>PORC Meeting No. | DATE: | 7-9-93 |
| APPROVED BY: | [illegible]<br>Plant General Manager | DATE: | 7/9/93 |

## TABLES

# GENERAL NOTES FOR EAL TECHNICAL BASIS

The following general notes apply to the Calvert Cliffs EAL Technical Basis information:

1. The format of the EAL Technical Basis information was developed to address training needs, to facilitate NRC approval, and to facilitate future revisions and 10 CFR 50.54(q) evaluations.

2. NUMARC generic information is quoted directly from NUMARC/NESP-007, Revision 2, dated January 1992. Changes from the NUMARC text are denoted by carat marks (< >). Such changes are based on the following criteria:

   - To put the NUMARC generic information in its proper context such as when it refers to a section of the NUMARC document.

   - To rename Initiating Conditions (ICs) from their NUMARC designation to the corresponding Calvert Cliffs designation.

   - To delete information that does not apply such as reference to BWR information.

3. The EAL Technical Basis information is organized by Event Category which is shown by the Title on each page:

   - Radioactivity Releases (R)
   - Fission Product Barrier Degradation (B)
   - SecurTy (T)
   - EQuipment Failure (Q)
   - Fire (I)
   - Natural Phenomena (N)
   - Electrical (E)
   - Other Hazards (O)

   Calvert Cliffs designations use two letters followed by one number. *The identifier numbers were selected so that they would not overlap with NUMARC IC designators and thereby cause confusion.* The first letter corresponds to the event category as shown above. The second letter corresponds to the emergency classification level for the IC:

   - U - (Notification of) Unusual Event
   - A - Alert
   - S - Site Emergency
   - G - General Emergency

   The number designates whether the IC is the first, second, third, etc., IC for that event category under that emergency classification. For example, BU2 is the identifier number for the second Fission Product Barrier Degradation category IC in the Unusual Event classification, EG1 is the first Electrical category IC in the General Emergency classification, etc.

   Similarly, Calvert Cliffs Fission Barrier EALs also use different designators than NUMARC. They are:

   - FCB - Fuel Clad Barrier
   - RCB - RCS Barrier
   - CNB - CoNtainment Barrier

4. Calvert Cliffs Operational Modes are referred to by the corresponding Technical Specification Table 1.1 numbers. These are:

   - Mode 1 - Power Operation
   - Mode 2 - Startup
   - Mode 3 - Hot Standby
   - Mode 4 - Hot Shutdown
   - Mode 5 - Cold Shutdown
   - Mode 6 - Refueling

Please refer to the Tech Spec table for the corresponding temperature, pressure, and reactivity parameters for each of these operational modes. *Operational modes applying to ICs/EALs are based on the operational mode that the plant was in immediately before the event sequence leading to entry into the emergency classification.*

For example, events/conditions addressed by ICs applicable to Mode 1 (Power Operation) are expected to lead to reactor trip which should bring the plant to Mode 3 (Hot Standby). However, the appropriate emergency classification would still be based on the applicable ICs for Mode 1 operation for these events/conditions.

5. The "Plant-Specific Basis" section for each IC/EAL provides the description of how NUMARC generic information was applied to develop Calvert Cliffs EALs. Supporting procedures, calculations, their underlying bases and assumptions, and their results are fully described in the "Plant-Specific Basis" section, as appropriate.

6. Frequently used terms are defined below:

*AC* - Alternating Current

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

*All* - Applies to Operational Modes 1 through 6 (listed above) plus defueled mode.

*AT LEAST* - Greater than or equal to

*ATWS* - Anticipated Transient Without Scram

*Barrier* - Same as Fission Product Barrier below.

*Barrier Monitoring Ability* - This must be considered as an SEC judgement factor in determining whether a fission product barrier is lost or potentially lost. Decreased ability to monitor a barrier results from a loss of/lack of reliable indicators, including instrumentation operability concerns, readings from portable instrumentation, and consideration for offsite monitoring results.

*Can NOT* - The final safety function status is of concern, not merely the inability to meet certain intermediate status check conditions.

*CDE* - Committed Dose Equivalent as defined in 10 CFR 20.1003

*CEA* - Control Element Assembly

*CEDE* - Committed Effective Dose Equivalent as defined in 10 CFR 20.1003

*CEDM* - Control Element Drive Mechanism

*CET* - Core Exit Thermocouple

*CFM* - Cubic Feet per Minute

*CNTMT* - Containment

*Compensatory non-alarming indications* - Includes computer based information such as SPDS. This should include all computer systems available for this use depending on specific plant design and subsequent retrofits.

*CPM* - Counts Per Minute

*CSFST* - Critical Safety Function Status Tree

*CST* - Condensate Storage Tank

*DAC* - Derived Air Concentration

*DC* - Direct Current

*Dominant accident sequences* - These will lead to degradation of all fission product barriers. They include ATWS and Station Blackout sequences that are separately addressed under the Equipment Failure and Electrical categories, respectively, as well as by the Fission Product Barrier Degradation EAL Tables.

*ECCS* - Emergency Core Cooling System

*EDE* - Effective Dose Equivalent as defined in 10 CFR 20.1003

*Emergency Action Levels (EAL)* - A pre-determined, site-specific, observable threshold for a plant Initiating Condition that places the plant in a given Emergency Class. An EAL can be: an instrument reading, an equipment status indicator, a measurable parameter (on-site or off-site), a discrete observable event, results of analyses, entry into specific emergency operating procedures, or another phenomenon which, if it occurs, indicates entry into a particular Emergency Class.

*Emergency Class* - Same as Emergency Classification Level below.

*Emergency Classification Level* - These are taken from 10 CFR 50, Appendix E. They are, in escalating order: (Notification of) Unusual Event (UE), Alert, Site Emergency, and General Emergency (GE).

*Fission Product Barrier* - One of the three principal barriers to uncontrolled release of radionuclides: Fuel Clad, Reactor Coolant System (RCS), and the Containment building (CNTMT).

*FOST* - Fuel Oil Storage Tank

*Fuel Clad* - The zirconium alloy tubes that contain the fuel pellets.

*General Emergency (GE)* - Events are in process or have occurred which involve actual or *imminent* substantial core degradation or melting with potential for loss of containment integrity. Releases can reasonably be expected to exceed EPA Protective Action Guide (PAG) exposure levels off-site for more than the immediate site area.

*GPM* - Gallons Per Minute

*Inadvertent* - Accidental or unintentional, *e.g.*, the event occurred because procedures were not strictly adhered to.

*Imminent* - Refers to anticipated degradation of any fission product barrier within 2 hours based on a projection of current safety system performance.

*In service* - A component or system in the appropriate configuration for normal operation and is considered "operable" as defined in the Calvert Cliffs Technical Specifications Section 1.6.

*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.

*KV (kV)* - Kilovolts, *i.e.*, thousand volts

*LOCA* - Loss of Coolant Accident

*Loss* (of a fission product barrier) - A severe challenge to a fission product barrier exists such that the barrier is considered incapable of performing its safety function.

*Millirem* - One thousandth of a rem

*MPH* - Miles Per Hour

*NOT Effective* - Corrective actions do not yield appropriate or satisfactory results based on available operable instrumentation readings.

*Notification of Unusual Event (NOUE)* - Same as Unusual Event below.

*Planned* - Loss of a component or system due to expected events such as scheduled maintenance and testing activities.

*Potential Loss* (of a fission product barrier) - A challenge to a fission product barrier exists such that the barrier is considered degraded in its ability to perform its safety function.

*PSIG* - Pounds per Square Inch Gauge

*PTS* - Pressurized Thermal Shock

*PWST* - Pretreated Water Storage Tank

*PZR* - Pressurizer

*RCS* - Reactor Coolant System

*RCP* - Reactor Coolant Pump

*Rem* - Unit of radiation dose as defined in 10 CFR 20.1004

*Required* - Entry into a given procedure is neither optional nor merely suggested; rather, it is imperative based on existing conditions.

*RFP* - Refueling Pool

*RTP* - Rated Thermal Power

*RVLMS* - Reactor Vessel Level Monitoring System

*RWT* - Refueling Water Tank

*SDC* - Shutdown Cooling

*SDCS* - Shutdown Cooling System

*SEC* - Site Emergency Coordinator

*SG* - Steam Generator

*Sievert (Sv)* - Unit of radiation dose equivalent to 100 rem

*Significant transient* - (See also, "Transient", below.) Includes response to automatic or manually initiated functions such as scrams, runbacks involving greater than 25% thermal power change, ECCS injections, or thermal power oscillations of 10% or greater.

*SIT* - Safety Injection Tank

*Site Area Emergency (SAE)* - Events are in process or have occurred which involve actual or likely major failures of plant functions needed for protection of the public. Any releases are not expected to result in exposure levels which exceed EPA Protective Action Guide (PAG) exposure levels except near the site boundary.

*Site Emergency* - Same as Site Area Emergency above.

*TEDE* - Total Effective Dose Equivalent as defined in 10 CFR 20.1003

*Transient* - A condition that is:

- Beyond the expected steady-state fluctuations in temperature, pressure, power level, or water level, and
- Beyond the normal manipulations of the Control Room operating crew, and
- Expected to require actuation of fast-acting automatic control or protection systems to bring the reactor to a new safe, steady-state condition.

*Uncontrolled* means that given condition is not the result of planned actions by the plant staff.

*Unisolable* means that actions taken from the Main Control Board or locally are not successful in eliminating the leakage path.

*Unplanned* is used to preclude the declaration of an emergency where a component or system has been removed intentionally from service (e.g., for maintenance and/or testing activities). As used in the context of rad releases, "unplanned" includes any release for which a radioactive discharge permit was not prepared, or a release that exceeds the conditions (*e.g.*, minimum dilution flow, maximum discharge flow, alarm setpoints, etc.) on the applicable permit.

*Unusual Event (UE)* - Events are in process or have occurred which indicate a potential degradation of the level of safety of the plant. No releases of radioactive material requiring off-site response or monitoring are expected unless further degradation of safety systems occurs.

*Valid* means that the indication is from instrumentation determined to be operable in accordance with the Technical Specifications or has been verified by other independent methods such as indications displayed on the control panels, reports from plant personnel, or radiological survey results.

*WRNGM* - Wide Range Noble Gas Monitor

| Table G-1: Comparison of NUMARC Guidelines to BG&E ICs<br>NUMARC Abnormal Radiation Levels/Radiological Effluent Category | | |
|---|---|---|
| Emergency Class | Generic NUMARC IC | Calvert Cliffs IC |
| Unusual Event | AU1 - Any Unplanned Release of Gaseous or Liquid Radioactivity to the Environment That Exceeds Two Times the Radiological Technical Specifications for 60 Minutes or Longer | RU1 - Unplanned Radioactive Release Exceeding 2 X Tech Spec Limits for AT LEAST 60 Minutes |
| | AU2 - Unexpected Increase in Plant Radiation<> | RU2 - Unexpected Increase in Plant Radiation<br>RU3 - Potential Degradation of Containment of Dry Stored Spent Fuel |
| Alert | AA1 - Any Unplanned Release of Gaseous or Liquid Radioactivity to the Environment That Exceeds 200 Times Radiological Technical Specifications for 15 Minutes or Longer | RA1 - Unplanned Radioactive Release Exceeding 200 X Tech Spec Limits for AT LEAST 15 Minutes |
| | AA2 - Major Damage to Irradiated Fuel or Loss of Water Level That Has or Will Result in the Uncovering of Irradiated Fuel Outside the Reactor Vessel | RA2 - Damage OR Uncovery of Single Irradiated Fuel Assembly Outside the Reactor Vessel |
| | AA3 - Release of Radioactive Material or Increases in Radiation Levels Within the Facility That Impedes Operation of Systems Required to Maintain Safe Operations or to Establish or Maintain Cold Shutdown | RA3 - Radiation Increases That Impede Safe Plant Operation |
| Site Emergency | AS1 - Boundary Dose Resulting From an Actual or Imminent Release of Gaseous Radioactivity Exceeds 100 mR Whole Body or 500 mR Child Thyroid for the Actual or Projected Duration of the Release | RS1 - Off-Site Dose of AT LEAST 0.1 Rem (EDE + CEDE) Or 0.5 Rem CDE Thyroid |
| General Emergency | AG1 - Boundary Dose Resulting From an Actual or Imminent Release of Gaseous Radioactivity Exceeds 1000 mR Whole Body or 5000 mR Child Thyroid for the Actual or Projected Duration of the Release | RG1 - Off-Site Dose of AT LEAST 1 Rem (EDE +CEDE) Or 5 Rem (CDE) Thyroid |

| Table G-2: Comparison of NUMARC Guidelines to BG&E ICs<br>NUMARC Hazards and Other Conditions Affecting Plant Safety Category | | |
|---|---|---|
| Emergency Class | Generic NUMARC IC | Calvert Cliffs IC |
| Unusual Event | HU1 - Natural and Destructive Phenomena Affecting the Protected Area | DU3 - Destructive Phenomena<br>NU1 - Natural Phenomena |
| | HU2 - Fire Within Protected Area Boundary Not Extinguished Within 15 Minutes of Detection | IU1 - Fire Within Protected Area Boundary Not Extinguished Within 15 Minutes of Detection |
| | HU3 - Release of Toxic or Flammable Gases Deemed Detrimental to Safe Operation of the Plant | DU2 - Toxic or Flammable Gases |
| | HU4 - Confirmed Security Event Which Indicates a Potential Degradation in the Level of Safety of the Plant | TU1 - Confirmed Security Event With Potential Degradation in the Level of Safety of the Plant |
| | HU5 - Other Conditions Existing Which in the Judgement of the Emergency Director Warrant Declaration of an Unusual Event | OU1 - SEC Judgement |
| Alert | HA1 - Natural and Destructive Phenomena Affecting the Plant Vital Area | OA3 - Destructive Phenomena Affecting Safe Shutdown<br>NA1 - Natural Phenomena Affecting Safe Shutdown |
| | HA2 - Fire or Explosion Affecting the Operability of Plant Safety Systems Required to Establish or Maintain Safe Shutdown | IA1 - Fire or Explosion Affecting Safe Shutdown |
| | HA3 - Release of Toxic or Flammable Gases Within a Facility Structure Which Jeopardizes Operation of Systems Required to Establish or Maintain Cold Shutdown | OA2 - Toxic or Flammable Gases Affecting Safe Shutdown |
| | HA4 - Security Event in a Plant Protected Area | TA1 - Security Event in the Plant Protected Area |
| | HA5 - Control Room Evacuation Has Been Initiated | OA4 - Control Room Being Evacuated |
| | HA6 - Other Conditions Existing Which in the Judgement of the Emergency Director Warrant Declaration of an Alert | OA1 - SEC Judgement |
| Site Emergency | HS1 - Security Event in Plant Vital Area | TS1 - Security Event in a Plant Vital Area |
| | HS2 - Control Room Evacuation Has Been Initiated and Plant Control Cannot be Established | OS2 - Control Room Has Been Evacuated and Timely Plant Control Can NOT Be Established |
| | HS3 - Other Conditions Existing Which in the Judgement of the Emergency Director Warrant Declaration of a Site Emergency | OS1 - SEC Judgement |
| General Emergency | HG1 - Security Event Resulting in Loss of Ability to Reach and Maintain Cold Shutdown | TG1 - Security Event Resulting in Loss of Ability to Reach AND Maintain Cold Shutdown |
| | HG2 - Other Conditions Existing Which in the Judgement of the Emergency Director Warrant Declaration of a General Emergency | OG1 - SEC Judgement |

| Table G-3: Comparison of NUMARC Guidelines to BG&E ICs<br>NUMARC System Malfunction Category | | |
|---|---|---|
| Emergency Class | Generic NUMARC IC | Calvert Cliffs IC |
| Unusual Event | SU1 - Loss of All Offsite Power to Essential Busses for Greater Than 15 Minutes | EU1 - Loss of Off-Site Power |
| | SU2 - Inability to Reach Required Shutdown Within Technical Specification Limits | QU4 - Inability to Reach Required MODE Within Technical Specification Limits |
| | SU3 - Unplanned Loss of All Safety System Annunciators for Greater Than 15 Minutes | QU2 - Unplanned Loss of Most or All Safety System Annunciators for GREATER THAN 15 Minutes |
| | SU4 - Fuel Clad Degradation | BU3 - Fuel Clad Degradation |
| | SU5 - RCS Leakage | BU2 - RCS Leakage |
| | SU6 - Unplanned Loss of All Onsite or Offsite Communications Capabilities | QU3 - Unplanned Loss of All On-Site or Off-Site Communications Capabilities |
| | SU7 - Unplanned Loss of Required DC Power During Cold Shutdown or Refueling Mode for Greater Than 15 Minutes | EU2 - Loss of Vital 125 Volt DC Power for GREATER THAN 15 Minutes |
| | Shutdown EAL not currently addressed by NUMARC | QU1 - Unplanned Loss of Any Function Needed to Maintain Cold Shutdown |
| Alert | SA1 - Loss of All Offsite Power and Loss of All Onsite AC Power During Cold Shutdown or Refueling Mode | EA1 - Station Blackout While on Shutdown Cooling |
| | SA2 - Failure of Reactor Protection System Instrumentation to Complete or Initiate an Automatic Reactor Scram Once a Reactor Protection System Setpoint Has Been Exceeded and Manual Scram Was Successful | QA1 - Failure of Automatic Reactor Trip |
| | SA3 - Inability to Maintain Plant in Cold Shutdown | QA2 - Inability to Maintain Plant in Cold Shutdown |
| | SA4 - Unplanned Loss of Most or All Safety System Annunciation or Indication in Control Room With Either (1) a Significant Transient in Progress or (2) Compensatory Non-Alarming Indicators are Unavailable | QA3 - Unplanned Loss of Safety System Annunciators With Transient in Progress |
| | SA5 - AC Power Capability to Essential Busses Reduced to a Single Power Source for Greater Than 15 Minutes Such That Any Additional Single Failure Would Result in Station Blackout | EA2 - Only One AC Power Source Available to Supply 4kV Emergency Buses |
| Site Emergency | SS1 - Loss of All Offsite Power and Loss of All Onsite AC Power to Essential Busses | ES1 - Station Blackout |
| | SS2 - Failure of Reactor Protection System Instrumentation to Complete or Initiate an Automatic Reactor Scram Once a Reactor Protection System Setpoint Has Been Exceeded and Manual Scram Was NOT Successful | QS1 - Failure of BOTH Automatic AND Manual Reactor Trip |
| | SS3 - Loss of All Vital DC Power | EA3 - Loss of 125 Volt DC Power and Reactor Trip<br>ES2 - Loss of All 125 Volt DC Buses |

| Table G-3: Comparison of NUMARC Guidelines to BG&E ICs<br>NUMARC System Malfunction Category | | |
|---|---|---|
| Emergency Class | Generic NUMARC IC | Calvert Cliffs IC |
| Site Emergency (Continued) | SS4 - Complete Loss of Function Needed to Achieve or Maintain Hot Shutdown | GS2 - Complete Loss of Function Needed to Achieve or Maintain Hot Shutdown |
| | SS5 - Loss of Water Level That Has or Will Uncover Fuel in the Reactor Vessel | GS3 - Loss of Water Level That Can Uncover Fuel in the Reactor Vessel |
| | SS6 - Inability to Monitor a Significant Transient in Progress | ES2 - Loss of All 125 Volt DC Buses |
| General Emergency | SG1 - Prolonged Loss of All Off-Site Power and Prolonged Loss of All On-Site AC Power | EG1 - Prolonged Station Blackout |
| | SG2 - Failure of the Reactor Protection System and Manual Scram was NOT Successful and There is Indication of an Extreme Challenge to the Ability to Cool the Core | QG1 - Failure of BOTH Automatic AND Manual Reactor Trip -AND- Extreme Challenge to the Ability to Cool the Core |

| Table G-4: Comparison of NUMARC Guidelines to BG&E ICs<br>NUMARC Fission Product Barrier Degradation Category | | |
|---|---|---|
| Emergency Class | Generic NUMARC IC | Calvert Cliffs IC |
| Unusual Event | FU1 - ANY Loss or ANY Potential Loss of Containment | BU1 - Loss OR Potential Loss of CNTMT Barrier |
| Alert | FA1 - ANY Loss or ANY Potential Loss of EITHER Fuel Clad OR RCS | BA1 - Loss OR Potential Loss of EITHER Fuel Clad Barrier OR RCS Barrier |
| Site Emergency | FS1 - Loss of BOTH Fuel Clad AND RCS<br>OR<br>Potential Loss of BOTH Fuel Clad AND RCS<br>OR<br>Potential Loss of EITHER Fuel Clad OR RCS and Loss of ANY Additional Barrier | BS1 - Loss of Potential Loss of ANY Two Barriers |
| General Emergency | FG1 - Loss of ANY Two Barriers<br>AND<br>Potential Loss of Third Barrier | BG1 - Loss of Two Barriers AND Potential Loss of Third Barrier |

| Table G-5: Comparison of NUMARC Guidelines to BG&E EALs<br>NUMARC Fission Product Barrier Degradation Category | | |
|---|---|---|
| EALs | Generic NUMARC EAL | Calvert Cliffs EAL |
| Fuel Clad Barrier | Fuel Clad 1 - Critical Safety Function Status | FCB1 - Safety Function Status/Functional Recovery |
| | Fuel Clad 2 - Primary Coolant Activity Level | FCB3 - Radiation |
| | Fuel Clad 3 - Core Exit Thermocouple Readings | FCB1 - Safety Function Status/Functional Recovery<br>FCB2 - Temperature |
| | Fuel Clad 4 - Reactor Vessel Water Level | FCB4 - Reactor Vessel Water Level |
| | Fuel Clad 5 - Containment Radiation Monitoring | FCB3 - Radiation |
| | Fuel Clad 6 - Other (Site-Specific) Indications | FCB5 - SEC Judgement |
| | Fuel Clad 7 - Emergency Director Judgement | FCB5 - SEC Judgement |
| RCS Barrier | RCS 1 - Critical Safety Function Status | RCB1 - Safety Function Status/Functional Recovery |
| | RCS 2 - RCS Leak Rate | RCB2 - Temperature<br>RCB4 - Coolant Leakage |
| | RCS 3 - SG Tube Rupture | RCB2 - Temperature<br>RCB4 - Coolant Leakage |
| | RCS 4 - Containment Radiation Monitoring | RCB3 - Radiation |
| | RCS 5 - Other (site-specific) Indications | RCB1 - Safety Function Status/Functional Recovery<br>RCB4 - Coolant Leakage |
| | RCS 6 - Emergency Director Judgement | RCB5 - SEC Judgement |
| Containment Barrier | Containment 1 - Critical Safety Function Status | CNB1 - Safety Function Status/Functional Recovery |
| | Containment 2 - Containment Pressure | CNB5 - Pressure |
| | Containment 3 - Containment Isolation Valve Status After Containment Isolation | CNB4 - Coolant Leakage |
| | Containment 4 - SG Secondary Side Release With Primary to Secondary Leakage | CNB4 - Coolant Leakage |
| | Containment 5 - Significant Radioactive Inventory in Containment | CNB3 - Radiation |
| | Containment 6 - Core Exit Thermocouple Readings | CNB2 - Temperature |
| | Containment 7 - Other (Site-Specific) Indications | CNB1 - Safety Function Status/Functional Recovery<br>CNB3 - Radiation |
| | Containment 8 - Emergency Director Judgement | CNB6 - SEC Judgement |

# OVERSIZE DOCUMENT PAGE PULLED

# SEE APERTURE CARDS

NUMBER OF OVERSIZE PAGES FILMED ON APERTURE CARDS 1

9307280166-01

APERTURE CARD/HARD COPY AVAILABLE FROM

RECORDS AND REPORTS MANAGEMENT BRANCH

# RADIOACTIVITY RELEASE

Emergency Classification Level: UNUSUAL EVENT

Applicable Operational Modes: All

Calvert Cliffs Initiating Condition:

## RU1 Unplanned Radioactive Release Exceeding 2 X Tech Spec Limits for AT LEAST 60 Minutes

NUMARC Recognition Category: Abnormal Rad Levels/Radiological Effluent

NUMARC Initiating Condition:

AU1 Any Unplanned Release of Gaseous or Liquid Radioactivity to the Environment that Exceeds Two Times the Radiological Technical Specifications for 60 Minutes or Longer

Barrier: Not Applicable

NUMARC Generic Basis:

*Unplanned*, as used in this context, includes any release for which a radioactive discharge permit was not prepared, or a release that exceeds the conditions (*e.g.*, minimum dilution flow, maximum discharge flow, alarm setpoints, etc.) on the applicable permit.

*Valid* means that a radiation monitor reading has been confirmed by the operators to be correct.

Unplanned releases in excess of two times the site technical specifications that continue for 60 minutes or longer represent an uncontrolled situation and hence, a potential degradation in the level of safety. The final integrated dose (which is very low in the Unusual Event emergency class) is not the primary concern here; it is the degradation in plant control implied by the fact that the release was not isolated within 60 minutes. Therefore, it is not intended that the release be averaged over 60 minutes. For example, a release of 4 times TS for 30 minutes does not exceed this initiating condition. Further, the Emergency Director should not wait until 60 minutes has elapsed, but should declare the event as soon as it is determined that the release duration has exceeded or will likely exceed 60 minutes.

For sites that have eliminated effluent technical specifications as provided in NRC Generic Letter 89-01, the corresponding maximum limit from the site's Offsite Dose Calculation Manual should be used as the numeric basis of the EAL.

10 CFR 50.72 requires a non-emergency four hour report for release that exceeds 2 times maximum permissible concentration (MPC) in unrestricted areas averaged over a period of one hour. There is generally more than one applicable technical specification (*e.g.*, air dose rate, organ dose rate, organ doses, release rate, etc.). Often, effluent monitor alarms are based on instantaneous release rates. Depending on the source term, other technical specifications may be more limiting. For this reason, the EALs should trigger an assessment of all applicable specifications.

Monitor indications should be calculated on the basis of the methodology of the site Offsite Dose Calculation Manual (ODCM), or other site procedures that are used to demonstrate compliance with 10 CFR 20 and/or 10 CFR 50 Appendix I requirements. Annual average meteorology should be used where allowed. <>

In <Generic> EAL 3, the 0.10 <mrem/h> value is based on a proration of two times the 500 mrem/yr basis of the 10 CFR 20 non-occupational <DAC> limits, rounded down to 0.10 <mrem/h>. If other Site-Specific values are applicable, these should be used.

Some sites may find it advantageous to address gaseous and liquid releases with separate initiating conditions and EALs.

Plant-Specific Information:

With the change in 10 CFR Part 20, the term MPC has been superseded by the term DAC (Derived Air Concentration). The new rule has also reduced the non-occupational radiation exposure from 500 mrem/yr to 100 mrem/yr. Calvert Cliffs will use the 500 mrem/yr value consistent with its Technical Specifications.

Calvert Cliffs does not have either a perimeter radiation monitoring system or automated real-time dose assessment capability. Thus, the generic EALs recommended by NUMARC do not apply to the Calvert Cliffs Nuclear Power Plant.

The main plant vents consist of the exhaust flow from the auxiliary building ventilation systems and the condensate offgas system. Batch releases from the Waste Gas Decay Tanks, containment vents and containment purges are also directed into this stream. Per ODCM Attachment 7, the Unit 1 and Unit 2 vent flow rates are assumed to be 59.4 $m^3$/sec and 47.1 $m^3$/sec, respectively. Each plant vent is monitored by a beta sensitive plastic scintillator Wide Range Noble Gas Monitor (WRNGM 1-RIC-5415 and 2-RIC-5415) which is displayed in $\mu$Ci/sec and a Geiger-Muller tube Main Vent Monitor (1-RI-5415 and 2-RI-5415) which is displayed in CPM. The values used for the EALs were determined assuming annual average meteorology, RCS noble gas concentrations, and using dose conversion factors used for emergency preparedness off-site dose assessment. The total gaseous release corresponding to 2 times Technical Specification limits is approximately 0.114 mrem in one hour, as calculated using the equation below.

2 x Technical Specification = 2 x 500 mrem/year = 1000 mrem/year

Hours/year = 24 x 365 = 8760 hours/year

(1000 mrem/year) / (8760 hours/year) = 0.114 mrem/hour (or 1.14E-3 mSv/hour)

The values for the vent radiation monitor readings are based on 90% of the 2 DAC (derived air concentration) at the site boundary. This reduction will account for events that may result in releases through both unit vents. The 10% factor allowance for the other unit vent is conservative because it is two to three orders of magnitude larger than the normal releases through each vent. For the main vent monitors, which read in CPM, the Unit 1 flow rate is assumed because it will result in the lowest concentration.

RIC-5415 EAL Threshold

Per Reference 5, Tech Spec limit corresponds to 1.8 E+5 $\mu$Ci/sec (site total)

2 x 1.8 E+5 $\mu$Ci/sec = 3.6 E+5 $\mu$Ci/sec

Assume event in one unit, allow 10% for release from other unit

RIC-5415 EAL Threshold = 0.9 x 3.6 E+5 $\mu$Ci/sec

= 3.24 E+5 $\mu$Ci/sec

Read as 3.2 E+5 $\mu$Ci/sec

Thus, EAL 1 is written as:

| |
|---|
| Valid WRNGM (RIC-5415) Reading of AT LEAST 3.2 E+5 $\mu$Ci/sec for GREATER THAN 60 Minutes |

Minimum Concentration Corresponding to RI-5415 Reading

$$\text{Concentration} = \frac{\text{Release rate } (\mu\text{Ci/sec})}{\text{Flow rate (cc/sec)}}$$

Unit 1 ODCM flow rates = 59.4 $m^3$/sec

$$\text{Unit 1 Concentration} = \frac{3.24\text{ E+5 } \mu\text{Ci/sec}}{59.4\ m^3/\text{sec} \times 10^6\ cc/m^3} = 5.5\text{ E-3 } \mu\text{Ci/cc}$$

Unit 2 ODCM flow rates = 47.1 $m^3$/sec

$$\text{Unit 2 Concentration} = \frac{3.24\text{ E+5 } \mu\text{Ci/sec}}{47.1\ m^3/\text{sec} \times 10^6\ cc/m^3} = 6.9\text{ E-3 } \mu\text{Ci/cc}$$

Convert Concentration to CPM for RI-5415 Reading
(See Reference 5 for Isotopic Mixture)

| Isotope | RCS Concentration | % Total | Unit 1 Concentration ($\mu$Ci/cc) | Unit 2 Concentration ($\mu$Ci/cc) | Monitor Efficiency (CPM/$10^6$) | Unit 1 CPM | Unit 2 CPM |
|---|---|---|---|---|---|---|---|
| Kr-85 | 0.43 | 9.62 | 5.3 E-4 | 6.6 E-4 | 35 | 1.9 E4 | 2.3 E4 |
| Kr-85m | 0.16 | 3.58 | 2.0 E-4 | 2.4 E-4 | 55 | 1.1 E4 | 1.3 E4 |
| Kr-87 | 0.15 | 3.36 | 1.8 E-4 | 2.3 E-4 | 218 | 4.0 E4 | 5.0 E4 |
| Kr-88 | 0.28 | 6.36 | 3.4 E-4 | 4.3 E-4 | 289 | 9.8 E4 | 1.2 E5 |
| Xe-133 | 2.6 | 58.17 | 3.2 E-3 | 4.0 E-3 | 1.87 | 6.0 E3 | 7.5 E3 |
| Xe-135 | 0.85 | 19.01 | 1.0 E-3 | 1.3 E-3 | 70 | 7.0 E4 | 9.1 E4 |
| Totals | 4.47 | 100.00 | 5.5 E-3 | 6.9 E-3 | | 2.4 E5 | 3.0 E5 |
| | | | | | | Use lower CPM value and read as 2.0 E5 CPM | |

Thus, EAL 2 is written as:

| |
|---|
| Valid Main Vent Monitor (RI-5415) Reading of AT LEAST 2.0 E+5 CPM for GREATER THAN 60 Minutes |

In a similar manner to that shown for RI-5415, values were determined for the Waste Processing Monitor (1-RI-5410 and 2-RI-5410) assuming noble gas distribution for Waste Gas Decay Tank rupture, average annual meteorology, and a nominal waste processing ventilation flow of 23.4 $m^3$/sec (49,500 CFM). At 2 DAC at the site boundary, per Reference 5 this corresponds to a reading of 4.0 E+5 CPM. Thus, EAL 3 is written as:

| |
|---|
| Valid Waste Processing Monitor (RI-5410) Reading of AT LEAST 4.0 E+5 CPM for GREATER THAN 60 Minutes |

In a similar manner to that shown for RI-5415, values were determined for the Fuel Handling Monitor (O-RI-5420) assuming only monitor response to noble gas released from a Fuel Handling Incident, average annual meteorology, and a nominal fuel handling area ventilation flow of 15.1 $m^3$/sec (32,000 CFM). At 2 DAC at the site boundary, per Reference 5 this corresponds to a reading of 3.4 E+5 CPM.

Thus, EAL 4 is written as:

| |
|---|
| Valid Fuel Handling Monitor (RI-5420) Reading of AT LEAST 3.4 E+5 CPM for GREATER THAN 60 Minutes |

Analysis was also performed for potential releases through Access Control Point and ECCS Pump Room. Per Reference 5, for each of these locations 2 DAC at the site boundary correspond to monitor readings that are greater than 1 E+6 CPM, *i.e.*, off-scale high.

Thus, EAL 5 is written as:

| |
|---|
| Valid Access Control Monitor (RI-5425) Reading Off-Scale HIGH for GREATER THAN 60 Minutes |

EAL 6 is written as:

| |
|---|
| Valid ECCS PP Room Monitor (RI-5406) Reading Off-Scale HIGH for GREATER THAN 60 Minutes |

Liquid effluent is monitored by the Liquid Waste Discharge Radiation Monitor (O-R E-2201). A high radiation alarm from this monitor will result in a signal to close the Liquid Waste Discharge Valves. If these valves will not shut, the operators will stop the pump being used for the discharge and shut the Liquid Waste RMS Outlet valve. It is extremely improbable that a liquid effluent discharge for greater than 60 minutes could exist following a valid monitor alarm. Thus, no EAL for liquid effluent release is required.

Source Documents/References/Calculations:

1. Technical Specifications
   - TS 3/4.3.3 Monitoring Instrumentation - Radiation Monitoring Instrumentation
   - TS 3/4.11, Radioactive Effluents

2. Abnormal Operating Procedures
   - AOP-6B, Accidental Release of Radioactive Liquid Waste

3. System Descriptions
   - No. 15, Radiation Monitoring System

4. Off-Site Dose Calculation Manual (ODCM) for the Baltimore Gas & Electric Company Calvert Cliffs Nuclear Power Plant

5. Radioactivity Release Emergency Action Levels, J.B. McIlvaine, JSB Associates, Inc., September 1990

6. 10 CFR Part 20, Standards for Protection Against Radiation; Final Rule, 56 FR 23360, May 21, 1991

Emergency Classification Level: UNUSUAL EVENT

Applicable Operational Modes: All

Calvert Cliffs Initiating Condition:

## RU2 Unexpected Increase in Plant Radiation

NUMARC Recognition Category: Abnormal Rad Levels/Radiological Effluent

NUMARC Initiating Condition:

AU2 Unexpected Increase in Plant Radiation < >

Barrier: Not Applicable

NUMARC Generic Basis:

*Valid* means that a radiation monitor reading has been confirmed by the operators to be correct.

<Events associated with this IC> tend to have long lead times relative to potential for radiological release outside the site boundary; thus, impact to public health and safety is very low. < >

In light of Reactor Cavity Seal failure incidents at two different PWRs occurring since 1984, explicit coverage of these types of events via EALs 1 <indication of uncontrolled water level decrease in the reactor refueling cavity with all irradiated fuel assemblies remaining water covered> and 2 <indication of uncontrolled water level decrease in the spent fuel and fuel transfer canal with all irradiated fuel assemblies remaining water covered> 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. < >

EAL <2 (valid Direct Area Radiation Monitor readings increase by a factor of 1000 over normal levels where Normal levels can be considered as the highest reading in the past twenty-four hours excluding the current peak value)> addresses unplanned increases of in-plant radiation levels that represent a degradation in the control of radioactive material, and represent a potential degradation in the level of safety of the plant. This <IC> escalates to an Alert per <IC RA2, Damage OR Uncovery of Irradiated Fuel Outside the Reactor Vessel, or IC RA3, Radiation Increases That Impede Safe Operation>.

Plant-Specific Information:

EALs related to dry storage of spent fuel in Horizontal Storage Modules are separately addressed under RU3, Potential Degradation of Containment of Dry Stored Spent Fuel.

Of concern in this IC are water level decreases over spent fuel that are sufficient to cause noticeable increases in measured radiation levels. Additionally, fuel handling incidents can lead to many of the same symptoms of increased plant radiation levels. Existence of spent fuel pool alarm (RI-5420), spent fuel pool area monitor alarm (RI-7024), or containment monitor (RI-5316A/B/C/D) reading of at least 100 mrem/h is used as the threshold for entry into this IC. One hundred mrem/h corresponds to the administrative limit for a high radiation area and is significantly higher than the dose rates expected for fuel handling.

Thus, EAL 1 is written as:

ADP-6D Or ADP-6E is Implemented AND Any of the Following:

- Valid Spent Fuel Pool Alarm (RI-5420)
- Valid Spent Fuel Pool Area Monitor Alarm (RI-7024)
- Valid Containment Radiation Monitor (RI-5316A/B/C/D) Reading of AT LEAST 100 mrem/h

EAL 2 is taken directly from NUMARC. Momentary increases due to events such as resin transfers or controlled movement of radioactive sources should not result in emergency declaration. Thus, a threshold of 5 minutes is selected to preclude such spikes. Certain radiation monitor alarms may go offscale high before reaching 1000 times normal readings.

Thus, EAL 2 is written as:

| |
|---|
| Valid Unexpected Rad Monitor Reading Offscale High OR GREATER THAN 1000 Times Normal Reading for GREATER THAN 5 Minutes |

*Valid* means that the indication is from instrumentation determined to be operable in accordance with the Technical Specifications or has been verified by other independent methods such as indications displayed on the control panels, reports from plant personnel, or radiological survey results.

The Unusual Event may be terminated when the following actions occur:

(1) The source has been identified,
(2) The source has been controlled or contained as appropriate, and
(3) Appropriate personnel radiation practices have been implemented.

Expected increases in radiation monitor readings due to controlled evolutions (such as lifting the reactor vessel head during refueling) should not result in emergency declaration. In-plant radiation level increases that would result in emergency declaration are also *unplanned, e.g.*, outside the limits established by an existing radioactive discharge permit.

Source Documents/References/Calculations:

1. System Descriptions
   - No. 10, Spent Fuel Pool and Spent Fuel Pool Cooling And Purification Systems
   - No. 13, Refueling Equipment
   - No. 15, Radiation Monitoring System

2. Abnormal Operating Procedures
   - AOP-6D, Fuel Handling Incident
   - AOP-6E, Loss of Refueling Pool Level

Emergency Classification Level: UNUSUAL EVENT

Applicable Operational Modes: ALL

Calvert Cliffs Initiating Condition:

## RU3 Potential Degradation of Containment of Dry Stored Spent Fuel

NUMARC Recognition Category: Abnormal Rad Levels/Radiological Effluent

NUMARC Initiating Condition:

AU2 Unexpected Increase in Plant Radiation < >

Barrier: Not Applicable

NUMARC Generic Basis:

*Valid* means that a radiation monitor reading has been confirmed by the operators to be correct.

<Events associated with this IC> tend to have long lead times relative to potential for radiological release outside the site boundary; thus, impact to public health and safety is very low. <>

<This IC> applies to plants with licensed dry storage of older irradiated spent fuel to address degradation of this spent fuel. One utility uses values of 2 R/hr at the face of any dry storage module or 1 R/hr one foot away from a damaged module. <>

Plant-Specific Information:

As a result of a meeting between BG&E Emergency Planning Staff and NRC Facilities Radiological Safety and Safeguards Branch personnel on July 16, 1992, the following EALs were developed regarding potential degradation of containment of dry stored spent fuel.

EAL 1 is written as:

| |
|---|
| Horizontal Storage Module (HSM) Access Door Contact Dose Rate GREATER THAN 500 mrem/h |

At 100 rem per Sievert, this corresponds to a dose rate of 5 (milli-Sieverts) mSv/h.

EAL 2 is written as:

| |
|---|
| Horizontal Storage Module (HSM) Side Wall Door Contact Dose Rate GREATER THAN 100 mrem/h |

This corresponds to a dose rate of 1 mSv/h.

EAL 3 is written as:

| |
|---|
| Any Unplanned Event Outside the Auxiliary Building Resulting in the Breach of a Dry Shielded Canister (DSC) Containing Spent Fuel |

*Unplanned* is used to preclude declaration of an emergency where the DSC has been intentionally opened for maintenance or repair activity in accordance with a valid radiation work permit.

EAL 4 is written as:

| |
|---|
| Dry Shielded Canister (DSC) Transfer Cask Containing Spent Fuel Has Been Dropped from the Trailer |

Source Documents/References/Calculations:

1. Letter dated September 24, 1992, L.B. Russell (BG&E) to U.S. Nuclear Regulatory Commission, re: Emergency Action Level Review Meeting held on July 16, 1992

2. BG E-01-121, Rev. 0, An Assessment of Storage Term Radiological Exposure Rates at the Calvert Cliffs NUHOMS® ISFSI, Pacific Nuclear Fuel Services, Inc., September 1990

Emergency Classification Level: ALERT

Applicable Operational Modes: All

Calvert Cliffs Initiating Condition:

## RA1 Unplanned Radioactive Release Exceeding 200 X Tech Spec Limits for AT LEAST 15 Minutes

NUMARC Recognition Category: Abnormal Rad Levels/Radiological Effluent

NUMARC Initiating Condition:

AA1 Any Unplanned Release of Gaseous or Liquid Radioactivity to the Environment that Exceeds 200 Times Radiological Technical Specifications for 15 Minutes or Longer

Barrier: Not Applicable

NUMARC Generic Basis:

*Valid* means that a radiation monitor reading has been confirmed by the operators to be correct.

This event escalates from the Unusual Event by escalating the magnitude of the release by a factor of 100. Prorating the 500 <mrem/yr> criterion for both time (8766 hr/yr) and the 200 multiplier, the associated site boundary dose rate would be 10 <mrem/h>. The required release duration was reduced to 15 minutes in recognition of the increased severity.

For sites that have eliminated effluent technical specifications as provided in NRC Generic Letter 89-01, the corresponding maximum limit from the site's Offsite Dose Calculation Manual, multiplied by 200, should be used as the numeric basis of this EAL.

Monitor indications should be calculated on the basis of the methodology of the site Offsite Dose Calculation Manual (ODCM), or other site procedures that are used to demonstrate compliance with 10 CFR 20 and/or 10 CFR 50 Appendix I requirements – adjusted upwards by a factor of 200. Annual average meteorology should be used where allowed. < >

In <Generic> EAL 3, the 10 <mrem/h> value is based on a proration of 200 times the 500 mrem/yr basis of the 10 CFR 20 non-occupational MPC limits, rounded down to 10 <mrem/h>. If other Site-Specific values are applicable, these should be used.

Plant-Specific Information:

With the change in 10 CFR Part 20, the term MPC has been superseded by the term DAC (Derived Air Concentration). The new rule has also reduced the non-occupational radiation exposure from 500 mrem/yr to 100 mrem/yr. Calvert Cliffs will use the 500 mrem/yr value consistent with its Technical Specifications.

Calvert Cliffs does not have either a perimeter radiation monitoring system or automated real-time dose assessment capability. Thus, the generic EALs recommended by NUMARC do not apply to the Calvert Cliffs Nuclear Power Plant.

A description of the applicable monitors and the methods used to calculate EAL values is shown in RU1, Unplanned Radioactive Release Exceeding 2 X Tech Spec Limits for GREATER THAN 60 Minutes. Values for this IC are based on the values shown in RU1 multiplied by 100. (See equation below.)

RA1 Threshold for RIC-5415, RI-5415

RU1 Value x 100 = RA1 Value

For RIC-5415

3.2 E+5 μCi/second x 100 = 3.2 E+7 μCi/second

For RI-5415

2.0 E+5 CPM x 100 = 2.0 E+7 CPM (Above top of scale)

The ECCS PP Room Monitors (1/2-RI-5406) and the Access Control Monitor (O-RI-5425) are not considered here because they will be offscale high at the Unusual Event emergency classification level. At the Alert level, the readings on the main vent monitors (1/2-RI-5415), the Waste Processing Vent Monitors (1/2-RI-5410), and the Fuel Handling Area Vent Monitor (O-RI-5420) correspond to readings well above the top of the range (1.0 E+6 CPM) for these instruments. Therefore, these monitors provide no useful information for this IC and are excluded from consideration.

Thus, EAL 1 is written as:

Valid WRNGM (RIC-5415) Reading of AT LEAST 3.2 E+7 μCi/sec for GREATER THAN 15 Minutes

The purpose of the Main Steam Effluent Radiation Monitor System is to monitor possible noble gas releases to the atmosphere from the main steam line through the atmospheric steam dump valves, the main steam safety relief valves, and the auxiliary feedwater steam turbine exhaust. The system includes two radiation monitors (1/2-RI-5421 and 1/2-RI-5421) for each unit - one radiation monitor for each steam generator. Each radiation detector is an ion chamber filled with xenon gas with a small "keep alive" source that produces a reading on the corresponding main control board rate meter of about $10^2$ R/hr.

The noble gas release rate of 3.2 E+7 μCi/second (which corresponds to a whole body dose of 10 mrem in one hour at the site boundary) may also occur through release via main steam safety valve or atmospheric dump valve. By reverse calculation using Attachment 3 of ERPIP 821 (see box below):

RA1 Threshold for RI-5421, RI-5422

Release Rate = 3.2 E+7 $\mu Ci/sec$ (see above)

Release Coefficient (for SG Tube Rupture) = 6.1 E+2 $\frac{\mu Ci/cm^3}{rem/h}$

Atmospheric Dump Valve Flow Rate = 1.4 E+6 $cm^3/sec$

Safety Valve Flow Rate = 2.4 E+6 $cm^3/sec$

Main Steam Monitor Reading (rem/h) = $\frac{\text{Release Rate}}{\text{Release Coefficient x Flow Rate}}$

For safety valve rem/h = $\frac{3.2\ E+7}{6.1\ E+2 \times 2.4\ E+6}$

= .022 rem/h (read as .02) (0.2 mSv/h)

For atmospheric dump valve rem/h = $\frac{3.2\ E+7}{6.1\ E+2 \times 1.4\ E+6}$

= .038 rem/h (read as .04) (0.4 mSv/h)

The minimum reading for RI-5421/5422 is 10 mrem/h due to the "keep alive" source. Twenty mrem/h would be difficult to read accurately. The high alarm setpoint for these monitors is set at 47 mrem/h ± 5 mrem/h. Therefore, for human factors reasons, the existence of the high alarm setpoint is used as the threshold for this EAL.

Thus, EAL 2 uses the lower value and is written as:

| Valid Main Steam Effluent Monitor (RI-5421, RI-5422) High Alarm for GREATER THAN 15 Minutes |
|---|

*Valid* means that the indication is from instrumentation determined to be operable in accordance with the Technical Specifications or has been verified by other independent methods such as indications displayed on the control panels, reports from plant personnel, or radiological survey results. Based on the March 14, 1993 SG tube rupture event at Palo Verde Unit 2, the main steam effluent monitors (RI-5421, RI-5422) may read $N^{16}$ immediately following SG tube rupture and prior to reactor trip. However, given the short half-life of $N^{16}$, this should clear within the first minute following reactor trip.

Source Documents/References/Calculations:

1. System Descriptions
   - No. 15, Radiation Monitoring System
2. Off-Site Dose Calculation Manual (ODCM) for the Baltimore Gas & Electric Company Calvert Cliffs Nuclear Power Plant
3. Radioactivity Release Emergency Action Levels, J.B. McIlvaine, JSB Associates, Inc., September 1990
4. Emergency Response Plan Implementation Procedures
   - ERPIP 821, Accidental Radioactivity Release Monitoring and Sampling Methods

5. BG&E Internal Memorandum, J. R. Hill (Nuclear Plant Operations) to R. L. Wenderlich, CE Operations Subcommittee Meeting - Trip Report, April 16, 1993

6. 10 CFR Part 20, Standards for Protection Against Radiation; Final Rule, 56 FR 23360, May 21, 1991

7. Calvert Cliffs Instructions
   - CCI-302, Calvert Cliffs Alarm Manual, Main Steam Effl Rad Monitor 2C24B

Emergency Classification Level: ALERT

Applicable Operational Modes: All

Calvert Cliffs Initiating Condition:

## RA2 Damage OR Uncovery of Single Irradiated Fuel Assembly Outside the Reactor Vessel

NUMARC Recognition Category: Abnormal Rad Levels/Radiological Effluent

NUMARC Initiating Condition:

AA2 Major Damage to Irradiated Fuel or Loss of Water Level that Has or Will Result in the Uncovering of Irradiated Fuel Outside the Reactor Vessel

Barrier: Not Applicable

NUMARC Generic Basis:

This IC applies to spent fuel requiring water coverage and is not intended to address spent fuel which is licensed for dry storage, which is discussed in <RU3, Potential Degradation of Containment of Dry Stored Spent Fuel>.

NUREG-0818, *Emergency Action Levels for Light Water Reactors*, forms the basis for these EALs. Each site should also define its EALs by the specific area where irradiated fuel is located such as Reactor Cavity, Reactor Vessel, or Spent Fuel Pool.

There is time available to take corrective actions, and there is little potential for substantial fuel damage. In addition, NUREG/CR-4982, *Severe Accident in Spent Fuel Pools in Support of Generic Safety Issue 82*, July 1987, indicates that even if corrective actions are not taken, no prompt fatalities are predicted, and that risk of injury is low. In addition, NRC Information Notice No. 90-08, *Kr-85 Hazards from Decayed Fuel*, presents the following in its discussion:

> In the event of a serious accident involving decayed spent fuel, protective actions would be needed for personnel on site, while off-site doses (assuming an exclusion area radius of one mile from the plant site) would be well below the Environmental Protection Agency's Protective Action Guides. Accordingly, it is important to be able to properly survey and monitor for Kr-85 in the event of an accident with decayed spent fuel.
>
> Licensees may wish to reevaluate whether Emergency Action Levels specified in the emergency plan and procedures governing decayed fuel-handling activities appropriately focus on concern for onsite workers and Kr-85 releases in areas where decayed spent fuel accidents could occur, for example, the spent fuel pool working floor. Furthermore, licensees may wish to determine if emergency plans and corresponding implementing procedures address the means for limiting radiological exposures of onsite personnel who are in other areas of the plant. Among other things, moving on-site personnel away from the plume and shutting off building air intakes downwind from the source may be appropriate.

Thus, an Alert Classification for this event is appropriate. Escalation, if appropriate, would occur via <other Radioactivity Release ICs or SEC Judgement ICs>.

Plant-Specific Information:

ADP-6E, Loss of Refueling Pool Level, provides actions to respond to a loss of Refueling Pool (RFP) inventory due to failure of the Refueling Pool Seal, Steam Generator Nozzle Dams, or the Refueling Pool Drain Line. These actions include placing spent fuel in safe storage locations (*i.e.*, all spent fuel will remain water covered following pool draindown to the reactor vessel flange elevation). If any spent fuel assembly can NOT be placed in an appropriate safe storage location, this corresponds to entry into this IC.

Thus, EAL 1 is written as:

| |
|---|
| AOP-6E, **Loss of Refueling Pool Level**, is Implemented AND Valid Containment Radiation Alarm (RI-5316A/B/C/D) |

EAL 2 is written as:

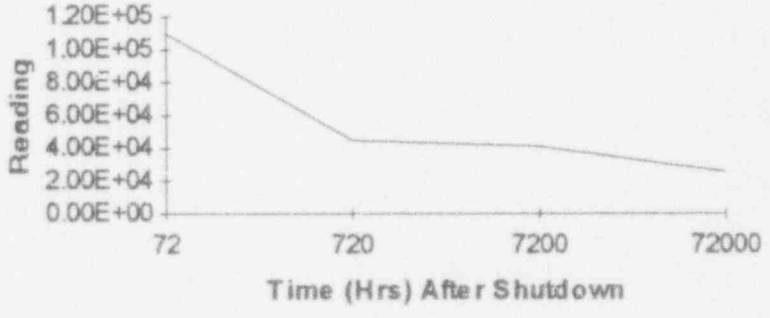
| |
|---|
| AOP-6D, **Fuel Handling Incident**, is Implemented AND Any of the Following:<br>• Valid Containment Radiation Alarm (RI-5316A/B/C/D)<br>• Valid Spent Fuel Pool Radiation Monitor (RI-5420) Reading of AT LEAST 2E4 CPM<br>• Valid Spent Fuel Service Platform Monitor (RI-7025) Reading of AT LEAST 100 mrem/h |

*Valid* means that the indication is from instrumentation determined to be operable in accordance with the Technical Specifications or has been verified by other independent methods such as indications displayed on the control panels, reports from plant personnel, or radiological survey results.

The containment radiation alarm corresponds to a dose rate of 200 mrem/h.

The value for RI-5420 was determined based on a fuel handling accident damaging one fuel rod in an average (unpeaked) fuel assembly. The results of the calculation, showing RI-5420 response versus age of the assembly (time after shutdown), is shown as Figure R1. The value of 2E4 CPM corresponds to the minimum expected response and is significantly higher than the alarm setpoint of 600 CPM.

**Figure R1: RI-5420 Reading for Single Fuel Rod Damage vs Time After Shutdown**




One hundred mrem/h is used for the Service Platform Monitor (RI-7025) because it corresponds to the administrative limit for a high radiation area and is significantly higher than the dose rates expected for fuel handling activities.

Expected increases in monitor readings due to controlled evolutions (such as lifting the reactor vessel head during refueling) should not result in emergency declaration. Nor should momentary increases due to events such as resin transfers or controlled movement of radioactive sources result in emergency declaration. In-plant radiation level increases that would result in emergency declaration are also *unplanned, e.g.*, outside the limits established by an existing radioactive discharge permit.

Source Documents/References/Calculations:

1. System Descriptions
   - No. 15, Radiation Monitoring System

2. Abnormal Operating Procedures
   - AOP-6D, Fuel Handling Incident
   - AOP-6E, Loss of Refueling Pool Level

3. Ogden Calculation #RA-1, O-RI-5420 Detector Response to Fuel Handling Accident

Emergency Classification Level: ALERT

Applicable Operational Modes: All

Calvert Cliffs Initiating Condition:

## RA3 Radiation Increases That Impede Safe Plant Operation

NUMARC Recognition Category: Abnormal Rad Levels/Radiological Effluent

NUMARC Initiating Condition:

AA3 Release of Radioactive Material or Increases in Radiation Levels Within the Facility That Impedes Operation of Systems Required to Maintain Safe Operations or to Establish or to Maintain Cold Shutdown

Barrier: Not Applicable

NUMARC Generic Basis:

*Valid* means that a radiation monitor reading has been confirmed by the operators to be correct.

This IC addresses increased radiation levels that impede necessary access to operating stations, or other areas containing equipment that must be operated manually, 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 the concern of this IC. The <SEC> must consider the source or cause of the increased radiation levels and determine if any other IC may be involved. For example, a dose rate of 15 <mrem/h> in the control room may be a problem in itself. However, the increase may also indicate high dose rates in the containment due to a LOCA. In this latter case, <a> SAE or GE may be indicated by fission product barrier matrix ICs.

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

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

Emergency planners developing the (Site-Specific) lists may refer to the site's abnormal operating procedures, emergency operating procedures, the 10 CFR 50 Appendix R analysis, and/or, the <analysis> performed in response to Section 2.1.6b of NUREG-0578, *TMI-2 Lessons Learned Task Force Status Report and Short-Term Recommendations*, when identifying areas containing safe shutdown equipment. With regard to the NUREG-0578 analysis, do not use the dose rate postulated therein as a basis for the radiation monitor readings for this IC, as the NUREG-0578 <analysis> address general emergency conditions.

Areas requiring continuous occupancy include the control room and, as appropriate to the site, any other control stations that are manned continuously, such as the radwaste control room or a central security alarm station. The value of 15 mrem/h 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 <mrem/h> value can be averaged over 30 days, the value used here is without averaging, as a 30 day duration implies an event potentially more significant than an Alert.

For areas requiring infrequent access, the (Site-Specific) value(s) should be based on radiation levels which result in exposure control measures intended to maintain doses within normal occupational exposure guidelines and limits (*i.e.*, 10 CFR 20), and in doing so, will impede necessary access. For many areas, it may be possible to

establish a single <Generic> EAL that represents a multiple of the normal radiation levels (*e.g.*, 1000 times normal). However, areas that have normally high dose rates may require a lower multiple (*e.g.*, 10 times normal).

Plant-Specific Information

The control room is required to be continuously occupied following design basis accidents. All actions required to achieve and maintain cold shutdown can be accomplished from the control room. Post-accident doses have been evaluated and shown to be less than limits based on GDC 19. On a control room high radiation signal, the control room emergency ventilation system automatically switches into a recirculation mode of operation with flow through the HEPA filters and charcoal absorber banks. EAL 1 is based on the GDC 19 limit recommended by NUMARC.

Thus, EAL 1 is written as:

| Valid Control Room Radiation Monitor (RI-5350) Reading GREATER THAN 15 mrem/h |
|---|

This corresponds to a dose rate of 0.15 mSv/h. *Valid* means that the indication is from instrumentation determined to be operable in accordance with the Technical Specifications or has been verified by other independent methods such as indications displayed on the control panels, reports from plant personnel, or radiological survey results.

EAL 2 addresses event sequences outside the plant design basis. In accordance with ERPIP-832, Emergency Work Permits, entry into any area with exposure rates of at least 250 R/h (2.5 Gray/h) is prohibited for plant saving missions.

Thus, EAL 2 is written as:

| Exposure Rate of AT LEAST 250 R/h in Areas Required to Achieve or Maintain Safe Shutdown |
|---|

*Required* means that entry into the area is not optional and is imperative based on existing conditions. Areas of concern for Safe Shutdown are listed below.

| Areas of Concern for Safe Shutdown | |
|---|---|
| • Control Room | • Electrical Penetration Rooms |
| • Control Room HVAC Room | • Auxiliary Feedwater Pump Room |
| • Cable Spreading Room | • Charging Pump Rooms |
| • Cable Chases | • Diesel Generator Rooms |
| • Switchgear Room | • Refueling Water Tank (RWT) 11(21) |
| • ECCS Pump Room | • Condensate Storage Tank (CST) 12 |
| • Service Water Pump Room | • Pretreated Water Storage Tank (PWST) 11(21) |
| • Component Cooling Pump Room | • Fuel Oil Storage Tank (FOST) 12 |
| • Main Steam Penetration Room | |
| This list of Safe Shutdown areas is displayed on the EAL Tables to assure that all areas related to Safe Shutdown are considered by the SEC. | |

Expected increases in monitor readings due to controlled evolutions (such as lifting the reactor vessel head during refueling) do not result in emergency declaration. Nor should momentary increases due to events such as resin transfers or controlled movement of radioactive sources result in emergency declaration. In-plant radiation level increases that would result in emergency declaration are also *unplanned, e.g.*, outside the limits established by an existing radioactive discharge permit. The containment radiation monitor readings should only apply to this IC when personnel are in containment for normal maintenance, inspection, surveillance, testing, or refueling activities.

Source Documents/References/Calculations:

1. System Descriptions
   - No. 15, Radiation Monitoring System

2. Letter, G.C. Creel (BG&E) to NRC Document Control Desk dated September 1, 1989, Control Room Dose

3. Letter, J.A. Tiernan (BG&E) to A.C. Thadani (NRC) dated March 5, 1986, Control Room Dose

4. Emergency Response Plan Implementation Procedure
   - ERPIP-832, Emergency Work Permits

5. CCI-800, Calvert Cliffs Radiation Safety Manual

Emergency Classification Level: **SITE EMERGENCY**

Applicable Operational Modes: **All**

Calvert Cliffs Initiating Condition:

## RS1 Off-Site Dose of AT LEAST 0.1 Rem (EDE + CEDE) Or 0.5 Rem CDE Thyroid

NUMARC Recognition Category: Abnormal Rad Levels/Radiological Effluent

NUMARC Initiating Condition:

AS1 Site Boundary Dose Resulting from an Actual or Imminent Release of Gaseous Radioactivity Exceeds 100 <mrem> Whole Body or 500 <mrem> Thyroid for the Actual or Projected Duration of the Release

Barrier: Not Applicable

NUMARC Generic Basis:

*Valid* means that a radiation monitor reading has been confirmed by the operators to be correct.

The 100 <mrem> integrated dose in this initiating condition is based on the proposed 10 CFR 20 annual average population exposure. This value also provides a desirable gradient (one order of magnitude) between the Alert, Site <E>mergency, and General Emergency classes. It is deemed that exposures less than this limit are not consistent with the Site <E>mergency class description. The 500 <mrem> integrated < > thyroid dose was established in consideration of the 1:5 ratio of the EPA Protective Action Guidelines for whole body and thyroid.

Integrated doses are generally not monitored in real-time. In establishing the emergency action levels, it is suggested that a duration of one hour be assumed, and that the EALs be based on a site boundary dose of 100 <mrem/h> whole body or <500 mrem/h> child thyroid, whichever is more limiting (depending on source term assumptions). If individual site analyses indicate a longer or shorter duration for the period in which the substantial portion of the activity is released, these dose rates should be adjusted.

The FSAR source terms applicable to each monitored pathway should be used in conjunction with annual average meteorology in determining indications for the monitors on that pathway.

Plant-Specific Information

10 CFR Part 20 was revised following the development of the NUMARC methodology. Calvert Cliffs uses the new rule as its basis for determining dose. *EDE* is the Effective Dose Equivalent as defined in 10CFR20.1003. *CEDE* is the Committed Effective Dose Equivalent as defined in 10CFR20.1003. *CDE* is the Committed Dose Equivalent as defined in 10CFR20.1003.

Calvert Cliffs does not have either a perimeter radiation monitoring system or automated real-time dose assessment capability. Thus, the generic EALs recommended by NUMARC do not apply to the Calvert Cliffs Nuclear Power Plant.

A description of the applicable monitors and the methods used to calculate EAL values for the WRNGM is shown in RU1, Unplanned Radioactive Release Exceeding 2 X Tech Spec Limits for GREATER THAN 60 Minutes. Values for this IC are based on the values shown in RU1 scaled up from 0.114 mrem in an hour (*i.e.*, hourly rate resulting in 2 X 500 mrem in one year) to 100 mrem (EDE + CEDE) (1 mSV) in an hour. (See box below.)

EALs 1 and 2 only apply if dose assessment capability is not available, *i.e.*, without dose assessment. The preferred method of declaration is via EAL3, with EALs 1 and 2 as backup methods, if required.

RS1 Threshold for RIC-5415

Scale up from RU1 uncorrected release rate of 3.6 E+5 $\mu$Ci/sec

$$\text{RS1 Value} = \frac{100 \text{ mrem/h}}{0.114 \text{ mrem/h (or .00114 mSv/h)}} \times 3.6 \text{ E+5 } \mu\text{Ci/sec}$$

$$= 3.2 \text{ E+8 } \mu\text{Ci/sec}$$

Read as 3 E+8 $\mu$Ci/sec

Thus, EAL 1 is written as:

Valid WRNGM (RIC-5415) Reading of AT LEAST 3 E+8 $\mu$Ci/sec for GREATER THAN 15 Minutes (Without Dose Assessment)

This value corresponds to a concentration of about 5 $\mu$Ci/cc and falls well within the range of the WRNGM.

The purpose of the Main Steam Effluent Radiation Monitor System is to monitor possible noble gas releases to the atmosphere from the main steam line through the atmospheric steam dump valves, the main steam safety relief valves, and the auxiliary feedwater steam turbine exhaust. The system includes two radiation monitors (1/2-RI-5421 and 1/2-RI-5421) for each unit - one radiation monitor for each steam generator. Each radiation detector is an ion chamber filled with xenon gas with a small "keep alive" source that produces a reading on the corresponding main control board rate meter of about $10^2$ R/hr.

The noble gas release rate of 3.2 E+8 $\mu$Ci/sec (which corresponds a whole body dose of 100 mrem in one hour at the site boundary) may also occur through release via main steam safety valve or atmospheric dump valve.

By reverse calculation using Attachment 3 of ERPIP 821:

RS1 Threshold for RI-5421, RI-5422

Release Rate = 3.2 E+8 $\mu$Ci/sec (see above)

Release Coefficient (for SG Tube Rupture) = 6.1 E+2 $\frac{\mu Ci/cm^3}{rem/h}$

Atmospheric Dump Valve Flow Rate = 1.4 E+6 $cm^3$/sec

Safety Valve Flow Rate = 2.4 E+6 $cm^3$/sec

Main Steam Monitor Reading (rem/h) = $\frac{\text{Release Rate}}{\text{Release Coefficient x Flow Rate}}$

For safety valve rem/h = $\frac{3.2\ E+8}{6.1\ E+2 \times 2.4\ E+6}$

= 0.22 rem/h (read as 0.2) (2 mSv/h)

For atmospheric dump valve rem/h = $\frac{3.2\ E+8}{6.1\ E+2 \times 1.4\ E+6}$

= 0.38 rem/h (read as 0.4) (4 mSv/h)

Thus, EAL 2 is written as:

| |
|---|
| Valid Main Steam Effluent Monitor (RI-5421, RI-5422) Reading of AT LEAST 0.2 rem/h for GREATER THAN 15 Minutes (Without Dose Assessment) |

*Valid* means that the indication is from instrumentation determined to be operable in accordance with the Technical Specifications or has been verified by other independent methods such as indications displayed on the control panels, reports from plant personnel, or radiological survey results. Based on the March 14, 1993 SG tube rupture event at Palo Verde Unit 2, the main steam effluent monitors (RI-5421, RI-5422) may read $N^{16}$ immediately following SG tube rupture and prior to reactor trip. However, given the short half-life of $N^{16}$, this should clear within the first minute following reactor trip.

Dose consequences can be determined by use of ERPIP 822, Initial Dose Assessment Manual Calculation Methods, or by use of ERPIP 823, Dose Assessment Computer. Dose assessment will be performed in accordance with the new 10 CFR 20 scheduled to take effect January 1, 1994.

Thus, EAL 3 is written as:

| |
|---|
| Dose Assessment Determines Integrated Accident Forecast Dose Off-Site is AT LEAST 0.1 rem (EDE + CEDE) Or 0.5 rem CDE Thyroid |

This corresponds to doses of 1 mSv (EDE+CEDE) and 5 mSv CDE Thyroid, respectively.

Source Documents/References/Calculations:

1. System Descriptions
   - Radiation Monitoring System

2. Emergency Response Plan Implementation Procedures
   - ERPIP-810, Main Steam Radioactivity Release Estimate
   - ERPIP-821, Accidental Radioactivity Release Monitoring and Sampling Methods
   - ERPIP-822, Initial Dose Assessment Manual Calculation Methods
   - ERPIP-823, Dose Assessment Computer

3. Radioactivity Release Emergency Action Levels, J.B. McIlvaine, JSB Associates, Inc., September 1990

4. BG&E Fuel Degradation EALs Calculation Worksheet, JSB Associates, February 18, 1993

5. Radioactivity Release Emergency Action Levels, J.B. McIlvaine, JSB Associates, Inc., September 1990

6. BG&E Internal Memorandum, J. R. Hill (Nuclear Plant Operations) to R. L. Wenderlich, CE Operations Subcommittee Meeting - Trip Report, April 16, 1993

7. 10 CFR 20, Standards for Protection Against Radiation; Final Rule, 56 FR 23360, May 21, 1991

Emergency Classification Level: GENERAL EMERGENCY

Applicable Operational Modes: All

Calvert Cliffs Initiating Condition:

## RG1 Off-Site Dose of AT LEAST 1 Rem (EDE + CEDE) Or 5 Rem CDE Thyroid

NUMARC Recognition Category: Abnormal Rad Levels/Radiological Effluent

NUMARC Initiating Condition:

AG1 Site Boundary Dose Resulting from an Actual or Imminent Release of Gaseous Radioactivity that Exceeds 1000 <mrem> Whole Body or 5000 <mrem> Child Thyroid for the Actual or Projected Duration of the Release Using Actual Meteorology

Barrier: Not Applicable

NUMARC Generic Basis:

*Valid* means that a radiation monitor reading has been confirmed by the operators to be correct.

The 1000 mrem <EDE + CEDE> and 5000 mrem <CDE> thyroid integrated doses are based on the EPA protective action guidance which indicates that public protective actions are indicated if the dose exceeds 1 rem <EDE +CEDE> or 5 rem <CDE> thyroid. This is consistent with the emergency class description for a General Emergency. This level constitutes the upper level of the desirable gradient for the Site <E>mergency. Actual meteorology is specifically identified in the initiating condition since it gives the most accurate dose assessment. Actual meteorology (including forecasts) should be used whenever possible.

Integrated doses are generally not monitored in real-time. In establishing the emergency action levels, it is suggested that a duration of one hour be assumed, and that the EALs be based on site boundary doses for either <EDE + CEDE> or <CDE> thyroid, whichever is more limiting (depending on source term assumptions). If individual site analyses indicate a longer or shorter duration for the period in which the substantial portion of the activity is released, these dose rates should be adjusted.

The FSAR source terms applicable to each monitored pathway should be used in conjunction with annual average meteorology in determining indications for the monitors on that pathway.

Plant-Specific Information

10 CFR Part 20 was revised following the development of the NUMARC methodology. Calvert Cliffs uses the new rule as its basis for determining dose. *EDE* is the Effective Dose Equivalent as defined in 10CFR20.1003. *CEDE* is the Committed Effective Dose Equivalent as defined in 10CFR20.1003. *CDE* is the Committed Dose Equivalent as defined in 10CFR20.1003.

Calvert Cliffs does not have either a perimeter radiation monitoring system or automated real-time dose assessment capability. Thus, the generic EALs recommended by NUMARC do not apply to the Calvert Cliffs Nuclear Power Plant.

A description of the applicable monitors and the methods used to calculate EAL values for the WRNGM is shown in RU1, Unplanned Radioactive Release Exceeding 2 X Tech Spec Limits for GREATER THAN 60 Minutes. Values for this IC are based on the values shown in RU1 scaled up from 0.114 mrem in an hour (*i.e.*, hourly rate resulting in 2 X 500 mrem in one year) to 1000 (EDE + CEDE) mrem in an hour (10 mSv/h).

EALs 1 and 2 only apply if dose assessment capability is not available, *i.e.*, without dose assessment. The preferred method of declaration is via EAL 3, with EALs 1 and 2 as backup methods, if required.

RG1 Threshold for RIC-5415

Scale up from RU1 uncorrected release rate of 3.6 E+5 μCi/sec

RG1 Value = $\frac{1000 \text{ mrem/h}}{0.114 \text{ mrem/hour (or .00114 mSv/h)}}$ x 3.6 E+5 μCi/sec

= 3.2 E+9 μCi/sec

Read as 3 E+9 μCi/sec

This value corresponds to a concentration of about 50 μCi/cc and falls within the range of the WRNGM.

Thus, EAL 1 is written as:

Valid WRNGM (RIC-5415) Reading of AT LEAST 3 E+9 μCi/sec for GREATER THAN 15 Minutes (Without Dose Assessment)

The Main Steam Effluent Radiation Monitor System is described under IC RS1, Off-Site Dose of AT LEAST 0.1 Rem (EDE + CEDE) OR 0.5 Rem CDE Thyroid. The appropriate EAL value for this IC was determined by scaling up the RS1 reading to correspond to 1,000 mrem in one hour (10 mSv/h).

RG1 Threshold for RI-5421, RI-5422

RG1 Value = RS1 Value x $\frac{1000 \text{ mrem/h}}{100 \text{ mrem/h}}$

= 0.2 rem/h x 10

= 2 rem/h (20 mSv/h)

The 2 rem/h (20 mSv/h) on 1/2-RI-5421/5422 is based on assuming a single stuck open safety valve. A value of 3 rem/h (30 mSv/h) corresponds to assuming a single stuck open atmospheric dump valve.

Thus, EAL 2 is written as:

Valid Main Steam Effluent Monitor (RI-5421, RI-5422) Reading of AT LEAST 2 rem/h for GREATER THAN 15 Minutes (Without Dose Assessment)

*Valid* means that the indication is from instrumentation determined to be operable in accordance with the Technical Specifications or has been verified by other independent methods such as indications displayed on the control panels, reports from plant personnel, or radiological survey results. Based on the March 14, 1993 SG tube rupture event at Palo Verde Unit 2, the main steam effluent monitors (RI-5421, RI-5422) may read $N^{16}$ immediately following SG tube rupture and prior to reactor trip. However, given the short half-life of $N^{16}$, this should clear within the first minute following reactor trip.

Dose consequences can be determined by use of ERPIP 822, Initial Dose Assessment Manual Calculation Methods, or by use of ERPIP 823, Dose Assessment Computer. Dose assessment will be performed in accordance with the new 10 CFR 20 scheduled to take effect January 1, 1994.

Thus, EAL 3 is written as:

| |
|---|
| Dose Assessment Determines Integrated Accident Forecast Dose Off-Site is AT LEAST 1 rem (EDE + CEDE) Or 5 rem CDE Thyroid |

This corresponds to doses of 10 mSv (EDE+CEDE) and 50 mSv CDE Thyroid, respectively.

Source Documents/References/Calculations:

1. System Descriptions
   - No. 15, Radiation Monitoring System

2. Emergency Response Plan Implementation Procedures
   - ERPIP-810, Main Steam Radioactivity Release Estimate
   - ERPIP-821, Accidental Radioactivity Release Monitoring and Sampling Methods
   - ERPIP-822, Initial Dose Assessment Manual Calculation Methods
   - ERPIP-823, Dose Assessment Computer

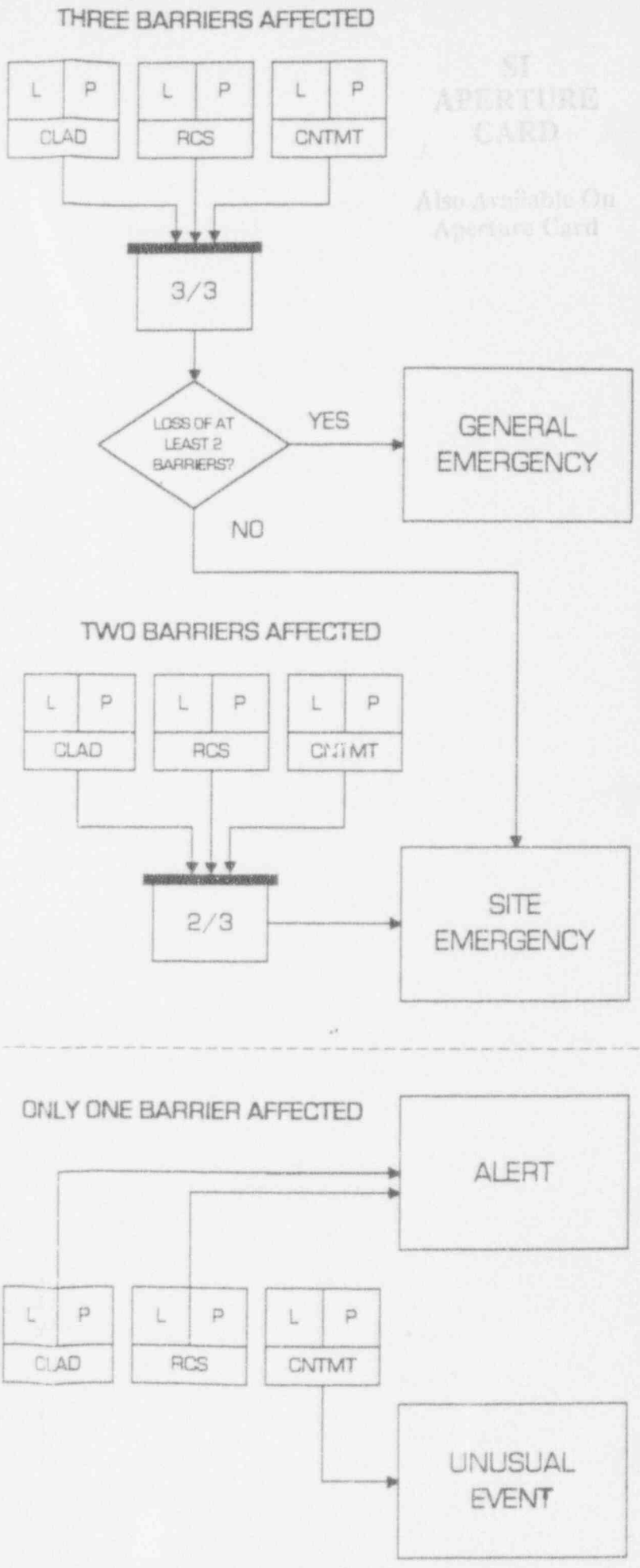
3. Radioactivity Release Emergency Action Levels, J.B. McIlvaine, JSB Associates, Inc., September 1990

4. BG&E Internal Memorandum, J. R. Hill (Nuclear Plant Operations) to R. L. Wenderlich, CE Operations Subcommittee Meeting - Trip Report, April 16, 1993

5. 10 CFR 20, Standards for Protection Against Radiation; Final Rule, 56 FR 23360, May 21, 1991

| INDICATORS | FUEL CLAD BARRIER | RCS BARRIER |
|---|---|---|
| SAFETY FUNCTION STATUS/FUNCTIONAL RECOVERY | *Loss* - Not Applicable<br><br>*Potential Loss*<br>[P] EOP-8, Functional Recovery Procedure, Can NOT Meet Core and RCS Heat Removal Acceptance Criteria AND Shutdown Cooling is NOT in Service | *Loss*<br>[L] EOP-8, Functional Recovery Procedure, is implemen from EOP-6, Steam Generator Tube Rupture<br><br>*Potential Loss*<br>[P] Uncontrolled RCS Cooldown AND RCS Pressure-Temperature in the Non-Operating Area (Left of the Cooldown Curve)<br>OR<br>[P] EOP-8, Functional Recovery Procedure, Can NOT M Core and RCS Heat Removal Acceptance Criteria AN Shutdown Cooling is NOT in Service |
| TEMPERATURE | *Loss*<br>[L] Valid Core Exit Thermocouple Readings GREATER THAN 1200°F<br><br>*Potential Loss*<br>[P] Valid Core Exit Thermocouple Readings Indicate Superheat | *Loss*<br>[L] RCS Subcooling Can NOT Be Maintained AT LEAST 25<br><br>*Potential Loss* - Not Applicable |
| RADIATION | *Loss*<br>[L] Dose Rate at One Foot From PASS Sample of AT LEAST 40 mrem/h<br>OR<br>[L] Valid RI-5317A/B Reading of AT LEAST 3,500 rem/h Within 2 Hours After Reactor Shutdown<br>OR<br>[L] AT LEAST 5% Fuel Clad Damage as Determined From Core Damage Assessment<br><br>*Potential Loss* - Not Applicable | *Loss*<br>[L] Valid RI-5317A/B Reading of AT LEAST 5 rem/h Wit Hours After Reactor Shutdown<br><br>*Potential Loss* - Not Applicable |
| COOLANT LEAKAGE | Not Applicable | *Loss* - Not Applicable<br><br>*Potential Loss*<br>[P] RCS Leakage Exceeds Available CVCS Capacity<br>OR<br>[P] EOP-5, Loss of Coolant Accident, or EOP-8, Function Recovery Procedure, is Implemented for RCS Leakag |
| PRESSURE | Not Applicable | Not Applicable |
| WATER LEVEL | *Loss* - Not Applicable<br><br>*Potential Loss*<br>[P] Valid RVLMS Reading at 29 Inches and Trending Toward 0 | Not Applicable |
| SEC JUDGEMENT | Any Condition Which in the SEC's Judgement Indicates Loss or Potential Loss of the Fuel Clad Barrier Based on:<br>• Imminent Barrier Degradation Due to Safety System Performance<br>• Degraded Ability to Monitor Barriers | Any Condition Which in the SEC's Judgement Indicates Loss Potential Loss of the RCS Barrier Based on:<br>• Imminent Barrier Degradation Due to Safety System Performance<br>• Degraded Ability to Monitor Barriers |

| | CNTMT BARRIER |
|---|---|
| | *Loss* - Not Applicable |
| | *Potential Loss*<br>P EOP-8, **Functional Recovery Procedure**, is Implemented AND Containment Environment Acceptance Criteria Can NOT Be Met |
| | *Loss* - Not Applicable |
| | *Potential Loss*<br>P Valid Core Exit Thermocouple Readings GREATER THAN 1300°F AND INCREASING |
| | *Loss*<br>L EOP-5, **Loss of Coolant Accident**, or EOP-8, **Functional Recovery Procedure**, is implemented AND Radiation Levels External to CNTMT Can NOT Meet Acceptance Criteria |
| | *Potential Loss*<br>P Valid 5317A/B Reading of AT LEAST 14,000 rem/h Within 2 Hours After Reactor Shutdown<br>OR<br>P EOP-5, **Loss of Coolant Accident**, is implemented AND LOCA is NOT Occurring Within CNTMT as Indicated by Aux Building Sump Alarms or Aux Building RMS Alarms |
| | *Loss*<br>L Leakage Pathway Exists From Inside CNTMT to Outside CNTMT<br>OR<br>L SG Tube Rupture in Progress AND Both of the Following:<br>• Affected SG Level Can NOT Be Maintained LESS THAN +50 Inches AND<br>• Affected SG Pressure GREATER THAN 900 PSIG. |
| | *Potential Loss* - Not Applicable |
| | *Loss*<br>L Rapid Unexplained CNTMT Pressure Decrease Following Initial Increase |
| | *Potential Loss*<br>P CNTMT Pressure of AT LEAST 50 PSIG And Increasing<br>OR<br>P CNTMT H2 Concentration of AT LEAST 4.0% |
| | **Not Applicable** |
| | Any Condition Which in the SEC's Judgement Indicates Loss or Potential Loss of the CNTMT Barrier Based on:<br>• Imminent Barrier Degradation Due to Safety System Performance<br>• Degraded Ability to Monitor Barriers |






9307280166-02

# FISSION PRODUCT BARRIER DEGRADATION

Emergency Classification Level: UNUSUAL EVENT

Applicable Operational Modes: 1, 2, 3, 4

Calvert Cliffs Initiating Condition:

## BU1 Loss OR Potential Loss of CNTMT Barrier

NUMARC Initiating Condition:

FU1 ANY Loss or ANY Potential Loss of Containment

Barrier: Containment

*This IC is entered based on the Fission Barrier Reference Table EALs discussed below.*

Emergency Classification Level: UNUSUAL EVENT

Applicable Operational Modes: ALL

Calvert Cliffs Initiating Condition:

## BU2 RCS Leakage

NUMARC Recognition Category: System Malfunction

NUMARC Initiating Condition:

SU5 RCS Leakage

Barrier: RCS

NUMARC Generic Basis:

This IC is included as an Unusual Event 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. The 10 <GPM> value for unidentified or pressure boundary leakage was selected because it is observable with normal control room indications. Lesser values must generally be determined through time-consuming surveillance tests (*e.g.*, mass balances). The EAL for identified leakage is set at a higher value due to the lesser significance of identified leakage in comparison to unidentified or pressure boundary leakage. In either case, escalation of this IC to the Alert level is via Fission Product Barrier Degradation <EALs or the IC QA2, Inability to Maintain Plant in Cold Shutdown>.

Only operational modes in which fuel is in the reactor coolant system and the system is pressurized are specified.

Plant-Specific Information:

Technical Specification Section 3.4.6.2 specifies allowable RCS leakage as:

a. No Pressure Boundary Leakage

b. 1 GPM unidentified leakage

c. 1 GPM total primary-to-secondary leakage through both steam generators and 0.1 GPM through any one steam generator

d. 10 GPM identified leakage from the RCS

STP-O-27-1/2 is the daily surveillance test procedure that the operators use to measure the amount of RCS leakage. The RCS GROSS leakage rate is based upon the following parameters: $T_{avg}$, RC Makeup Integrator reading, Boric Acid Integrator reading, Diversion integrator reading, volume control tank level, pressurizer pressure and pressurizer level. If the RCS GROSS leakage rate is calculated to be GREATER THAN 11.0 GPM, ADP-2A is implemented. This 11 GPM threshold corresponds to the net RCS make-up from one charging pump in the normal CVCS alignment (44 GPM charging flow minus the total flow from reactor coolant pump seal leak-off and minimum letdown). If the RCS GROSS leakage rate is calculated between 1.0 GPM and 11.0 GPM, the difference between RCS GROSS leakage rate, Reactor Coolant Drain Tank (RCDT) inleakage, safety injection tank (SIT) outleakage, Quench Tank (QT) inleakage, and the calculated SG leakage from CP-224. If the difference is GREATER THAN 1.0 GPM, the CRS is notified and with his approval, ADP-2A is implemented.

Calvert Cliffs EALs have been written to be consistent with procedural requirements. These leakage rates are very similar to the NUMARC generic leakage. ADP-2A specifies certain flow paths that can be isolated to terminate RCS leakage. If isolation of the leakage path is successful (*e.g.*, isolating a leaking pressurizer power

operated relief valve), reactor operation can continue and this EAL does not apply. However, if RCS leakage could not be isolated, then under these conditions the reactor would have to be shut down in accordance with technical specifications. The EAL language was picked to assure that: (1) leakage is greater than net RCS make-up flow threshold of 11 GPM, and (2) Such leakage could not be isolated in accordance with procedural requirements.

Thus, the Calvert Cliffs EAL is written as:

| |
|---|
| **AOP-2A, Excessive Reactor Coolant Leakage**, Is Implemented For RCS Leakage Exceeding the Capacity of One Charging Pump AND Reactor Shutdown is Required |

NUREG 1449 raises concerns regarding events involving leakage through RCS temporary boundaries. RCS leakage EALs apply to all operational modes at Calvert Cliffs. This will assure that leakage is appropriately addressed for cold shutdown and refueling modes and address NRC concerns about leakage through temporary RCS boundaries as they apply to EALs.

Source Documents/References/Calculations:

1. Technical Specifications
   - TS 3.4.6.2, Reactor Coolant System Leakage

2. Abnormal Operating Procedures
   - AOP-2A, Excessive Reactor Coolant Leakage

3. Surveillance Test Procedure (STP) O-27-1/2, RCS Leakage Evaluation

4. NUREG 1449, Shutdown and Low-Power Operation at Commercial Nuclear Power Plants in the United States, Draft for Comment, February 1992

Emergency Classification Level: UNUSUAL EVENT

Applicable Operational Modes: ALL

Calvert Cliffs Initiating Condition:

## BU3 Fuel Clad Degradation

NUMARC Recognition Category: System Malfunction

NUMARC Initiating Condition:

SU4 Fuel Clad Degradation

Barrier: Fuel Clad

NUMARC Generic Basis:

This IC is included as an Unusual Event because it is considered to be a potential degradation in the level of safety of the plant and a potential precursor of more serious problems. <Generic> EAL 1 addresses (Site-Specific) radiation monitor readings such as failed fuel monitors, etc., that provide indication of fuel clad integrity. <Generic> EAL 2 addresses coolant samples exceeding coolant technical specifications for iodine spike. Escalation of this IC to the Alert level is via the <Fission Product Barrier Degradation EALs>.

Plant-Specific Information:

A significant rise in the count rate on the Activity Monitor or valid actuation of the "RADIATION MONITOR LEVEL HI" alarm can be due to either fuel clad failure or to crud burst. In accordance with ADP-6A, the response to high RCS activity level is to notify Plant Chemistry to perform a sample analysis to determine what radionuclides caused the radiation alarm. This means that the monitor indications are not sufficient alone to determine whether fuel clad damage has occurred at Calvert Cliffs. Thus, <Generic> EAL 1 is not appropriate for use at Calvert Cliffs.

Clad damage is determined from specific activity levels contained in reactor coolant samples. Per ADP-6A, Fuel Reliability Plan Action Level 4 is defined as Dose Equivalent $I^{131}$ ($I^{131}$ DEQ) of at least the Technical Specification Section 3.4.8 limits. These are:

a. Not more than 1 $\mu$Ci/gram $I^{131}$ DEQ.

b. Not more than $100/\bar{E}$ $\mu$Ci/gram of gross radioactivity.

The specific activity of the reactor coolant may be as high as the limits defined by Technical Specification Figure 3.4-1 for up to 48 hours. The lowest limit for this figure corresponds to 60 $\mu$Ci/gram $I^{131}$ DEQ. Scaling down from the value shown for FCB3, Radiation, corresponding 1500 $\mu$Ci/gram $I^{131}$ DEQ an RCS sample dose rate at one foot is computed as shown in the equation below.

RCS Sample Reading For 60 $\mu$Ci/gram $I^{131}$ DEQ

Refer to EAL FC84, High RCS Activity

BU3 Value = $\frac{60\ \mu Ci/gram}{1500\ \mu Ci/gram}$ x 168 mrem/h = 6.7 mrem/h

Read as 6 mrem/h (.06 mSv/h)

Thus, the EAL is written as:

| |
|---|
| Dose Rate at One Foot from RCS Sample of AT LEAST 6 mrem/h |

This corresponds to a dose rate of 0.06 mSv/h.

Source Documents/References/Calculations:

1. Technical Specifications
   - TS 3.4.8, Reactor Coolant System - Specific Activity
2. Abnormal Operating Procedures
   - AOP-6A, Response to High RCS Activity
3. BG&E Fuel Degradation EALs Calculation Worksheet, JSB Associates, February 18, 1993

Emergency Classification Level: ALERT

Applicable Operational Modes: 1, 2, 3, 4

Calvert Cliffs Initiating Condition:

**BA1 Loss OR Potential Loss of EITHER Fuel Clad Barrier OR RCS Barrier**

NUMARC Initiating Condition:

FA1 ANY Loss or ANY Potential Loss of EITHER Fuel Clad OR RCS

Barrier: Fuel Clad, RCS

*This IC is entered based on the Fission Barrier Reference Table EALs discussed below.*

Emergency Classification Level: SITE EMERGENCY

Applicable Operational Modes: 1, 2, 3, 4

Calvert Cliffs Initiating Condition:

## BS1 Loss Or Potential Loss of ANY Two Barriers

NUMARC Initiating Condition:

FS1 Loss of BOTH Fuel Clad AND RCS OR
Potential Loss of BOTH Fuel Clad AND RCS OR
Potential Loss of EITHER Fuel Clad OR RCS AND Loss of ANY Additional Barrier

Barrier: Fuel Clad, RCS, Containment

Calvert Cliffs logic is simplified from the generic NUMARC logic based on the following considerations:

1. Human Factors - It is easier to understand and to remember the escalation from Alert to Site Emergency to General Emergency using the simpler logic.

2. Comprehensiveness - A comparison was made of the combinations of barrier losses and potential losses corresponding to Site Emergency between the Calvert Cliffs logic and the NUMARC logic. This comparison is shown by Tables B-1 and B-2 below. All six NUMARC barrier loss/potential loss combinations (Table B-2) are addressed in the Calvert Cliffs logic that addresses 12 combinations of barrier loss/potential loss (Table B-1).

3. Escalation of SG Tube Rupture Sequences - This logic change is consistent with NUMARC's intended scheme for classifying steam generator tube rupture sequences. *No other sequences are significantly affected by the Fission Barrier EAL logic change.* IC BU2, RCS Leakage, addresses smaller sized SG tube leakage that exceeds Tech Spec allowable but fall well within normal makeup capacity. SG tube leaks in this category should result in declaration of an Unusual Event. Fission Barrier EAL RCB4, Coolant Leakage, addresses tube breaks with leak rates that are somewhat larger than normal makeup capacity, but are readily controlled in accordance with the EOPs. SG breaks of this category result in declaration of an Alert due to potential loss of the RCS Barrier. Larger spectrum tube rupture events that can lead to SG overfill and prolonged releases off-site are addressed by Fission Barrier EAL CNB4, Coolant Leakage. Leaks of this size result in simultaneously achieving the thresholds of RCB4 and CNB4 result in declaration of a Site Emergency due to potential loss of the RCS barrier and loss of the CTMT barrier. Escalation to General Emergency would be based on further degradation of the RCS barrier and the subsequent potential loss of the Fuel Clad barrier.

*This IC is entered based on the Fission Barrier Reference Table EALs discussed below.*

Table B-1: SAE Barrier Loss/Potential Loss Combinations for CCNPP Logic

Loss or Potential Loss of ANY Two Barriers

| Fuel Clad | | RCS | | Containment | |
|---|---|---|---|---|---|
| Loss | Potential Loss | Loss | Potential Loss | Loss | Potential Loss |
| 1. X | | X | | | |
| 2. X | | | X | | |
| 3. X | | | | X | |
| 4. X | | | | | X |
| 5. | X | X | | | |
| 6. | X | | X | | |
| 7. | X | | | X | |
| 8. | X | | | | X |
| 9. | | X | | X | |
| 10. | | X | | | X |
| 11. | | | X | X | |
| 12. | | | X | | X |

## Table B-2: SAE Barrier Loss/Potential Loss Combinations for NUMARC Logic

Loss of BOTH Fuel Clad AND RCS OR Potential Loss of BOTH Fuel Clad AND RCS
OR Potential Loss of EITHER Fuel OR RCS, AND Loss of ANY Additional Barrier

| Fuel Clad | | RCS | | Containment | |
|---|---|---|---|---|---|
| Loss | Potential Loss | Loss | Potential Loss | Loss | Potential Loss |
| 1. X | | X | | | |
| 2. X | | | X | | |
| 3. | | | | | |
| 4. | | | | | |
| 5. | X | X | | | |
| 6. | X | | X | | |
| 7. | X | | | X | |
| 8. | | | | | |
| 9. | | | | | |
| 10. | | | | | |
| 11. | | | X | X | |
| 12. | | | | | |

Emergency Classification Level: GENERAL EMERGENCY

Applicable Operational Modes: 1, 2, 3, 4

Calvert Cliffs Initiating Condition:

## BG1 Loss of Two Barriers AND Potential Loss of Third Barrier

NUMARC Initiating Condition:

FG1 Loss of ANY Two Barriers AND Potential Loss of Third Barrier

Barrier: Fuel Clad, RCS, Containment

*This IC is entered based on the Fission Barrier Reference Table EALs discussed below.*

# FUEL CLAD BARRIER EALs

Emergency Classification Level: PER FISSION BARRIER REFERENCE TABLE

Applicable Operational Modes: 1, 2, 3, 4

Calvert Cliffs Emergency Action Level:

## FCB1 Safety Function Status/Functional Recovery

NUMARC Emergency Action Level:

Fuel Clad 1 Critical Safety Function Status
- *Loss* - Core Cooling-RED
- *Potential Loss* - Core Cooling-ORANGE or Heat Sink-RED

Barrier: Fuel Clad - The Fuel Clad Barrier is the <zirconium alloy> tubes that contain the fuel pellets.

NUMARC Generic Basis:

This <Generic> EAL is for PWRs using Critical Safety Function Status Tree (CSFST) monitoring and functional recovery procedures. < >

Plant-Specific Information:

Calvert Cliffs does not use Critical Safety Function Status Trees. Calvert Cliffs uses Safety Function Status Checks developed by the Combustion Engineering Owners' Group (C-E OG) which are based on logic similar to that used for CSFSTs developed for Westinghouse PWRs. However, there is no Safety Function Status Check condition that corresponds directly to Core Cooling - RED path as a loss EAL. Thus, the <Generic> loss EAL is incorporated into FCB2. This is better addressed by core exit temperature readings as shown in FCB2, Temperature, below.

As stated above, the Potential Loss EAL should correspond to loss of subcooling conditions and the Loss EAL should correspond to conditions indicating significant superheat. A review was made of the Emergency Operating Procedure basis information contained in CEN-152, Emergency Procedure Guidelines, to determine the applicable Calvert Cliffs symptoms corresponding to the generic conditions of interest, *i.e.*, symptoms of inadequate core cooling sequences leading to core heatup and significant fuel clad damage.

Satisfying the appropriate RCS and Core Heat Removal criteria assures that adequate core cooling exists. Following a LOCA, there are two paths initially available for RCS heat removal: heat transfer to the secondary side via the steam generators, and heat transfer via the fluid flowing out the break. Large break LOCAs have sufficient fluid flowing out the break to provide adequate heat removal. Small break LOCAs do not have sufficient fluid flowing out of the break to provide adequate heat removal. Therefore, under these conditions steam generator heat removal is required in addition to break flow to assure that there is adequate core heat removal. For the largest breaks, the RCS depressurizes to an equilibrium pressure with containment. In this condition, the RCS fluid is at a lower temperature than that of the steam generators.

The steam generators, therefore, act as a heat source, superheating any steam in the RCS which may be flowing through the steams generators to the break. By cooling down the steam generators, heat input to the RCS is reduced. EOP-5, Loss of Coolant Accident, does not distinguish between large and small break LOCAs, and requires steam generator heat removal be maintained at all times during a LOCA, if at all possible. Once RCS pressure and temperature are reduced, RCS heat removal can be provided by the Shutdown Cooling System (SDCS). Once the SDCS is placed in service, the steam generator heat sink capability is no longer necessary.

In the event that the liquid inventory in the steam generators is not adequate to remove decay heat, a source of feedwater is unavailable, and the SDCS is not in service, the operator will transition to EOP-8, Functional Recovery Procedure. If RCS cooling through the steam generators cannot be restored, then the operator is instructed to implement once through RCS Cooling via the (pressurizer) PORVs before depleting the remaining steam generator inventory.

The applicable acceptance criteria for Core and RCS Heat Removal are shown on the Safety Function Status Checks. They are:

Steam Generators Available for RCS Heat Removal

1. Adequate secondary side liquid inventory in at least one steam generator as indicated by level between -170 and +30 inches, and

2. Adequate source of feedwater available to assure continued liquid inventory available as indicated by Condensate Storage Tank level greater than 5 feet, and

3. Steam Generators acting as effective heat sink as indicated by Cold Leg Temperatures ($T_{COLD}$) constant or lowering.

Primary Side Conditions for Core and RCS Heat Removal

1. Adequate core heat removal as indicated by Core Exit Thermocouple readings less than superheated, and

2. Either of the following:

   - Natural circulation established as indicated by the temperature difference between Hot Leg Temperature ($T_{HOT}$) and $T_{COLD}$ of between 10°F and 50°F

   or

   - Forced circulation effective as indicated by $T_{HOT}$ - $T_{COLD}$ less than 10°F.

Based on the above discussion, the Potential Loss EAL is written as:

| |
|---|
| EOP-8, **Functional Recovery Procedure**, Can NOT Meet Core and RCS Heat Removal Acceptance Criteria AND Shutdown Cooling is NOT In Service |

*Can NOT* is used because the final safety function status is of concern, not merely the inability to meet certain intermediate status check conditions.

*In service* means that the SDCS is in the proper configuration for RCS heat removal (SDCS isolation valves open, LPSI pumps operating, etc.) and is considered "operable" as defined in the Calvert Cliffs Technical Specifications Section 1.6.

Source Documents/References/Calculations:

1. Emergency Operating Procedures
   - EOP-5, Loss of Coolant Accident
   - EOP-8, Functional Recovery Procedure

2. CEN-152, Emergency Procedure Guidelines

Calvert Cliffs Emergency Action Level:

## FCB2 Temperature

NUMARC Emergency Action Level:

Fuel Clad 3 Core Exit Thermocouple Readings
- *Loss* - GREATER THAN (Site-Specific) °F
- *Potential Loss* - GREATER THAN (Site-Specific) °F

NUMARC Generic Basis:

The Loss EAL (Site-Specific) reading should correspond to significant superheating of the coolant. This value typically corresponds to the temperature reading that indicates core cooling - RED in Fuel Clad Barrier EAL 1, usually about 1200°F.

The Potential Loss EAL (Site-Specific) reading should correspond to loss of subcooling. This value typically corresponds to the temperature reading that indicates core cooling - ORANGE in Fuel Clad Barrier EAL 1, usually about 700 to 900°F.

Plant-Specific Information:

Calvert Cliffs uses the generic value of 1200 °F as the fuel clad "loss" indicator. This is consistent with Attachment 3 of ERPIP 802, Core Damage Assessment Using Core Exit Thermocouples. This shows that at Calvert Cliffs, clad rupture due to high temperature is not expected for core exit thermocouple temperature readings of less than 1200 °F.

Thus, the Loss EAL is written as:

| Valid Core Exit Thermocouple Readings GREATER THAN 1200 °F |
|---|

*Valid* means that the thermocouple channel(s) are considered to be operable in accordance with the Technical Specifications.

For consistency with Calvert Cliffs EOPs, the Potential Loss EAL is written as:

| Valid Core Exit Thermocouple Readings Indicate Superheat |
|---|

Source Documents/References/Calculations:

1. Emergency Response Plan Implementation Procedures
   - ERPIP-802, Core Damage Assessment Using Core Exit Thermocouples

2. Emergency Operating Procedures
   - EOP-5, Loss of Coolant Accident
   - EOP-8, Functional Recovery Procedure

Calvert Cliffs Emergency Action Level:

## FCB3 Radiation

NUMARC Emergency Action Level:

Fuel Clad 2 Primary Coolant Activity Level

- *Loss* - Coolant Activity GREATER THAN (Site Specific) Value
- *Potential Loss* - Not Applicable

Fuel Clad 5 Containment Radiation Monitoring

- *Loss* - Containment Radiation Monitor Reading GREATER THAN (Site-Specific) R/Hr
- *Potential Loss* - Not Applicable

NUMARC Generic Basis:

[Fuel Clad 2]
This (Site-Specific) value corresponds to 300 $\mu$Ci/cc $I_{131}$ equivalent. Assessment by the NUMARC EAL Task Force indicates that this amount of coolant activity is well above that expected for iodine spikes and corresponds to about 2% to 5% fuel clad damage. This amount of clad damage indicates significant clad heating and thus the Fuel Clad Barrier is considered lost.

There is no equivalent Potential Loss EAL for this item.

[Fuel Clad 5]
The (Site-Specific) reading is a value which indicates release of reactor coolant, with an elevated activity indicative of fuel damage, into the containment. The reading should be calculated assuming the instantaneous release and dispersal of reactor coolant noble gas and iodine inventory associated with a concentration of 300 $\mu$Ci/gm dose equivalent $I_{131}$ into the containment atmosphere. Reactor coolant concentrations of this magnitude are several times larger than the maximum concentrations (including iodine spiking) allowed within technical specifications and are therefore indicative of fuel damage (approximately 2 - 5% clad failure depending on core inventory and RCS volume.) This value is higher than that specified for RCS Barrier Loss <EAL 2>. Thus, this EAL indicates a loss of both the fuel clad barrier and the RCS barrier <and would indicate at least a Site Emergency classification>.

There is no Potential Loss EAL associated with this item.

Plant-Specific Information:

The NUMARC Methodology is based on the assumption that the typical maximum iodine spike allowed in the Technical Specifications is about 60 $\mu$Ci/cc DEQ $I_{131}$, and thus a value of 300 $\mu$Ci/cc is readily distinguishable. For Calvert Cliffs, the corresponding iodine spike allowable value is 270 $\mu$Ci/cc DEQ $I_{131}$/Technical Specification Figure 3.4.8-1. Given the uncertainties in the sample analysis process, the Calvert Cliffs allowable iodine spike value can be indistinguishable from the generic value. The site specific value was determined by calculating various coolant radionuclide concentrations postulated to result from 5% gap release at Calvert Cliffs. This corresponds to about 1500 $\mu$Ci/cc DEQ $I_{131}$Under those conditions, PASS sampling using 12.5 ml pressurized bomb samples would be used. The corresponding values for a PASS sample are:

- 42 mrem/h (0.42 mSv/h) at 1 foot due to radio-iodines (unpressurized sample)
- 2.2 mrem/h (0.022 mSv/h) at 1 foot due to noble gases
- 44 mrem/h (0.44 mSv/h) at 1 foot for pressurized sample

Therefore, whether the sample is pressurized or not makes little difference, as the largest contribution to the dose rate after 1 hour decay is from the radio-iodines.

Thus, Loss EAL 1 is written as:

| |
|---|
| Dose Rate at One Foot from PASS Sample of AT LEAST 40 mrem/h |

This corresponds to a dose rate of 0.4 mSv/h. Per Reference 3, this also results in a dose rate at one foot from an *unshielded RCS sample* of about 168 mrem/h. (1.7 mSv/h)

The plant-specific containment monitor radiation values were determined from ERPIP-801, assuming 5% fuel clad damage. This procedure can be used to determine the containment radiation monitor readings resulting from 5% fuel clad failure using Attachment 2 and assuming no power correction.

The radiation monitor reading (1-RI-5317A & B, 2-RI-5317 A & B) corresponding to 5% fuel clad failure at 2 hours after shutdown is about 3,500 rem/h (35 Sv/h).

Thus, Loss EAL 2 is written as:

| |
|---|
| Valid RI-5317A/B Reading of AT LEAST 3,500 rem/h Within 2 Hours After Reactor Shutdown |

*Valid* means that the applicable radiation monitoring channel(s) are considered to be operable in accordance with the Technical Specifications.

*The EAL uses the value of 2 hours after the initiating event (assumed to closely correspond to the time of reactor shutdown) for simplicity in presentation to the Shift Supervisor acting as the Site Emergency Coordinator (SEC). The two hour point was also picked because it allows ample time for transfer of the SEC duties to outside the Control Room.*

Technical support personnel can also use ERPIP-801, -802, -803, and -804 to determine core damage. Thus, Loss EAL 2 is written as:

| |
|---|
| AT LEAST 5% Fuel Clad Damage As Determined From Core Damage Assessment |

Source Documents/References/Calculations:

1. Technical Specifications
   - Figure 3.4.8-1, Dose Equivalent I-131 Primary Coolant Specific Activity Limit Versus Percent of Rated Power With the Primary Coolant Specific Activity > 1.0 μCi/Gram Dose Equivalent I-131

2. Emergency Response Plan Implementation Procedures
   - ERPIP-801, Core Damage Assessment Using Containment Radiation Dose Rates
   - ERPIP-802, Core Damage Assessment Using Core Exit Thermocouples
   - ERPIP-803, Core Damage Assessment Using Hydrogen
   - ERPIP-804, Core Damage Assessment Using Radiological Analysis of Samples

3. BG&E Fuel Degradation EALs Calculation Worksheet, JSB Associates, February 18, 1993

Calvert Cliffs Emergency Action Level:

## FCB4 Reactor Vessel Water Level

NUMARC Emergency Action Level:

Fuel Clad 4 Reactor Vessel Water Level
- *Loss* - Not Applicable
- *Potential Loss* - Level LESS TH[illegible]N (Site-Specific) Value

Barrier: Fuel Clad

NUMARC Generic Basis:

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

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

Plant-Specific Information:

As part of its Inadequate Core Cooling instrumentation, Calvert Cliffs uses a reactor vessel level monitoring system (RVLMS) that is displayed to the operators and can measure water level from the top of the fuel alignment plate to the top of the reactor vessel head. The bottom of this instrument's span closely corresponds to the (Site-Specific) water indication of Potential Loss used by NUMARC. At the bottom of the pressurizer, the RVLMS initiates the first alarm. From AOP-3B, the transition to the EOPs is contingent upon the decrease of the pressurizer level. Per AOP-3B, Attachment 14, a 29" RVLMS indication corresponds to the bottom of the hot leg elevation and is the sixth (6th) RVLMS alarm. The threshold corresponding to the bottom of the hot leg with a trend to zero thus is chosen because it is readily recognizable by operators (i.e., consistent declaration) and indicates a severe loss of inventory.

Thus, the Potential Loss EAL is written as:

| Valid RVLMS Reading at 29 Inches and Trending Toward 0 |
|---|

*Valid* means that the applicable vessel level monitoring channel(s) are considered to be operable in accordance with the Technical Specifications.

Source Documents/References/Calculations:

1. Abnormal Operating Procedures
   - AOP-3B Attachment 14, RCS Levels

2. Updated Final Safety Analysis Report
   - Section 7.5.9, Inadequate Core Cooling Instrumentation

Calvert Cliffs Emergency Action Level:

## FCB5 SEC Judgement

NUMARC Emergency Action Level:

Fuel Clad 6 Other (Site-Specific) Indications
Fuel Clad 7 Emergency Director Judgement

NUMARC Generic Basis:

[Fuel Clad 6]
This EAL is to cover other (site-specific) indications that may indicate loss or potential loss of the Fuel Clad barrier, including indications from containment air monitors or any other (site-specific) instrumentation.

[Fuel Clad 7]
This EAL addresses any other factors that are to be used by the <SEC> in determining whether the Fuel Clad barrier is lost or potentially lost. In addition, the inability to monitor the barrier should also be incorporated in this EAL as a factor in <SEC> judgement that the barrier may be considered lost or potentially lost. (See IC <EG1, Prolonged Station Blackout> for additional information.)

Plant-Specific Information:

Other indications were also considered and no additional reliable indications of fuel clad loss or potential loss could be determined. Thus, the generic "Other (Site-Specific) Indications" Fuel Clad EAL does not apply to the Calvert Cliffs Plant.

Per the Emergency Response Plan, the Site Emergency Coordinator (SEC) is the title for the emergency director function at Calvert Cliffs. SEC considerations for determining whether any barrier Loss or Potential Loss include *imminent* degradation, *barrier monitoring* capability, and *dominant accident sequences*.

Anticipated degradation of ANY Barrier within 2 hour based on a projection of current safety system performance is considered to be *imminent* Barrier degradation. This must be considered by the SEC for timely declaration of a General Emergency. The term *imminent* refers to the inability to reach final safety acceptance before completing all checks.

Decreased *barrier monitoring* ability from loss of/lack of reliable indicators must also be considered by the SEC when judging whether a Barrier may be Lost or Potentially Lost. This assessment should also include instrumentation operability concerns, readings from portable instrumentation, and consideration off-site monitoring results.

*Dominant accident sequences* will lead to degradation of all Barriers. Such sequences can lead to entry into EOP-8, Functional Recovery Procedure. The SEC should also consult Station Blackout and ATWS ICs, as appropriate, to assure timely emergency classification declaration.

Thus, the EAL is written as:

| |
|---|
| Conditions Which in the SEC's Judgement Indicate Loss or Potential Loss of the Fuel Clad Barrier Based on:<br>• Imminent Barrier Degradation Due to Safety System Performance<br>• Degraded Ability to Monitor Barrier |

Source Documents/References/Calculations:

1. Emergency Response Plan

# RCS BARRIER EALs

Emergency Classification Level: PER FISSION BARRIER REFERENCE TABLE

Applicable Operational Modes: 1, 2, 3, 4

Calvert Cliffs Emergency Action Level:

## RCB1 Safety Function Status/Functional Recovery

NUMARC Emergency Action Level:

RCS 1 Critical Safety Function Status
- *Loss* - Not Applicable
- *Potential Loss* - RCS Integrity-RED OR Heat Sink-RED

RCS 5 Other (Site-Specific) Indications

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

NUMARC Generic Basis:

[RCS1]
This EAL is for PWRs using Critical Safety Function Status Tree (CSFST) monitoring and functional recovery procedures. < > There is no Loss EAL associated with this item.

[RCS 5]
This EAL is to cover other (site-specific) indications that may indicate loss or potential loss of the RCS barrier, including indications from containment air monitors or any other (site-specific) instrumentation.

Plant-Specific Information:

Calvert Cliffs does not use Critical Safety Function Status Trees. Calvert Cliffs uses Safety Function Status Checks developed by the Combustion Engineering Owners' Group (C-E OG) which are based on logic similar to that used for CSFSTs developed for Westinghouse PWRs.

A review of plant design information and procedures showed that an appropriate site-specific Loss EAL could be developed based on an EOP transition. Contingency actions related to maintaining RCS Cooling, RCS Inventory, and RCS Pressure functions in accordance with EOP-6 direct the operators to EOP-8, Functional Recovery Procedure.

Thus, the Loss EAL is written as:

| |
|---|
| EOP-8, **Functional Recovery Procedure**, is Implemented from EOP-6, **Steam Tube Rupture** |

The generic indications of concern for the Potential Loss EAL correspond to exceeding Pressurized Thermal Shock (PTS) cooldown limits or the determination of loss of secondary heat sink. These are discussed below.

Among the Safety Functions to be maintained is RCS Pressure Control. The purpose of maintaining RCS Pressure Control is to maintain the RCS inventory in a subcooled condition to provide an adequate cooling medium for the core, and to prevent the loss of inventory out of a relief valve. Per EOP-4, the potential exists for pressurized thermal shock from an excessive cooldown rate followed by a repressurization.

The EOPs require that the plant conditions be maintained within the limits of the RCS Pressure-Temperature Curve (which is shown as Attachment 1 to the EOPs). Uncontrolled RCS cooldowns which result in pressure-temperature conditions to the left of these curves (based on the combinations of Reactor Coolant Pumps in

operation), which is labeled as the Non-Operating Area, is the condition which most closely corresponds to the NUMARC concern.

Thus, based on the above, Potential Loss EAL 1 is written as:

> Uncontrolled RCS Cooldown AND RCS Pressure-Temperature in the Non-Operating Area (Left of the Cooldown Curve)

*Uncontrolled* means that the RCS cooldown was not the result of deliberate action performed in accordance with plant procedures and exceeds allowable vessel cooldown limits.

The applicable acceptance criteria for Core and RCS Heat Removal via the Steam Generators are discussed under FCB1 above. Once RCS pressure and temperature are reduced, RCS heat removal can be provided by the Shutdown Cooling System (SDCS). Once the SDCS is placed in service, the steam generator heat sink capability is no longer necessary.

On the basis of the above discussion, Potential Loss EAL 2 is written as:

> EOP-8, **Functional Recovery Procedure**, Can NOT Meet Core and RCS Heat Removal Acceptance Criteria AND Shutdown Cooling is NOT In Service

*Can NOT* is used because the final safety function status is of concern, not merely the inability to meet certain intermediate status check conditions.

*in service* means that the SDCS is in the proper configuration for RCS heat removal (SDCS isolation valves open, LPSI pumps operating, etc.) and is considered "operable" as defined in the Calvert Cliffs Technical Specifications.

Source Documents/References/Calculations:

1. Emergency Operating Procedures
   - EOP-0, Post-Trip Immediate Actions
   - EOP-1, Reactor Trip
   - EOP-3, Loss of Feedwater
   - EOP-4, Excess Steam Demand Event
   - EOP-5, Loss of Coolant Accident
   - EOP-6, Steam Generator Tube Rupture
   - EOP-8, Functional Recovery Procedure

2. Emergency Operating Procedures Attachment 1

3. CEN-152, Emergency Procedure Guidelines

Calvert Cliffs Emergency Action Level:

## RCB2 Temperature

NUMARC Emergency Action Level:

RCS 2 RCS Leak Rate
- *Loss* - GREATER THAN Available Makeup Capacity as Indicated by a Loss of RCS Subcooling

RCS 3 SG Tube Rupture
- *Loss* - (Site-Specific) <Indication>

NUMARC Generic Basis:

[RCS 2]
The "Loss" EAL addresses conditions where leakage from the RCS is greater than available inventory control capacity such that a loss of subcooling has occurred. The loss of subcooling is the fundamental indication that the inventory control systems are inadequate in maintaining RCS pressure and inventory against the mass loss through the leak. <>

*<"Potential Loss" EALs are addressed in IC RCB4, Coolant Leakage.>*

[RCS 3]
This EAL is intended to address the full spectrum of Steam Generator (SG) tube rupture events in conjunction with <Loss EAL CNB4 and FCB EALs>. The "Loss" EAL addresses ruptured SG(s) with an unisolable Secondary Line Break corresponding to the loss of 2 of 3 fission product barriers (RCS Barrier and Containment Barrier - this EAL will always result in <Loss EAL CNB4>). This allows the direct release of radioactive fission and activation products to the environment. Resultant off-site dose rates are a function of many variables. Examples include: Coolant Activity, Actual Leak Rate, SG Carry Over, Iodine Partitioning, and Meteorology. Therefore, dose assessment in accordance with IC <RG1, Off-Site Dose of AT LEAST 1 Rem (EDE + CEDE) OR 5 Rem CDE Thyroid> is required when there is indication that the fuel matrix/clad is potentially lost.

(Site-specific) indication should be consistent with the diagnostic activities of the Emergency Operating Procedures (EOPs), if available. This should include indication of reduction in primary coolant inventory, increased secondary radiation levels, and an uncontrolled or complete depressurization of the ruptured SG. Secondary radiation increases should be observed via radiation monitoring of Condenser Air Ejector Discharge, SG Blowdown, Main Steam, and/or SG Sampling System. Determination of the "uncontrolled" depressurization of the ruptured SG should be based on indication that the pressure decrease in the ruptured steam generator is not a function of operator action. This should prevent declaration based on a depressurization that results from an EOP-induced cooldown of the RCS that does not involve the prolonged release of contaminated secondary coolant from the affected SG to the environment. This EAL should encompass steam breaks, feed breaks, and stuck open safety or relief valves.

Plant-Specific Information:

A review of EOP-6 shows that the minimum acceptable RCS subcooling value is 25°F. Following AOP-2A procedures for Excessive RCS Leakage Exceeds One Charging Pump in Modes 1 & 2, EOP-0, Post-Trip Immediate Actions is initiated. After the completion of EOP-0, EOP-6 requires that the RCS Subcooling be maintain a minimum of at least 25 °F. Failing this criterion will prompt entry into EOP-5. In addition, AOP-2A procedures for Excessive SG Tube Leakage with LTOP (i.e., plant initially in Mode 3) require that the RCS Subcooling maintain at least 25 °F. For consistency with procedural requirements, the lower value of subcooling is used for this EAL.

Thus, the Loss EAL is written as:

| |
|---|
| RCS Subcooling Can NOT Be Maintained AT LEAST 25 °F |

Source Documents/References/Calculations:

1. Abnormal Operating Procedures
   - AOP-2A, Excessive Reactor Coolant Leakage

2. Emergency Operating Procedures
   - EOP-0, Post-Trip Immediate Actions
   - EOP-1, Reactor Trip
   - EOP-5, Loss of Coolant Accident
   - EOP-6, Steam Generator Tube Rupture

Calvert Cliffs Emergency Action Level:

## RCB3 Radiation

NUMARC Emergency Action Level:

RCS 4 Containment Radiation Monitoring

- *Loss* - Containment Rad Monitor Reading GREATER THAN (Site-specific) R/Hr
- *Potential Loss* - Not Applicable

NUMARC Generic Basis:

The (Site-specific) reading is a value which indicates the release of reactor coolant into the containment. The reading should be calculated assuming the instantaneous release and dispersal of the reactor coolant noble gas and iodine inventory associated with normal operating concentrations (*i.e.*, within TS) into the containment atmosphere. The reading will be less than that specified for Fuel Clad Barrier <EAL 2>. Thus, this EAL would be indicative of an RCS leak only. < >.

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

There is no Potential Loss EAL associated with this item.

Plant-Specific Information:

Only small amounts of noble gases would be dissolved in the reactor coolant because of very high clad integrity. The EAL uses a value of 5 rem/h (50 mSv/h) for ease of identification using RI-5317 A & B monitors, because it in the first decade of the log scale and will be readable by the operators.

Thus, the Loss EAL is written as:

| Valid RI-5317A/B Reading of AT LEAST 5 R/h Within 2 Hours After Reactor Shutdown |
|---|

By specifying the time of the reading as being after reactor shutdown, it also eliminates from consideration such factors as "shine" and N-16 effects on the detectors.

*Valid* means that the applicable radiation monitoring channel(s) are considered to be operable in accordance with the Technical Specifications.

*The EAL uses the value of 2 hours after the initiating event (assumed to closely correspond to the time of reactor shutdown) for simplicity in presentation to the Shift Supervisor acting as the Site Emergency Coordinator (SEC). The two hour point was also picked because it allows ample time for the transfer of the SEC duties to outside the Control Room.*

Source Documents/References/Calculations:

1. Emergency Response Plan Implementation Procedures
   - ERPIP-801, Core Damage Assessment Using Containment Radiation Dose Rates

Calvert Cliffs Emergency Action Level:

## RCB4 Coolant Leakage

NUMARC Emergency Action Level:

RCS 2 RCS Leak Rate
- *Potential Loss* - Unisolable Leak Exceeding the Capacity of One Charging Pump in the Normal Charging Mode

RCS 3 SG Tube Rupture
- *Potential Loss* - (Site-Specific) Indication that a SG is Ruptured and Has a Non-Isolable Secondary Line Break OR (Site-Specific) Indication that a SG is Ruptured and a Prolonged Release of Secondary Coolant is Occurring From the Affected SG to the Environment

RCS 5 Other (Site-Specific) Indications

NUMARC Generic Basis:

[RCS 2, RCS 3]
*<Loss EALs are addressed under IC RCB2, Temperature.> <>*

The Potential Loss EAL is based on the inability to maintain normal liquid inventory within the Reactor Coolant System (RCS) by normal operation of the Chemical and Volume Control System which is considered as one centrifugal charging pump discharging to the charging header. <This indication, applying to any RCS leakage including primary-to-secondary leakage> assures that any event that results in significant RCS inventory shrinkage or loss (*e.g.*, events leading to reactor scram and ECCS actuation) will result in no lower than an "Alert" emergency classification.

[RCS 5]
This EAL is to cover other (site-specific) indications that may indicate loss or potential loss of the RCS barrier, including indications from containment air monitors or any other (site-specific) instrumentation.

Plant-Specific Information:

The Calvert Cliffs Chemical and Volume Control System (CVCS) uses three positive displacement horizontal pumps with a capacity of 44 GPM each. The pressurizer level control program regulates letdown purification subsystem flow by adjusting the letdown flow control valve so that the reactor coolant pump (RCP) controlled leak-off plus the letdown flow matches the input from the operating charging pump. Equilibrium pressurizer level conditions may be disturbed due to RCS temperature changes, power changes, or RCS inventory loss due to leakage. A decrease in pressurizer water level below the programmed level will result in a control signal to start one or both standby charging pumps to restore water level. An increase in pressurizer water level above the programmed level will result in a control signal to increase letdown purification flow rate and initiate a backup signal to stop the two standby charging pumps.

A start signal is sent to all three charging pumps on a Safety Injection Actuation Signal (SIAS), aligning the charging pumps suction to the Boric Acid Storage Tanks (BASTs) via the boric acid pumps. All three charging pumps will then inject highly concentrated boric acid into the RCS to ensure that the reactor is shutdown. Potential Loss of the RCS corresponds to conditions where the CVCS can not maintain pressurizer water level within normal limits requiring transition into the EOPs when the reactor is initially critical.

Thus, Potential Loss EAL 1 is written as:

| |
|---|
| RCS Leakage Exceeds Available CVCS Capacity |

However, review showed that an appropriate site-specific Potential Loss EAL could be developed based on entry into EOP-5, Loss of Coolant Accident, or EOP-8, Functional Recovery Procedure, for an RCS leak.

Thus, Potential Loss EAL 2 is written as:

| |
|---|
| EOP-5, **Loss of Coolant Accident**, Or EOP-8, **Functional Recovery Procedure**, is implemented for RCS Leakage |

Source Documents/References/Calculations:

1. Abnormal Operating Procedures
   - AOP-2A, Excessive Reactor Coolant Leakage

2. Emergency Operating Procedures
   - EOP-5, Loss of Coolant Accident
   - EOP-8, Functional Recovery Procedure

3. Surveillance Test Procedure (STP) O-27-1/2, RCS Leakage Evaluation

4. Updated Final Safety Analysis Report
   - Section 9.1, Chemical and Volume Control System

Calvert Cliffs Emergency Action Level:

## RCB5 SEC Judgement

NUMARC Emergency Action Level:

RCS 6 Emergency Director Judgement

NUMARC Generic Basis:

This EAL addresses any other factors that are to be used by the <SEC> in determining whether the RCS barrier is lost or potentially lost. In addition, the inability to monitor the barrier should also be incorporated in this EAL as a factor in <SEC> judgement that the barrier may be considered lost or potentially lost. (See also <IC EG1, Prolonged Station Blackout>, for additional information.)

Plant-Specific Information:

Per the Emergency Response Plan, the Site Emergency Coordinator (SEC) is the title for the emergency director function at Calvert Cliffs. SEC considerations for determining whether any barrier Loss or Potential Loss include *imminent* degradation, *barrier monitoring* capability, and *dominant accident sequences*. This information is included on the Fission Product Barrier reference page which is to be reviewed by the SEC before using the Fission Product Barrier Table.

Anticipated degradation of ANY Barrier within 2 hour based on a projection of current safety system performance is considered to be *imminent* Barrier degradation. This must be considered by the SEC for timely declaration of a General Emergency. The term *imminent* refers to the inability to reach final safety acceptance before completing all checks.

Decreased *barrier monitoring* ability from loss of/lack of reliable indicators must also be considered by the SEC when judging whether a Barrier may be Lost or Potentially Lost. This assessment should also include instrumentation operability concerns, readings from portable instrumentation, and consideration off-site monitoring results.

*Dominant accident sequences* will lead to degradation of all Barriers. The SEC should also consult Station Blackout and ATWS ICs, as appropriate, to assure timely emergency classification declaration.

Thus, the EAL is written as:

| |
|---|
| Conditions Which in the SEC's Judgement Indicate Loss or Potential Loss of the RCS Barrier Based on:<br>• Imminent Barrier Degradation Due to Safety System Performance<br>• Degraded Ability to Monitor Barrier |

Source Documents/References/Calculations:

1. Emergency Response Plan

# CONTAINMENT BARRIER EALs

Emergency Classification Level: PER FISSION BARRIER REFERENCE TABLE

Applicable Operational Modes: 1, 2, 3, 4

Calvert Cliffs Emergency Action Level

## CNB1 Safety Function Status/Functional Recovery

NUMARC Emergency Action Level:

Containment 1 Critical Safety Function Status

- *Loss* - Not Applicable
- *Potential Loss* - Containment - Red

Containment 7 Other (Site-Specific) Indications

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

NUMARC Generic Basis:

[Containment 1]
This <Generic> EAL is for PWRs using Critical Safety Function Status Tree (CSFST) monitoring and functional recovery procedures. < >Thus, this EAL is primarily a discriminator between Site <E>mergency and General Emergency representing a potential loss of the third barrier.

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

[Containment 7]
This <Generic> EAL should cover other (site-specific) indications that may unambiguously indicate loss or potential loss of the containment barrier, including indications from area or ventilation monitors in containment annulus or other contiguous buildings. If site emergency operations procedures provide for venting of the containment during an emergency as a means of preventing catastrophic failure, a Loss EAL should be included for the containment barrier. This <Generic> EAL should be declared as soon as such venting is imminent. Containment venting as part of recovery actions is classified in accordance with <Radiation Releases ICs>.

Plant-Specific Information:

Calvert Cliffs does not use Critical Safety Function Status Trees. There is no direct equivalent to the generic containment status tree "potential loss" EAL at Calvert Cliffs.

Calvert Cliffs does not include containment venting as part of its EOPs. Other conditions of interest are already addressed by the other CNTMT EALs below. Therefore, there is no Loss EAL in this category at Calvert Cliffs.

The potential loss addresses the inability to maintain required containment conditions following entry into the Emergency Operating Procedures. This corresponds to a potential challenge to containment integrity and thus is an appropriate potential loss EAL.

Thus, the Potential Loss EAL is written as:

| |
|---|
| EOP-8, Functional Recovery Procedure, is Entered AND Containment Environment Acceptance Criteria Can NOT Be Met |

*Can NOT* is used because the ability to meet the final acceptance criteria is the appropriate concern, not whether intermediate acceptance criteria are not being achieved at any given moment.

Source Documents/References/Calculations:

1. Emergency Operating Procedures
   - EOP-8, Functional Recovery Procedure

Emergency Classification Level: PER FISSION BARRIER REFERENCE TABLE

Applicable Operational Modes: 1, 2, 3, 4

Calvert Cliffs Emergency Action Level

## CNB2 Temperature

NUMARC Emergency Action Level:

Containment 6 Core Exit Thermocouple Readings

- *Loss* - Not Applicable
- *Potential Loss* - Core Exit Thermocouples in Excess of 1200°F and Restoration NOT Effective Within 15 Minutes; OR Core Exit Thermocouples in Excess of 700°F With Reactor Vessel Level Below Top of Active Fuel and Restoration Procedures NOT Effective Within 15 Minutes

NUMARC Generic Basis:

In this EAL, the function restoration procedures are those emergency operating procedures that address the recovery of the core cooling critical safety functions. The procedure is considered effective if the temperature is decreasing or if the vessel water level is increasing.

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

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

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

Plant-Specific Information:

As described in EAL FCB4, Reactor Vessel Water Level, the RVLMS measures water level to slightly above the top of the active fuel. Therefore, the generic condition of water level below the top of the active fuel and temperature greater than 700 °F does not apply to Calvert Cliffs.

EOP-8, Functional Recovery Procedure, would be entered on symptoms of inadequate core cooling. This includes core exit thermocouples reading superheat. The functional recovery procedure would be entered well before 1200 °F core exit temperature is achieved, which is the threshold for clad rupture due to high temperature used in EAL FCB2.

The clear intent of the NUMARC methodology is to provide a higher threshold for containment "potential loss" above that of fuel clad "loss" at 1200°F for the core damage sequences of concern. If core exit temperature continued to increase above this value, it would clearly indicate that functional recovery of RCS heat removal was ineffective and that core conditions are continuing to degrade. Per ERPIP-802, 1300°F corresponds to clad damage on the order of 20%. In order to provide a discriminator from the FCB2 "loss" condition (1200°F), temperature of 1300°F and increasing is used here.

Thus, the Potential Loss EAL is written as:

| |
|---|
| Valid Core Exit Thermocouple Readings GREATER THAN 1300 °F AND Increasing |

*Valid* means that the thermocouple channel(s) are considered to be operable in accordance with the Technical Specifications.

Source Documents/References/Calculations:

1. Emergency Response Plan Implementation Procedures
   - ERPIP-802, Core Damage Assessment Using Core Exit Thermocouples

2. CEN-152, Emergency Procedure Guidelines

3. Emergency Operating Procedures
   - EOP-8, Functional Recovery Procedure

4. Abnormal Operating Procedures
   - AOP-3B, Abnormal Shutdown Cooling Conditions, Attachment 14, RCS Levels

5. Updated Final Safety Analysis Report
   - UFSAR Section 7.5.9, Inadequate Core Cooling Instrumentation

Calvert Cliffs Emergency Action Level:

## CNB3 Radiation

NUMARC Emergency Action Level:

Containment 5 Significant Radioactive Inventory in Containment

- *Loss* - Not Applicable
- *Potential Loss* - Containment Rad Monitor Reading GREATER THAN [Site-Specific] R/hr

Containment 7 Other (Site-Specific) Indications

NUMARC Generic Basis:

[Containment 5]
The (Site-specific) reading is a value which indicates significant fuel damage well in excess of the EALs associated with <loss of both Fuel Clad and RCS Barriers>. As stated in <NUMARC/NESP-007>, a major release of radioactivity requiring offsite protective actions from core damage is not possible unless a major failure of fuel cladding allows radioactive material to be released from the core into the reactor coolant. Regardless of whether containment is challenged, this amount of activity in containment, if released, could have such severe consequences that it is prudent to treat this as a potential loss of containment, such that a General Emergency declaration is warranted. NUREG-1228, Source Estimations During Incident Response to Severe Nuclear Power Plant Accidents, indicates that such conditions do not exist when the amount of clad damage is less than 20%. Unless there is a (site-specific) analysis justifying a higher value, it is recommended that a radiation monitor reading corresponding to 20% fuel clad damage be specified here. <Thus, this EAL corresponds to loss of both the fuel clad and RCS barriers with Potential Loss of the Containment barrier, and would result in declaration of a General Emergency>.

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

[Containment 7]
This <Generic> EAL should cover other (site-specific) indications that may unambiguously indicate loss or potential loss of the containment barrier, including indications from area or ventilation monitors in the containment annulus or contiguous buildings...

Plant-Specific Information:

Entry into EOP-5 (Loss of Coolant Accident) or EOP-8 (Functional Recovery Procedure) would be made following a LOCA. As part of the required actions in these procedures, a check is made of radiation levels external to the containment is made to assure that containment bypass has not occurred. The location of such a leak is indicated by sump alarms, room level alarms and area RMS alarms. If a significant leak bypassing containment existed that could not be isolated, then the acceptance criteria for radiation levels external to containment could not be met and this would indicate a CNTMT Loss.

Thus, the Loss EAL is written as:

| |
|---|
| EOP-5, **Loss of Coolant Accident**, Or EOP-8, **Functional Recovery Procedure**, is Implemented AND Radiation Levels External to CNTMT Can NOT Meet Acceptance Criteria |

*Can NOT* is used because the final safety function status is of concern, not merely the inability to meet certain intermediate status check conditions.

Potential Loss EALs 1 and 2 address significant radioactive inventory in containment. The plant-specific containment radiation values were determined from ERPIP-801, assuming 20% fuel clad damage. This procedure

can be used to determine the containment radiation monitor readings resulting from 20% fuel clad failure using Attachment 2 and assuming no power correction.

The radiation monitor reading (1-RI-5317A & B, 2-RI-5317 A & B) corresponding to 20% fuel clad failure at 2 hours after shutdown is about 14,000 rem/h (140 Gray/h).

Thus, Potential Loss EAL 1 is written as:

| |
|---|
| Valid RI-5317A/B Reading of AT LEAST 14,000 rem/h Within 2 Hours After Reactor Shutdown |

*Valid* means that the applicable radiation monitoring channel(s) are considered to be operable in accordance with the Technical Specifications.

*The EAL uses the value of 2 hours after the initiating event (assumed to closely correspond to the time of reactor shutdown) for simplicity in presentation to the Shift Supervisor acting as the Site Emergency Coordinator (SEC). The two hour point was also picked because it allows ample time for transfer of the SEC duties to outside the Control Room.*

Technical support personnel can also use ERPIP-801, -802, -803, and -804 to determine core damage.

Thus, Potential Loss EAL 2 is written as:

| |
|---|
| AT LEAST 20% Clad Damage As Determined From Core Damage Assessment |

Potential Loss EAL 3 addresses conditions where leakage outside containment is detected. As part of EOP-5, Loss of Coolant Accident, the operator is instructed to review potential leak paths from the RCS to outside the Containment and isolate such paths, if possible. Actions to be performed include verifying:

- Letdown line isolation are shut
- RCS sample isolation valves are shut
- Leakage into the Component Cooling System is not occurring

Existence of leakage outside containment would indicate that the plant systems were not performing in accordance with the design basis for containment isolation. Therefore, it is appropriate to classify this condition as a Potential Loss.

Thus, Potential Loss EAL 3 is written as:

| |
|---|
| EOP-5, **Loss of Coolant Accident**, is Implemented AND LOCA is NOT Occurring Within the CNTMT As Indicated by Aux Building Sump Alarms or Aux Building RMS Alarms |

If the leakage were significant and could not be isolated, then the acceptance criteria for radiation levels levels external to containment could not be met and the Loss condition specified above would exist.

Source Documents/References/Calculations:

1. Emergency Response Plan Implementation Procedures
   - ERPIP-801, Core Damage Assessment Using Containment Radiation Dose Rates
   - ERPIP-802, Core Damage Assessment Using Core Exit Thermocouples
   - ERPIP-803, Core Damage Assessment Using Hydrogen
   - ERPIP-804, Core Damage Assessment Using Radiological Analysis of Samples

2. Emergency Operating Procedures
   - EOP-5, Loss of Coolant Accident
   - EOP-8, Functional Recovery Procedure

Calvert Cliffs Emergency Action Level:

## CNB4 Coolant Leakage

NUMARC Emergency Action Level:

Containment 3 Containment Isolation Valve Status After Containment Isolation

- *Loss* - Valve(s) NOT Closed and Downstream Pathway to the Environment Exists
- *Potential Loss* - Not Applicable

Containment 4 SG Secondary Side Release With Primary-to-Secondary Leakage

- *Loss* - Release of Secondary Side to Atmosphere with Primary to Secondary Leakage GREATER THAN TS Allowable
- *Potential Loss* - Not Applicable

NUMARC Generic Basis:

[Containment 3]
This <Generic> EAL is intended to address incomplete containment isolation that allows direct release to the environment. It represents a loss of the containment barrier.

There is no Potential Loss EAL associated with this item.

[Containment 4]
This <Generic> EAL addresses SG tube ruptures. Secondary side releases to atmosphere include those from the condenser air ejector, atmospheric <steam> dump valves, and main steam safety valves. For smaller breaks not exceeding the normal charging capacity threshold in Potential Loss <EAL RCB4, Coolant Leakage>, this EAL results in an Unusual Event <declaration under IC BU2, RCS Leakage>. For larger breaks, <EAL RCB4 Potential Loss> would result in an Alert. For <larger spectrum> SG tube ruptures < >, this <Loss> EAL would exist in conjunction with <EAL RCB4, Coolant Leakage or Loss EAL RCB2, Temperature,> and would result in a Site <E>mergency. Escalation to General Emergency would <then> be based on "Potential Loss" of the Fuel Clad Barrier.

Plant-Specific Information:

Loss EAL 1 addresses containment isolation valve status. It is written in language that facilitates operating staff recognition. In accordance with TS 3.6.1.7 and TS 3.6.4, the containment purge isolation valves are not in operation for Modes 1, 2, 3, & 4; they are closed. The only time the valves are operation is Mode 6 under administrative control.

Thus, Loss EAL 1 is written as:

| Leakage Pathway Exists From Inside CNTMT to Outside CNTMT |
|---|

Existence of a leakage pathway may be determined by radiation monitoring, physical observation, or by control room valve indications.

Larger spectrum steam generator tube ruptures of concern for Loss EAL 2 will result in entry into EOP-6, Steam Generator Tube Rupture. EOP-6 requires that ruptured SG water level be maintained between +30 inches and -170 inches. If the water level cannot be maintained within these limits, entry into EOP-8, Functional Recovery Procedure, is then made. EOP-8 has a wider allowable acceptance band for ruptured SG water level, between +50 inches and -170 inches.

If the ruptured steam generator water level could not be maintained below +50 inches, this would indicate a larger spectrum steam generator tube rupture with potential to overfill the ruptured SG. Additionally, in order to have a release to atmosphere following isolation of the affected SG in accordance with EOP-6, the affected SG steam pressure would need to exceed the minimum steam generator safety valve set pressure or the atmospheric dump valve minimum pressure. At Calvert Cliffs, this corresponds to about 900 psig.

Thus, Loss EAL 2 is written as:

SG Tube Rupture in Progress AND Both of the Following:
- Affected SG Level Can NOT Be Maintained LESS THAN +50 Inches AND
- Affected SG Pressure GREATER THAN 900 PSIG

*Can NOT* is used to indicate a larger spectrum SG tube rupture that can result in overfilling the affected SG.

Source Documents/References/Calculations:

1. Technical Specifications
   - TS 3.4.6.2, Reactor Coolant System Leakage
   - TS 3.6.1.7, Containment Purge System
   - TS 3.6.4, Containment Isolation Valves

2. Abnormal Operating Procedures
   - AOP-2A, Excessive Reactor Coolant Leakage

3. Emergency Operating Procedures
   - EOP-0, Post-Trip Immediate Action
   - EOP-6, Steam Generator Tube Rupture
   - EOP-8, Functional Recovery Procedure

4. Updated Final Safety Analysis Report
   - Chapter 6, Engineered Safety Features
   - Section 9.1, Chemical and Volume Control System

Calvert Cliffs Emergency Action Level:

## CNB5 Pressure

NUMARC Emergency Action Level:

Containment 2 Containment Pressure

- *Loss* - Rapid Unexplained Decrease Following Initial Increase OR Containment or Sump Level NOT Consistent with LOCA Conditions
- *Potential Loss* - (Site-specific) PSIG and Indreasing OR Explosive Mixture Exists OR Containment Pressure GREATER THAN Containment Depressurization System Setpoint With LESS THAN One Full Train of Depressurization Equipmetn Operating

Barrier: Containment

NUMARC Generic Basis:

Rapid unexplained loss of pressure (*i.e.*, not attributable to containment spray or condensation effects) following an initial pressure increase indicates a loss of containment integrity. Containment pressure and sump levels should increase as a result of the mass and energy release into containment from a LOCA. Thus, sump level or pressure not increasing indicates containment bypass (V-sequence) and a loss of containment integrity. The (site-specific) PSIG for potential loss of containment is based on the containment design pressure. Existence of an explosive mixture means a hydrogen and oxygen concentration of at least the lower deflagration limit curve exists. The indications of potential loss under this EAL corresponds to some of those leading to the RED path in EAL CNB1 above and may be declared by those sites using CSFSTs. <T>his <Generic> EAL is primarily a discriminator between Site <E>mergency and General Emergency representing a potential loss of the third barrier.

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

Plant-Specific Information:

The Calvert Cliffs Loss EALs correspond directly to the NUMARC EAL. Because it is difficult to determine whether pressure and sump level response is consistent with expected, and the other Containment Loss EALs address containment response in a way that is observable by the operations staff, the second condition specified in the generic EAL is not used at Calvert Cliffs.

Thus, Loss EAL 1 is written as:

| |
|---|
| Rapid Unexplained CNTMT Pressure Decrease Following Initial Increase |

The design pressure for the Calvert Cliffs containment is 50 psig. Proper actuation and operation of the containment spray system when required maintains containment pressure below its design pressure following LOCA or secondary side break inside containment.

Thus, Potential Loss EAL 1 is written as:

| |
|---|
| CNTMT Pressure of AT LEAST 50 PSIG and Increasing |

The EAL uses the lower limit of flammability of hydrogen in air, *i.e.*, 4% hydrogen concentration. However, 4% corresponds to the explosive mixture condition specified by NUMARC.

Thus, Potential Loss EAL 2 is written as:

| |
|---|
| CNTMT $H_2$ Concentration of AT LEAST 4.0% |

Source Documents/References/Calculations:

1. Technical Specifications
   - TS 3/4.6, Containment Systems

2. Emergency Operating Procedures
   - EOP-8, Functional Recovery Procedure

3. Updated Final Safety Analysis Report
   - Chapter 6, Engineered Safety Features

Calvert Cliffs Emergency Action Level:

## CNB6 SEC Judgement

NUMARC Emergency Action Level:

Containment 8 Emergency Director Judgement

NUMARC Generic Basis:

This EAL addresses any other factors that are to be used by the <SEC> in determining whether the Containment barrier is lost or potentially lost. In addition, the inability to monitor the barrier should also be incorporated in this EAL as a factor in <SEC> judgement that the barrier may be considered lost or potentially lost. (See also <IC EG1, Prolonged Station Blackout,> for additional information.)

Plant-Specific Information:

Per the Emergency Response Plan, the Site Emergency Coordinator (SEC) is the title for the emergency director function at Calvert Cliffs. SEC considerations for determining whether any barrier Loss or Potential Loss include *imminent* degradation, *barrier monitoring* capability, and *dominant accident sequences*. This information is included on the Fission Product Barrier reference page which is to be reviewed by the SEC before using the Fission Product Barrier Table.

Anticipated degradation of ANY Barrier within 2 hours based on a projection of current safety system performance is considered to be *imminent* Barrier degradation. This must be considered by the SEC for timely declaration of a General Emergency. The term *imminent* refers to the inability to reach final safety acceptance before completing all checks.

Decreased *barrier monitoring* ability from loss of/lack of reliable indicators must also be considered by the SEC when judging whether a Barrier may be Lost or Potentially Lost. This assessment should also include instrumentation operability concerns, readings from portable instrumentation, and consideration off-site monitoring results.

*Dominant accident sequences* will lead to degradation of all Barriers. The SEC should also consult Station Blackout and ATWS ICs, as appropriate, to assure timely emergency classification declaration.

Thus, the EAL is written as:

Conditions Which in the SEC's Judgement Indicate Loss or Potential Loss of the CNTMT Barrier Based on:

- Imminent Barrier Degradation Due to Safety System Performance
- Degraded Ability to Monitor Barrier

Source Documents/References/Calculations:

1. Emergency Response Plan

EQUIPMENT FAILURE

Emergency Classification Level: UNUSUAL EVENT

Applicable Operational Modes: 4, 5, 6

Calvert Cliffs Initiating Condition:

## QU1 Unplanned Loss of Any Function Needed to Maintain Cold Shutdown

NUMARC Recognition Category: System Malfunction

NUMARC Initiating Condition:

Not Applicable

Barrier: Not Applicable

NUMARC Generic Guidance:

None

Plant-Specific Information:

*Unplanned* is used to preclude the declaration of an emergency where a component or system has been removed intentionally from service (*e.g.*, for maintenance and testing).

In order to maintain the anticipatory overall philosophy of the NUMARC EAL methodology and to assure that precursors to shutdown accidents are appropriately classified, Calvert Cliffs has added this Initiating Condition in the Unusual Event classification. NUREG 1449 raises concerns regarding Inadvertent Criticality Events during shutdown. In its regulatory analysis of the NUMARC methodology, NRC noted that there is a likelihood that the results of ongoing risk studies relating to shutdown (*e.g.*, NUREG-1449) may necessitate revision of both existing NRC EAL guidance and the new NUMARC guidance as well. Thus, Calvert Cliffs has added this IC that precursor events of concern are appropriately addressed and to better assure that the NUMARC-based methodology was complete before its implementation at Calvert Cliffs.

Per the Technical Specifications, the functions required to be operable during Cold Shutdown and Refueling modes and are associated with maintaining required shutdown conditions (temperature, pressure, and subcriticality) are:

- Reactivity Control System (TS 3.1)
- Coolant Loops and Coolant Circulation (TS 3.4.1, 3.9.8)
- Safety Valves (TS 3.4.2)
- Overpressure Protection System (TS 3.4.9.3)
- On-Site Power Sources (TS 3.8)

AC and DC power systems availability are separately addressed under the Loss of Power Event Category. Thus, these are not addressed under this Initiating Condition. RCS leakage (*e.g.*, requiring use of the Charging/HPSI Subsystems or resulting from Overpressure Protection System malfunctions) is addressed by IC BU2, RCS Leakage, and the Radioactivity Release ICs related to uncovery of irradiated fuel. Boration systems are addressed by maintaining required Shutdown Margin (SDM) as discussed below.

Loss of SDC (which is required by Technical Specifications) includes loss of shutdown cooling support functions such as Component Cooling Water that are required to remove heat from the Shutdown Cooling heat exchangers. Under the conditions of concern, AOP-3B, Abnormal Shutdown Cooling Conditions, would be entered.

Emergency Classification Level: UNUSUAL EVENT

Applicable Operational Modes: 1, 2, 3, 4

Calvert Cliffs Initiating Condition:

## QU2 Unplanned Loss of Most or All Safety System Annunciators for GREATER THAN 15 Minutes

NUMARC Recognition Category: System Malfunction

NUMARC Initiating Condition:

SU3 Unplanned Loss of All Safety System Annunciators for Greater Than 15 Minutes

Barrier: Not Applicable

NUMARC Generic Basis:

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

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

*Unplanned* loss of annunciators or indicators excludes scheduled maintenance and testing activities.

*Compensatory non-alarming indications* in this context includes computer based information such as SPDS. This should include all computer systems available for this use depending on specific plant design and subsequent retrofits.

Quantification of "most" is arbitrary, however, it is estimated that if approximately 75% of the safety systems annunciators or indicators are lost, there is an increased risk that a degraded plant condition could go undetected. It is not intended that plant personnel perform a detailed count of the instrumentation lost but use the value as a judgement threshold for determining the severity of the plant conditions. This judgement is supported by the specific opinion of the Shift Supervisor that additional operating personnel will be required to provide increased monitoring of system operation to safely operate the unit(s).

It is further recognized that most plant designs provide redundant safety system indication from separate uninterruptible power supplies. While failure of a large portion of annunciators is more likely than a failure of a large portion of indications, the concern is included in this EAL due to the difficulty associated with the assessment of plant conditions. The loss of specific, or several, safety system indicators should remain as a function of that specific system or component operability status. This will be addressed by the specific Technical Specification. The initiation of a Technical Specification imposed plant shutdown related to the instrument loss will be reported via 10 CFR 50.72. If the shutdown is not in compliance with the Technical Specification action, the Unusual Event is based on <IC QU4, Inability to Reach Required MODE Within Technical Specification Limits>.

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

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

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

Thus, EAL 1 is written as:

| |
|---|
| Entry Into AOP-3B, **Abnormal Shutdown Cooling Conditions**, is Required For GREATER THAN 15 Minutes |

*Required* means that entry into the Abnormal Operating Procedure is neither optional nor merely suggested, but rather imperative based on existing conditions.

The Cold Shutdown and Refueling Modes are defined by specific plant conditions - reactivity condition ($K_{eff}$) and coolant temperature. Maintenance of the ability to remove core decay heat addresses the coolant temperature criteria. The EALs addressing required subcriticality conditions for operation in modes 5 and 6 are missing from the NUMARC EALs. Per Technical Specification Table 1.1, Operational Modes, the required SDM is $K_{eff}$ less than 0.99 for Mode 5 and $K_{eff}$ not more than 0.95 for Mode 6. Per Technical Specification 3.9.1, the minimum boron concentration required during refueling mode is at least 2300 ppm. Under the conditions of concern, AOP-1A would be entered.

Thus, EAL 2 is written as:

| |
|---|
| Entry Into AOP-1A, **Inadvertent Boron Dilution**, Is Required AND Shutdown Margin NOT Maintained |

Source Documents/References/Calculations:

1. Technical Specifications

2. Abnormal Operating Procedures
   - AOP-1A, Inadvertent Boron Dilution
   - AOP-3B, Abnormal Shutdown Cooling Conditions

3. NUREG 1449, Shutdown and Low-Power Operation at Commercial Nuclear Power Plants in the United States, Draft for Comment February 1992

4. Regulatory Analysis - Revision of Regulatory Guide 1.101 to Accept the Guidance in NUMARC/NESP-007, Rev. 2 as an Alternative Methodology for the Development of Emergency Action Levels

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

Plant-Specific Information:

The EAL is based on NUMARC. INPO SER 16-92 was reviewed and determined not to apply to Calvert Cliffs Annunciator design.

Thus, the EAL is written as:

| |
|---|
| Unplanned Loss of 75% of Main Control Board Annunciators for GREATER THAN 15 Minutes |

Source Documents/References/Calculations:

1. Abnormal Operating Procedures
   - AOP-7J, Loss of 120 Volt Vital AC or 125 Volt Vital DC Power

2. Updated Final Safety Analysis Report

3. INPO Significant Event Report (SER) 16-92, Loss of All Annunciation When Computer Lost With Annunciators

Emergency Classification Level: UNUSUAL EVENT

Applicable Operational Modes: ALL

Calvert Cliffs Initiating Condition:

## QU3 Unplanned Loss of All On-Site or Off-Site Communications Capabilities

NUMARC Recognition Category: System Malfunction

NUMARC Initiating Condition:

SU6 Unplanned Loss of All On-Site or Off-Site Communications Capabilities

Barrier: Not Applicable

NUMARC Generic Basis:

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

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

(Site-specific list) offsite communications loss must encompass the loss of all means of communications with off-site authorities. This should include the ENS, Bell Lines, FAX transmissions, and dedicated EPP phone systems. This EAL is intended to be used only when extraordinary means are being utilized to make communications possible (relaying of information from radio transmissions, individuals being sent to off-site locations, etc.).

Plant-Specific Information:

A communication system with multiple redundancy has been provided to ensure availability and ease of operation. The communication system consists of six electronic subsystems:

- Plant Public Address
- Commercial Telephone
- Microwave System
- Sound powered phones for plant use
- Sound powered phones for emergency use
- Radio telephone system

Thus, EAL 1 is written as:

| Loss of ALL On-Site Electronic Communications Methods |
|---|

Communications with off-site authorities are provided by three electronic methods. They are:

- Dedicated Off-Site Agency Telephone
- Commercial Telephone
- Radio Telephone System

EAL 2 is written as:

| Loss of ALL Telephone Communications With Government Agencies |
|---|

Source Documents/References/Calculations:

1. Emergency Response Plan
   - Chapter 5, Facilities and Equipment; Section II, Communications

2. Emergency Response Plan Implementation Procedures
   - ERPIP 508, Plant Parameters Communicator, EOF
   - ERPIP 901, Communications Equipment

Emergency Classification Level: UNUSUAL EVENT

Applicable Operational Modes: 1, 2, 3, 4

Calvert Cliffs Initiating Condition:

## QU4 Inability to Reach Required MODE Within Technical Specification Limits

NUMARC Recognition Category: System Malfunction

NUMARC Initiating Condition:

SU2 Inability to Reach Required Shutdown Within Technical Specification Limits

Barrier: Not Applicable

NUMARC Generic Basis:

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

Plant-Specific Information:

LCOs, their associated action statements, and applicable time frames for placing the unit in a shutdown mode are found in the Calvert Cliffs Technical Specifications, Section 3.0.3. When an LCO is NOT met, except as provided in the associated action requirements, then other action requirements apply as stated in Applicability, Section 3/4.0.

Thus, the EAL is written as:

| |
|---|
| Unit Can NOT Be Brought to Required Mode Within Applicable LCO Action Statement Time Limits |

Source Documents/References/Calculations:

1. Technical Specifications
   - TS 3/4.0, Applicability - Limiting Condition for Operation

Emergency Classification Level: ALERT

Applicable Operational Modes: 1, 2

Calvert Cliffs Initiating Condition:

## QA1 Failure of Automatic Reactor Trip

NUMARC Recognition Category: System Malfunction

NUMARC Initiating Condition:

SA2 Failure of Reactor Protection System Instrumentation to Complete or Initiate an Automatic Reactor Scram Once a Reactor Protection System Setpoint Has Been Exceeded and Manual Scram Was Successful

Barrier: Not Applicable

NUMARC Generic Basis:

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

Plant-Specific Information:

Exceeding any of the following setpoints should result in an automatic reactor trip:

| REACTOR TRIP | COINCIDENCE | SETPOINT |
|---|---|---|
| High Power Level | 2/4 | Variable |
| High Rate-of-Change of Power | 2/4 below 15% RTP | 2.6 decade/min. |
| Low Reactor Coolant Flow | 2/4 above $10^{-4}$% RTP | Variable |
| Low Steam Generator Pressure | 2/4 | 670 psig |
| Low Steam Generator Water Level | 2/4 | 10" below top of feed ring |
| High Pressurizer Pressure | 2/4 | 2385 psig |
| Thermal Margin/Low Pressure | 2/4 above $10^{-4}$% RTP | Variable |
| Loss of Load | 2/4 above 15% RTP | N/A |
| High Containment Pressure | 2/4 | 4 psig |
| Axial Flux Offset | 2/4 | Variable |
| Thermal Margin/SG Press. Diff. Hi | 2/4 above $10^{-4}$% RTP | 135 psid |

Per EOP-0, Post-Trip Immediate Actions, the operator is to ensure that the reactor has tripped by depressing one set of Manual Reactor Trip buttons immediately following any symptoms of a reactor trip. These symptoms include:

- Reactor Trip alarm
- Control Element Assembly (CEA) Circuit Breaker(s) Trip alarms
- Rapid Lowering in Reactor Power
- Protection Channel Trip alarm
- Reactor Protective System (RPS) Trip Bistable Lights lit

Following depression of the reactor trip buttons, the operator is to verify that reactor power is decreasing. If these responses can not be verified, then as part of contingency actions, the operator is instructed to open the motor generator (MG) set feeder breakers providing power to the Control Element Drive Mechanism (CEDM).

*Entry into the Alert emergency classification occurs whenever it is determined by the Shift Supervisor that a required automatic reactor trip did not occur, based on the entry conditions into EOP-0 listed above.* It is recognized that EOP-0 instructs the operator to depress the manual trip buttons, whether or not a required automatic reactor trip actually occurred. However, the failure of a redundant front-line automatic protection system function (*i.e.*, the failure of the RPS to complete a reactor trip following receipt of a trip signal) meets the Alert classification threshold of potential substantial degradation in the level of safety of the plant. This is true whether or not fuel damage is determined to have occurred.

Thus, the EAL is written as:

| |
|---|
| Automatic Reactor Trip Signal Generated AND Manual Trip Was Required to Trip the Reactor (EOP-0, Post-Trip Immediate Actions, Reactivity Control, Successful) |

Source Documents/References/Calculations:

1. Technical Specifications
   - TS 3/4.3.1, Reactor Protective Instrumentation
2. Emergency Operating Procedures
   - EOP-0, Post-Trip Immediate Actions
3. Updated Final Safety Analysis Report
   - Chapter 7, Instrumentation and Control

Emergency Classification Level: ALERT

Applicable Operational Modes: 5, 6

Calvert Cliffs Initiating Condition:

## QA2 Inability to Maintain Plant in Cold Shutdown

NUMARC Recognition Category: System Malfunction

NUMARC Initiating Condition:

SA3 Inability to Maintain Plant in Cold Shutdown

Barrier: Not Applicable

NUMARC Generic Basis:

This IC and its associated EAL address complete loss of functions required for core cooling during refueling and cold shutdown modes. Escalation to Site <E>mergency or General Emergency would be via <Radioactivity Release or SEC Judgement> ICs.

For PWRs, this IC and its associated EAL 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. Under these conditions, RCS integrity is lost and fuel clad integrity is lost or potentially lost, which is consistent with a Site <E>mergency. (Site-specific) indicators for these EALs are those methods used by the plant in response to Generic Letter 88-17 which include core exit temperature monitoring and RCS water level monitoring. In addition, radiation monitor readings may also be appropriate as indicators of this condition.

*Uncontrolled* means that system temperature increase is not the result of planned actions by the plant staff.

The EAL guidance related to uncontrolled temperature rise is necessary to preserve the anticipatory philosophy of NUREG-0654 for events starting from temperatures much lower than the cold shutdown temperature limit.

Escalation to the Site <E>mergency is by <Radioactivity Release> ICs.

Multi-unit stations with shared safety functions should further consider how this IC may affect more than one unit and how this may be a factor in escalating the emergency class.

Plant-Specific Information:

Per Calvert Cliffs Technical Specifications, the functions required to be operable during Cold Shutdown and Refueling modes and are associated with maintaining required shutdown conditions (temperature, pressure, and subcriticality) are:

- Reactivity Control Systems (TS 3.1)
- Coolant Loops and Coolant Circulation (TS 3.4.1, 3.9.8)
- RCS Safety Valves (TS 3.4.2)
- Overpressure Protection System (TS 3.4.9.3)
- On-Site Power Sources (TS 3.8)

AC and DC power systems availability are separately addressed under the Electrical Event Category. Thus, these are not addressed under this Initiating Condition. RCS leakage (*e.g.*, requiring use of the Charging/HPSI Subsystems or resulting from Overpressure Protection System malfunctions) are addressed by IC BU2, RCS Leakage, and the Radioactivity Release ICs related to uncovery of irradiated fuel. Boration systems are addressed by EAL 2 discussed below.

EAL 1 is written as:

| |
|---|
| Uncontrolled RCS Temperature Increase of AT LEAST 10°F That Results in RCS Temperature GREATER THAN 200°F |

This corresponds to the inability to maintain required temperature conditions for Cold Shutdown. The 10°F threshold was picked to assure that minor cooling interruptions occurring at the transition between Mode 4 and Mode 5 (that are already addressed by QU1) do not result in unnecessary declaration of an Alert.

*Uncontrolled* means that the temperature increase is not due to deliberate operator action.

Cold Shutdown and Refueling modes are defined by specific plant conditions - core reactivity condition and reactor coolant temperature/pressure. Maintenance of the ability to remove core decay heat addresses coolant temperature. The reactivity condition is addressed by maintenance of required shutdown margin. At the Alert emergency classification, this corresponds to assuring that the reactor is not critical.

Thus, EAL 2 is written as:

| |
|---|
| Inadvertent Criticality as Determined by Valid Wide Range Logarithmic Channel Indications |

*Inadvertent* means accidental or unintentional, *e.g.*, the event occurred because procedures were not strictly adhered to.

*Valid* means that the indication is from instrumentation determined to be operable in accordance with the Technical Specifications or has been verified by other independent methods such as indications displayed on the control panels, reports from plant personnel, or radiological survey results.

Source Documents/References/Calculations:

1. Technical Specifications

2. Abnormal Operating Procedures
   - AOP-3B, Abnormal Shutdown Cooling Conditions

3. NUREG 1449, Shutdown and Low-Power Operation at Commercial Nuclear Power Plants in the United States, Draft for Comment, February 1992

Emergency Classification Level: ALERT

Applicable Operational Modes: 1, 2, 3, 4

Calvert Cliffs Initiating Condition:

## QA3 Unplanned Loss of Safety System Annunciators With Transient In Progress

NUMARC Recognition Category: System Malfunction

NUMARC Initiating Condition:

SA4 Unplanned Loss of Most or All Safety System Annunciation or Indication in Control Room With Either (1) a Significant Transient in Progress, or (2) Compensatory Non-Alarming Indicators are Unavailable

Barrier: Not Applicable

NUMARC Generic Basis:

This IC and its associated <Generic> EAL are intended to recognize the difficulty associated with monitoring changing plant conditions with the use of a major portion of the annunciation or indication equipment during a transient. Recognition of the availability of computer based indication equipment is considered (SPDS, plant computer, etc.).

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

Quantification of most is arbitrary, however, it is estimated that if approximately 75% of the safety systems annunciators or indicators are lost, there is an increased risk that a degraded plant condition could go undetected. It is not intended that plant personnel perform a detailed count of the instrumentation lost but use the value as a judgement threshold for determining the severity of the plant conditions. This judgement is supported by the specific opinion of the Shift Supervisor that additional operating personnel will be required to provide increased monitoring of system operation to safely operate the unit(s).

It is further recognized that most plant designs provide redundant safety system indication from separate uninterruptible power supplies. While failure of a large portion of annunciators is more likely than a failure of a large portion of indications, the concern is included in this EAL due to the difficulty associated with the assessment of plant conditions. The loss of specific, or several, safety system indicators should remain as a function of that specific system or component operability status. This will be addressed by the specific Technical Specification. The initiation of a Technical Specification imposed plant shutdown related to the instrument loss will be reported via 10 CFR 50.72. If the shutdown is not in compliance with the Technical Specification action, the Unusual Event is based on <C QU4, Inability to Reach Required MODE Within Technical Specification Limits>.

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

*Significant transient* includes response to automatic or manually initiated functions such as scrams, runbacks involving greater than 25% thermal power change, ECCS injections, or thermal power oscillations of 10% or greater.

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

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

This Alert will be escalated to a Site <E>mergency if the operating crew cannot monitor the transient in progress.

Plant-Specific Information:

Compensatory non-alarming indications include the Safety Parameter Display System (SPDS) and the plant computer.

Thus, the EAL is written as:

| |
|---|
| Unplanned Loss of 75% of Main Control Board Annunciators AND EITHER of the Following:<br>• Plant Transient in Progress<br>• SPDS Or Plant Computer NOT Available |

*Transient* means a condition that is:

- Beyond the expected steady-state fluctuations in temperature, pressure, power level, or water level, and
- Beyond the normal manipulations of the Control Room operating crew, and
- Expected to require actuation of fast-acting automatic control or protection systems to bring the reactor to a new safe, steady-state condition.

Escalation to Site Emergency would be based on plant transient response, occurrence of other equipment malfunctions requiring operator actions outside the control room, or loss of additional monitoring instrumentation (such as ICC instrumentation) required to determine plant conditions.

Source Documents/References/Calculations:

1. Abnormal Operating Procedures
   - AOP-7J, Loss of Vital 120V AC or 125V Vital DC Power

2. Updated Final Safety Analysis Report

Emergency Classification Level: SITE EMERGENCY

Applicable Operational Modes: 1, 2

Calvert Cliffs Initiating Condition:

## QS1 Failure of BOTH Automatic AND Manual Reactor Trip

NUMARC Recognition Category: System Malfunction

NUMARC Initiating Condition:

SS2 Failure of Reactor Protection System Instrumentation to Complete or Initiate an Automatic Reactor Scram Once a Reactor Protection System Setpoint Has Been Exceeded and Manual Scram Was NOT Successful

Barrier: Not Applicable

NUMARC Generic Basis:

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

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

Plant-Specific Information:

EOP-0, Post-Trip Immediate Actions, are described under IC QA1, Failure of Automatic Reactor Trip. As stated under QA1, entry into the Alert emergency classification occurs whenever it is determined by the Shift Supervisor that a required automatic reactor trip did not occur, based on the entry conditions into EOP-0. Entry into the Site Emergency is made consistent with EOP-0 procedural requirements and so corresponds to not satisfying the reactivity control criteria of EOP-0. This means that both automatic and manual actions were not effective in bringing the reactor subcritical and that entry into EOP-8, Functional Recovery Procedure, is required.

Thus, the EAL is written as:

| |
|---|
| EOP-8, **Functional Recovery Procedure**, is Implemented per EOP-0, **Post Trip Immediate Actions, Reactivity Control** |

*Can NOT* is used because the ability to meet the final acceptance criteria is the appropriate concern, not whether intermediate acceptance criteria are not being achieved at one point in time.

Source Documents/References/Calculations:

1. Emergency Operating Procedures
   - EOP-0, Post-Trip Immediate Actions
   - EOP-8, Functional Recovery Procedure

Emergency Classification Level: SITE EMERGENCY

Applicable Operational Modes: 1, 2, 3, 4

Calvert Cliffs Initiating Condition:

## QS2 Complete Loss of Function Needed to Achieve or Maintain Hot Shutdown

NUMARC Recognition Category: System Malfunction

NUMARC Initiating Condition:

SS4 Complete Loss of Function Needed to Achieve or Maintain Hot Shutdown

Barrier: Not Applicable

NUMARC Generic Basis:

This <IC and its associated Generic EAL> address complete loss of functions, including ultimate heat sink and reactivity control, required for hot shutdown with the reactor at pressure and temperature. Under these conditions, there is an actual major failure of a system intended for protection of the public. Thus, declaration of a Site <E>mergency is warranted. Escalation to General Emergency would be via <Radioactivity Release, Fission Product Barrier Degradation, or SEC Judgement> ICs.

Multi-unit stations with shared safety functions should further consider how this IC may affect more than one unit and how this may be a factor in escalating the emergency class.

Plant-Specific Information:

Per Calvert Cliffs Technical Specifications, the following functions are required to be operable during Cold Shutdown and Refueling modes and are necessary to maintain Hot Shutdown (Mode 4) conditions (temperature, pressure, and subcriticality):

- Reactivity Control Systems (TS 3.1)
- Coolant Loops and Coolant Circulation (TS 3.4.1, 3.9.8)
- ECCS Subsystems (TS 3.5.2, 3.5.3)
- Refueling Water Tank (TS 3.5.4)
- Safety Valves (TS 3.4.2)
- Service Water System (TS 3.7.4)
- Overpressure Protection System (TS 3.4.9.3)
- On-Site Power Sources (TS 3.8)
- Monitoring Instrumentation (TS 3.3.3)
- Reactor Coolant System Vents (TS 3.4.13)

AC and DC power systems availability are separately addressed under the Loss of Power Event Category. Thus, these are not addressed under this Initiating Condition. The Overpressure Protection System and Reactor Coolant System Vents are not directly related to core cooling and subcriticality functions. Failures of these systems functions resulting are addressed by Fission Product Barrier Degradation ICs. Loss of Monitoring Instrumentation is not directly related to maintaining subcriticality and heat removal functions, and therefore is not required to be addressed by this IC.

Per AOP-3B, Abnormal Shutdown Cooling Conditions, auxiliary feedwater and atmospheric steam dump capability to at least one SG is necessary to achieve Hot Shutdown conditions under natural circulation conditions. Around the transition from Mode 3 to Mode 4, the Shutdown Cooling System (SDCS) is typically used as the means to remove sensible and decay heat. Once the SDCS is placed in service, the steam generator heat sink capability is no longer necessary. Thus, the EAL reflects that neither the steam generators nor Shutdown Cooling are fully capable of performing heat removal functions. The applicable acceptance criteria for Core and RCS Heat Removal are shown on the Safety Function Status Checks and are fully explained under the basis information for EAL FCB1, Safety Function Status/Functional Recovery.

Thus, EAL 1 is written as:

> EOP-8, **Functional Recovery Procedure**, is Implemented AND Either of the Following:
> - Reactivity Control Acceptance Criteria Can NOT Be Met
> - Shutdown Cooling is NOT In Service AND Core and RCS Heat Removal Acceptance Criteria Can NOT Be Met

*Can NOT* is used because the ability to meet the final acceptance criteria is the appropriate concern, not whether intermediate acceptance criteria are not being achieved at one point in time.

*In service* means that the SDCS is in the proper configuration for RCS heat removal (SDCS isolation valves open, LPSI pumps operating, etc.) and is considered "operable" as defined in the Calvert Cliffs Technical Specifications Section 1.6.

In order for there to be a path for heat removal between the core and the steam generators or the shutdown cooling system, there must be enough RCS liquid inventory to maintain natural circulation. Recent information from the CE Owners Group indicates that two-phase natural circulation (reflux boiling) works very well and will maintain the RCS between 200 °F and 300 °F. This requires that the RCS water level be below the top of the hot legs. Per AOP-3B, Attachment 14, 50" RVLMS Indication corresponds to the middle of the hot leg and is the 5th RVLMS alarm level. Staying above this level (and below the top of the hot legs at the 71" level) assures that, at a minimum, reflux boiling can be maintained.

Thus, EAL 2 is written as:

> Zero (0) Indicated Subcooling Margin Determined Using CET Temperatures AND Valid RVLMS Level Indication of LESS THAN 50 Inches

Per Technical Specification Table 1.1, Operational Modes, the required SDM is $K_{eff}$ less than 0.99 for Mode 4 (Hot Shutdown). The existence of a positive startup rate that could not be eliminated by operation of any reactivity control mechanism corresponds to conditions where a major function intended for the protection of the public has failed and therefore meets the threshold for a Site Emergency classification.

Source Documents/References/Calculations:

1. Technical Specifications

2. Abnormal Operating Procedures
   - AOP-3B, Abnormal Shutdown Cooling Conditions

3. Emergency Operating Procedures
   - EOP-8, Functional Recovery Procedure

4. Internal Memorandum, J. R. Hill to R. L. Wenderlich, CE Operations Subcommittee Meeting - Trip Report, April 16, 1993

Emergency Classification Level: SITE EMERGENCY

Applicable Operational Modes: 5, 6

Calvert Cliffs Initiating Condition:

## QS3 Loss of Water Level That Can Uncover Fuel in the Reactor Vessel

NUMARC Initiating Condition:

SS5 Loss of Water Level in the Reactor Vessel That Has or Will Uncover Fuel in the Reactor Vessel

Barrier: FUEL CLAD

NUMARC Generic Basis:

Under the conditions specified by this IC, severe core damage can occur and reactor coolant system pressure boundary integrity may not be assured. <> For PWRs, this IC covers sequences such as prolonged boiling following loss of decay heat removal.

Thus, declaration of a Site <E>mergency is warranted under the conditions specified by the IC. Escalation to a General Emergency is via <Radioactivity Release IC RG1, Off-Site Dose of AT LEAST 1 REM (EDE+CEDE) Whole Body or 5 REM (CDE) Thyroid>.

Plant-Specific Information:

Sequences that can result in uncovery of fuel in the reactor vessel (indirectly by prolonged boiling) include leakage through SG nozzle dams, pipe breaks in the Shutdown Cooling (SDC) System or Chemical & Volume Control System (CVCS), or loss of the SDC function. These leakage sources are outside the reactor vessel at most could only result in water level decreases to the bottom of the hot leg elevation. This water level decrease would cause loss of SDC suction. In-core instrumentation (ICI) penetrations for Calvert Cliffs are through the vessel head. Thus, these do not have to be considered for this IC.

A review of attachments to ADP-3B, Abnormal Shutdown Cooling Conditions, shows that depending on previous power history and assuming an initial RCS temperature of 140°F, boiling in the core can begin in as little as 7 minutes following loss of SDC during mid-loop operation. ADP-3B also shows that under these conditions, without any operator action, core uncovery can begin within about 80 minutes after loss of SDC.

Available methods to restore RCS inventory and to remove core heat include restoring the SDCS, injecting into the RCS from the Refueling Water Tank (RWT) using the HPSI, LPSI, CS or charging pumps, using the steam generators as a heat sink, using the Refueling Pool as a heat sink, aligning a LPSI pump to take suction from the RWT, or even injecting into the RCS using Safety Injection Tanks (SITs). *Given the number of methods to restore inventory, and the amount of time available, it is highly unlikely that this IC will be entered.*

Thus, the EAL is written as:

ADP-3B, **Abnormal Shutdown Cooling Conditions**, is Implemented AND ANY of the Following Conditions Exist:

- Alternate Methods for Restoring RCS Inventory Are NOT Effective
- Valid RVLMS Reading Indicating 0% Level
- Valid CET Reading Indicating Superheat Conditions

*NOT Effective* means that inventory is not being restored based on available operable instrumentation readings such as CETs, RVLMS, Hot Leg Level, or from decreasing level indications from applicable suction sources such as the RWT, containment sump, or SITs.

*Valid* means that the indication is from instrumentation determined to be operable in accordance with the Technical Specifications or has been verified by other independent methods such as indications displayed on the control panels, reports from plant personnel, or radiological survey results. For example, under conditions where the CETs and the RVLMS are disconnected to allow reactor vessel head removal, these instrument readings would not be valid.

Source Documents/References/Calculations:

1. Abnormal Operating Procedures
   - AOP-3B, Abnormal Shutdown Cooling Conditions

Emergency Classification Level: GENERAL EMERGENCY

Applicable Operational Modes: 1

Calvert Cliffs Initiating Condition:

## QG1 Failure of BOTH Automatic AND Manual Reactor Trip -AND- Extreme Challenge to the Ability to Cool the Core

NUMARC Recognition Category: System Malfunction

NUMARC Initiating Condition:

SG2 Failure of the Reactor Protection System to Complete an Automatic Scram and Manual Scram was NOT Successful and There is Indication of an Extreme Challenge to the Ability to Cool the Core

Barrier: Not Applicable

NUMARC Generic Basis:

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

Under the conditions of this IC and its associated <Generic> EAL, the efforts to bring the reactor subcritical have been unsuccessful and, as a result, the reactor is producing more heat than the maximum decay heat load for which the safety systems were designed. Although there are capabilities away from the reactor control console, such as emergency boration, <> the continuing temperature rise indicates that these capabilities are not effective. This situation could be a precursor for a core melt sequence.

For PWRs, the extreme challenge to the ability to cool the core is intended to mean that the core exit temperatures are at or approaching 1200°F or that the reactor vessel water level is below the top of the active fuel. <>

Another consideration is the inability to initially remove heat during the early stages of this sequence. For PWRs, if emergency feedwater flow is insufficient to remove the amount of heat required by design from at least one steam generator, an extreme challenge should be considered to exist. <>

In the event either of these challenges exist at a time that the reactor has not been brought below the power associated with the safety system design (typically 3% to 5% power), a core melt sequence exists. In this situation, core degradation can occur rapidly. For this reason, the General Emergency declaration is intended to be anticipatory of the fission product barrier matrix declaration to permit maximum offsite intervention time.

Plant-Specific Information:

EOP-0, Post-Trip Immediate Actions, are described under IC QA1, Failure of Automatic Reactor Trip. As stated under QS1, entry into the Site Emergency classification means that both automatic and manual reactor trip were not effective in bringing the reactor subcritical and that functional recovery of reactivity control is required in accordance with EOP-8. Escalation to the General Emergency is indicated whenever Reactor power is not decreasing following actions to bring the reactor subcritical including automatic and manual reactor trip, manually inserting the control rods, tripping the CEDM motor generator sets or performing emergency boration and there are indications of inadequate core cooling.

Thus, the EAL is written as:

EOP-8, **Functional Recovery Procedure**, is Implemented AND Both of the Following:
- Reactivity Control Can NOT Meet Acceptance Criteria AND
- Core and RCS Heat Removal Can NOT Meet Acceptance Criteria

*Can NOT* is used because the ability to meet the final acceptance criteria is the appropriate concern, not whether intermediate acceptance criteria are not being achieved at any given moment.

Source Documents/References/Calculations:

1. Emergency Operating Procedures
   - EOP-0, Post-Trip Immediate Actions
   - EOP-8, Functional Recovery Procedure

# ELECTRICAL

Emergency Classification Level: UNUSUAL EVENT

Applicable Operational Modes: ALL

Calvert Cliffs Initiating Condition:

## EU1 Loss of Off-Site Power

NUMARC Recognition Category: System Malfunction

NUMARC Initiating Condition:

SU1 Loss of All Off-Site Power to Essential Busses for Greater Than 15 Minutes

Barrier: Not Applicable

NUMARC Generic 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 (Station Blackout). Fifteen minutes was selected as a threshold to exclude transient or momentary power losses.

Multi-unit stations with shared safety functions should further consider how this IC may affect more than one unit and how this may be a factor in escalating the emergency class.

Plant-Specific Information:

Procedure EOP-2, Loss of Off-Site Power, would be implemented under the conditions of concern. AOP-3F applies to the other operational modes when the plant is critical. Per EOP-2, the following are symptoms of a loss of off-site power:

- Momentary loss of Control Room lighting on both Units.
- 500KV Red Bus and Black Bus power available lights are de-energized.
- Diesel Generators automatically start.
- 13KV Service Buses 12 and 22 power available lights are de-energized.
- No RCPs are running on either Unit.
- Reactor Trip occurs due to RCS low flow.

For consistency with procedural requirements and to reflect potential severity, separate EALs have been developed for hot and cold conditions. With the plant initially operating in Mode 1 or 2, EOP-2 would be entered on a loss of off-site power. Under these conditions, restoring off-site power is expected to take no less than 15 minutes based on procedure implementation. Therefore, EAL 1 does not use the generic 15 minute threshold.

Thus, EAL 1 is written as:

| |
|---|
| EOP-2, Loss of Off-Site Power, Implemented On Either Unit |

EAL 2 addresses loss of off-site power when EOP-2 does not apply.

Thus, EAL 2 is written as:

| |
|---|
| Loss of Off-Site Power for GREATER THAN 15 Minutes |

Source Documents/References/Calculations:

1. Technical Specifications
   - TS 3.8.1, A.C. Sources

2. Emergency Operating Procedures
   - EOP-2, Loss of Off-Site Power

3. Abnormal Operating Procedures
   - AOP-3F, Loss of Off-Site Power While in Modes 3, 4, 5, or 6

Emergency Classification Level: UNUSUAL EVENT

Applicable Operational Modes: All

Calvert Cliffs Initiating Condition:

## EU2 Loss of Vital 125 Volt DC Power for GREATER THAN 15 Minutes

NUMARC Recognition Category: System Malfunction

NUMARC Initiating Condition:

SU7 Unplanned Loss of Required DC Power During Cold Shutdown or Refueling Mode Greater Than 15 Minutes

Barrier: Not Applicable

NUMARC Generic Basis:

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

*Unplanned* is included in this IC and EAL to preclude the declaration of an emergency as a result of planned maintenance activities. Routinely, plants will perform maintenance on a train related basis during shutdown periods. It is intended that the loss of the operating (operable) train is to be considered. If this loss results in the inability to maintain cold shutdown, the escalation to an Alert will be per <QA2, Inability to Maintain Plant in Cold Shutdown>.

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

Plant-Specific Information:

The 125 volt dc and 120 volt vital ac systems for the plant are divided into four independent and isolated channels. Each channel consists of one battery, two battery chargers, one dc bus, multiple dc unit control panels, and two inverters. Each inverter has an associated vital ac distribution panel board. Power to the dc bus, dc unit control panels, and inverters is supplied by the station batteries and/or the battery chargers.

Each battery charger is fully rated and can recharge a discharged battery while at the same time supplying the steady state power requirements of the system.

A reserve 125 volt dc system for the plant is completely independent and isolated from all four separation groups, yet is capable of replacing any of the 125 volt dc batteries. This system consists of one battery, one battery charger, and the associated DC switching equipment. Only the battery may be transferred for replacement duty.

The 125 volt dc bus 11 provides control power for equipment associated with load group A for both units. The 125 volt dc bus 21 provides control power for equipment associated with load group B for both units. The 125 volt dc buses 12 and 22 are used to supply power to the computer inverters, diesel generator 12 control circuits, control room emergency lighting, and two channels of the 120 volt vital ac system.

There is one battery charger fed from Unit 1 and another battery charger fed from Unit 2 connected to each 125 volt dc bus. The ac power for both battery chargers per bus is obtained from the same load group. The reserve battery is connected to its own charger when it is not connected to a safety related 125 volt dc bus.

Each of the four 125 volt dc power sources is equipped with the following instrumentation in the control room to enable continual operator assessment of 125 volt dc power source condition:

- DC bus undervoltage alarm
- Battery current indication
- Charger current indication
- Charger malfunction alarm (including input ac undervoltage, output dc undervoltage, and output dc overvoltage)
- DC bus voltage indication, and
- DC ground indication

Components affected by the loss of 125 volt dc buses 11, 12, 21, or 22 are listed in table EU2-1.

Thus, the EAL is written as:

| |
|---|
| AOP-7J, **Loss of 120 Volt Vital AC or 125 Volt Vital DC Power**, is Implemented AND 125 Volt DC Power Lost for GREATER THAN 15 Minutes |

Source Documents/References/Calculations:

1. Abnormal Operating Procedures
   - AOP-7J, Loss of 120 Volt Vital AC or 125 Volt Vital DC Power
2. Updated Final Safety Analysis Report
3. BG&E Drawing 61-030-E, Single Line Diagram, Vital 120V AC & 125V DC - Emergency 250V DC
4. BG&E Drawing 61-057-E, Block Diagram - Auxiliary System Load Groups - Units 1 & 2

| Table E-1: Effects of Lost 125 Volt DC Buses 11, 21, 12, and 22 | | | |
|---|---|---|---|
| Loss of 11 125 volt dc Bus | Loss of 21 125 volt dc Bus | Loss of 12 125 volt dc Bus | Loss of 22 125 volt dc Bus |
| Channel ZD ESFAS and AFAS Sensor Cabinets de-energized | Channel ZE ESFAS and AFAS Sensor Cabinets de-energized | Channel ZF ESFAS and AFAS Sensor Cabinets de-energized | Channel ZG ESFAS and AFAS Sensor Cabinets de-energized |
| CNTMT Area Rad Monitor out of service | CNTMT Area Rad Monitor out of service | CNTMT Area Rad Monitor out of service | CNTMT Area Rad Monitor out of service |
| Channel A RPS Cabinet de-energized | Channel B RPS Cabinet de-energized | Channel C RPS Cabinet de-energized | Channel D RPS Cabinet de-energized |
| Loss of 11 EDG field flash and control power; the start solenoids fail shut (Unit 1 only) | Loss of 12 EDG field flash and control power; the start solenoids fail shut (Unit 2 only) | Loss of 12 EDG field flash and control power; the start solenoids fail shut if aligned to Unit 1 | Loss of 12 EDG field flash and control power; the start solenoids fail shut if aligned to Unit 2 |
| Loss of breaker position indication:<br>• Normal power supply to the 11A/21A and 12A/22A RCPs<br>• 11/21, 12/22, 15/25, and 16/26 4 KV buses<br>• 11A/21A, 11B/21B, 12A/22A, and 12B/22B 480 Volt Buses<br>• 11 and 12 13 KV buses (Unit 1 only) | Loss of breaker position indication:<br>• Normal power supply to the 11B/21B and 12B/22B RCPs<br>• 13/23 and 14/24 4 KV buses<br>• 13A/23A, 13B/23B, 14A/24A, and 14B/24B 480 Volt Buses | | |
| Loss of Unit 2 Annunciation | All Unit 1 Annunciator lights de-energized (Status Panels remain energized) | | |
| CC CNTMT SUPPLY fails shut | CC CNTMT RETURN fails shut | | |
| 12 SG AFW STM SUPP & BYPASS valves fail shut | 11 SG AFW STM SUPP & BYPASS valves fail shut | | |
| Loss of SRW to the Turbine Building | Loss of SRW to the Turbine Building | | |
| IA and PA may be lost due to loss of SRW to the Turbine Building | IA and PA may be lost due to loss of SRW to the Turbine Building | | |
| Channel A ESFAS and AFAS Actuation Cabinets de-energized | Channel B ESFAS and AFAS Actuation Cabinets de-energized | | |
| 11/21 SRW, 11/21 CC, and 11/21 ECCS Pump Room HX SW outlet valves fail open | 12/22 SRW, 12/22 CC, and 12/22 ECCS Pump Room HX SW outlet valves fail open | | |
| 11/21 Main Steam Effluent Rad Monitor out of service | 12/22 Main Steam Effluent Rad Monitor out of service | | |
| 11 and 12 SFP Heat Exchangers lose cooling flow due to SRW outlet CVs failing shut (Unit 1 only) | 11 and 12 SFP Heat Exchangers lose cooling flow due to SRW outlet CVs failing shut (Unit 1 only) | | |
| 11/21 MSIV loses position indication, but can still be closed from 1003/2003 | 12/22 MSIV loses position indication, but can still be closed from 1003/2003 | | |

| Table E-1: Effects of Lost 125 Volt DC Buses 11, 21, 12, and 22 | | | |
|---|---|---|---|
| Loss of 11 125 volt dc Bus | Loss of 21 125 volt dc Bus | Loss of 12 125 volt dc Bus | Loss of 22 125 volt dc Bus |
| CNTMT High Range Monitor Channel A out of service | | CNTMT High Range Monitor Channel B out of service | |
| Loss of open signal to the Turbine Bypass Valves and loss of quick open signal to the ADVs (Unit 1 only) | | | |
| Aux Spray Valve fails shut | | | |
| IA downstream of the CNTMT IA Control Valve is isolated ("CNTMT IA ISOLATED IA-2065-CV CLOSED" alarm does NOT actuate) | | | |
| CNTMT Gaseous Monitor out of service | | | |
| Gaseous and Liquid Waste release control valves fail shut (Unit 1 only) | | | |
| | 11B/21B and 12B/22B RCPs are untrippable from 1C06/2C06 | | |
| | Loss of letdown due to 1/2-CVC-516-CV failing shut | | |
| | AFW Turbine Driven Train Flow Control Valves 11 SG and 12 SG fail open (Unit 1 only) | | |
| | PORV-402 inoperable in MPT ENABLE (Unit 1 only) | | |
| TCBs 1 and 5 trip | TCBs 2, 6, and 9 trip | TCBs 3 and 7 trip | TCBs 4 and 8 trip |
| | | On 1C13, loss of position indications for 12 D/G SUPP AND RTN UNIT 2 SRW SYS valves and the valves fail open | On 1C13, loss of position indications for 12 D/G SUPP AND RTN UNIT 1 SRW SYS valves and the valves fail open |
| | | | Loss of plant oscillograph (Unit 1 only) |

Emergency Classification Level: ALERT

Applicable Operational Modes: 5, 6

Calvert Cliffs Initiating Condition:

## EA1 Station Blackout While On Shutdown Cooling

NUMARC Recognition Category: System Malfunction

NUMARC Initiating Condition:

SA1 Loss of All Off-Site Power and Loss of All On-Site AC Power to Essential Busses During Cold Shutdown Or Refueling Mode

Barrier: Not Applicable

NUMARC Generic Basis:

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

Plant-Specific Information:

Section IX of AOP-3B addresses loss of 4 kV power supplies interrupting shutdown cooling. This EAL addresses Station Blackout conditions during cold shutdown or refueling.

Thus, the EAL is written as:

| |
|---|
| AOP-3B, **Abnormal Shutdown Cooling**, is Implemented Due to Loss of 4 kV Power Supplies For GREATER THAN 15 Minutes |

Source Documents/References/Calculations:

1. Abnormal Operating Procedures
   - AOP-3B, Abnormal Shutdown Cooling

Emergency Classification Level: ALERT

Applicable Operational Modes: 1, 2, 3, 4

Calvert Cliffs Initiating Condition:

## EA2 Only One AC Power Source Available to Supply 4 kV Emergency Buses

NUMARC Recognition Category: System Malfunction

NUMARC Initiating Condition:

SA5 AC Power Capability to Essential Busses Reduced to a Single Power Source for Greater Than 15 Minutes Such That Any Additional Single Failure Would Result in Station Blackout

Barrier: Not Applicable

NUMARC Generic Basis:

This IC and its associated <Generic> EAL are intended to provide an escalation from IC <EU1, Loss of Off-Site Power>. The condition indicated by this IC is the degradation of the off-site and on-site power systems such that any additional single failure would result in a station blackout. This condition could occur due to a loss of off-site power with a concurrent failure of one diesel generator to supply power to its emergency busses. Another related condition could be the loss of all off-site power and loss of on-site emergency diesels with only one train of emergency busses being backfed from the unit main generator, or the loss of on-site emergency diesels with only one train of emergency busses being backfed from off-site power. The subsequent loss of this single power source would escalate the event to a Site <E>mergency in accordance with IC <ES1, Station Blackout>.

<Generic> EAL 1b should be expanded to identify the control room indications of the status of Site-specific power sources and distribution busses that, if unavailable, establish single failure vulnerability.

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

Plant-Specific Information:

The EAL addresses conditions while operating in Modes 1, 2, 3, or 4 under which only one method is available to supply the emergency buses and loss of that method will result in a Station Blackout.

Thus, the EAL is written as:

| |
|---|
| Only One Source (Off-Site or Diesel) Available to Supply Bus 11 Or 14 (Bus 21 Or 24) for GREATER THAN 15 Minutes AND Unit Not on Shutdown Cooling |

*Under conditions where diesel generator 12 is supplying power to one Unit, it should not be considered available as a power source for the other Unit.*

Source Documents/References/Calculations:

1. Updated Final Safety Analysis Report
   - Section 8, Electric Power Systems

2. Emergency Operating Procedures
   - EOP-2, Loss of Off-Site Power

3. Technical Specifications
   - TS 3.8.2, On-Site Power Distribution Systems

Emergency Classification Level: ALERT

Applicable Operational Modes: 1, 2

Calvert Cliffs Initiating Condition:

## EA3 Loss of 125 Volt DC Power AND Reactor Trip

NUMARC Recognition Category: System Malfunction

NUMARC Initiating Condition:

SS3 Loss of All Vital DC Power

Barrier: Not Applicable

NUMARC Generic Basis:

Loss of all DC power compromises ability to monitor and control plant safety functions. Prolonged loss of all DC power will cause core uncovering and loss of containment integrity when there is significant decay heat and sensible heat in the reactor system. Escalation to a <Site> Emergency would occur by <Radioactivity Release, Fission Product Barrier Degradation, Equipment Failure, or SEC Judgement ICs.> Fifteen minutes was selected as a threshold to exclude transient or momentary power losses.

Multi-unit stations with shared safety functions should further consider how this IC may affect more than one unit and how this may be a factor in escalating the emergency class.

Plant-Specific Information:

The Vital (Class 1E) 125 V DC power system is fully described under IC EU2, Loss of Vital 125 Volt DC Power for GREATER THAN 15 Minutes. Review of the information in Table E-1 shows that if either DC bus 11 or 21 were lost with at least one unit in operation the resulting plant response meets the threshold for an Alert at Calvert Cliffs. The EAL is written to be consistent with procedures applying to plant operation while the reactor is critical.

Thus, the EAL is written as:

| |
|---|
| EOP-8, Functional Recovery Procedure, is Implemented on Loss of 125 Volt DC Bus |

Source Documents/References/Calculations:

1. Abnormal Operating Procedures
   - AOP-7J, Loss of 120 Volt Vital AC or 125 Volt Vital DC Power
2. Emergency Operating Procedures
   - EOP-8, Functional Recovery Procedure
3. Updated Final Safety Analysis Report
4. BG&E Drawing 61-030-E, Single Line Diagram, Vital 120V AC & 125V DC - Emergency 250V DC
5. BG&E Drawing 61-057-E, Block Diagram - Auxiliary System Load Groups - Units 1 & 2

Emergency Classification Level: SITE EMERGENCY

Applicable Operational Modes: 1, 2, 3, 4

Calvert Cliffs Initiating Condition:

## ES1 Station Blackout

NUMARC Recognition Category: System Malfunction

NUMARC Initiating Condition:

SS1 Loss of All Offsite Power and Loss of All Onsite AC Power to Essential Busses

Barrier: Not Applicable

NUMARC Generic Basis:

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

Escalation to General Emergency is via Fission Product Barrier Degradation or IC <EG1, Prolonged Station Blackout>.

Multi-unit stations with shared safety functions should further consider how this IC may affect more than one unit and how this may be a factor in escalating the emergency class.

Plant-Specific Information:

The Calvert Cliffs EAL is based on NUMARC. Entry into EOP-7 corresponds to the NUMARC-specified conditions. Under these conditions, it is expected that restoring off-site power would take greater than 15 minutes. Therefore, CCNPP does not include the generic 15-minute threshold.

Thus, the EAL is written as:

| |
|---|
| EOP-7, Station Blackout, is Implemented |

Source Documents/References/Calculations:

1. Technical Specifications
   - TS 3.8.1, A.C. Sources
2. Emergency Operating Procedures
   - EOP-7, Station Blackout
3. Updated Final Safety Analysis Report
   - Section 8, Electric Power Systems

Emergency Classification Level: SITE EMERGENCY

Applicable Operational Modes: All

Calvert Cliffs Initiating Condition:

## ES2 Loss of All 125 Volt DC Buses

NUMARC Recognition Category: System Malfunction

NUMARC Initiating Condition:

SS3 Loss of All Vital DC Power
SS6 Inability to Monitor a Significant Transient in Progress

Barrier: Not Applicable

NUMARC Generic Basis:

[SS3]
Loss of all DC power compromises ability to monitor and control plant safety functions. Prolonged loss of all DC power will cause core uncovering and loss of containment integrity when there is significant decay heat and sensible heat in the reactor system. Escalation to a General Emergency would occur by <Radioactivity Release, Fission Product Barrier Degradation, or SEC> Judgement ICs. Fifteen minutes was selected as a threshold to exclude transient or momentary power losses.

Multi-unit stations with shared safety functions should further consider how this IC may affect more than one unit and how this may be a factor in escalating the emergency class.

[SS6]
This IC and its associated <Generic> EAL are intended to recognize the inability of the control room staff to monitor the plant response to a transient. A Site <E>mergency is considered to exist if the control room staff cannot monitor safety functions needed for the protection of the public.

(Site-specific) annunciators for this EAL should be limited to include those identified in the Abnormal Operating Procedures, in the Emergency Operating Procedures, and in other EALs (e.g., red monistors, etc.).

*Compensatory non-alarming indications* in this context include computer based information such as SPDS. This should include all computer systems available for this use depending on specific plant design and subsequent retrofits.

*Significant transient* includes response to automatic or manually initiated functions such as scrams, runbacks involving greater than 25% thermal power change, ECCS injections, or thermal power oscillations of 10% or greater.

(Site-Specific) indications needed to monitor safety functions necessary for protection of the public must include control room indications, computer generated indications and dedicated annunciation capability. The specific indications should be those used to determine such functions as the ability to shut down the reactor, maintain the core cooled and in a coolable geometry, to remove heat from the core, to maintain the reactor coolant system intact, and to maintain the containment intact.

*Planned* actions are excluded from this EAL since the loss of instrumentation of this magnitude is of such significance during a transient that the cause of the loss is not an ameliorating factor.

Plant-Specific Information:

Because of the 125 Volt DC and Annunciator design at Calvert Cliffs, NUMARC ICs SS3 and SS6 have been combined into one IC for Calvert Cliffs. The Vital (Class 1E) 125 V DC power system is fully described under IC EU2, Loss of Vital 125 Volt DC Power for GREATER THAN 15 Minutes. Review of the information in Table E-1 shows that if all 125 Volt DC buses were lost, the resulting plant response meets the threshold for a Site Emergency.

Thus, the EAL is written as:

| Loss of 125 Volt DC Buses 11, 12, 21 And 22 |
|---|

Source Documents/References/Calculations:

1. Abnormal Operating Procedures
   - ADP-7J, Loss of 120 Volt Vital AC or 125 Volt Vital DC Power

2. Emergency Operating Procedures
   - EOP-0, Post-Trip Immediate Actions

3. Updated Final Safety Analysis Report
   - Section 8, Electric Power Systems

Emergency Classification Level: GENERAL EMERGENCY

Applicable Operational Modes: 1, 2, 3, 4

Calvert Cliffs Initiating Condition:

## EG1 Prolonged Station Blackout

NUMARC Recognition Category: System Malfunction

NUMARC Initiating Condition:

SG1 Prolonged Loss of All Off-Site Power and Prolonged Loss of All Onsite AC Power

Barrier: Not Applicable

NUMARC Generic Basis:

Loss of all AC power compromises all plant safety systems requiring electric power including RHR, ECCS, Containment Heat Removal and the Ultimate Heat Sink. Prolonged loss of all AC power will lead to loss of fuel clad, RCS, and containment. The (Site-specific) hours to restore AC power can be based on a site blackout coping analysis performed in conformance with 10 CFR 50.63 and Regulatory Guide 1.155, Station Blackout, as available, with appropriate allowance for offsite emergency response. Although this IC may be viewed as redundant to the Fission Product Barrier Degradation IC, its inclusion is necessary to better assure timely recognition and emergency response.

This IC is specified to assure that in the unlikely event of a prolonged station blackout, timely recognition of the seriousness of the event occurs and that declaration of a General Emergency occurs as early as is appropriate, based on a reasonable assessment of the event trajectory.

<The likelihood of restoring at least one emergency bus should be based on a realistic appraisal of the situation since a delay in an upgrade decision based on only a chance of mitigating the event could result in a loss of valuable time in preparing and implementing public protective actions.>

In addition, under these conditions, fission product barrier monitoring capability may be degraded. Although it may be difficult to predict when power can be restored, it is necessary to give the <SEC> a reasonable idea of how quickly (s)he may need to declare a General Emergency based on two major considerations:

1. Are there any present indications that core cooling is already degraded to the point that Loss or Potential Loss of Fission Product Barriers is *IMMINENT*? <Refer to Fission Product Barrier Degradation EAL Table for more information>.

2. If there are no present indications of such core cooling degradation, how likely is it that power can be restored in time to assure that a loss of two barriers with a potential loss of the third barrier can be prevented?

Thus, indication of continuing core cooling degradation must be based on Fission Product Barrier monitoring with particular emphasis on <SEC> judgement as it relates to *IMMINENT* Loss or Potential Loss of fission product barriers and degraded ability to monitor fission product barriers.

Multi-unit stations with shared safety functions should further consider how this IC may affect more than one unit and how this may be a factor in escalating the emergency class.

Plant-Specific Information:

*Under conditions where a diesel generator is supplying power to one Unit, it should not be considered available as a power supply for the other Unit.*

The first part of this EAL corresponds to the threshold conditions for IC ES1, Station Blackout for GREATER THAN 15 Minutes. The second part of the EAL addresses the conditions that will escalate the SBO to General Emergency. Occurrence of any one of these conditions following SBO is sufficient for escalation to General Emergency. These conditions are: (1) SBO coping capability, or (2) indications of inadequate core cooling. Each of these conditions is discussed below:

1. SBO Coping Capability

Calvert Cliffs falls within the four hour SBO coping category. The ability of each unit to cope with a four hour SBO duration was based on an assessment of condensate inventory required for decay heat removal, Class 1E battery capacity, compressed air availability or manual operation of certain valves, effects of loss of ventilation, containment isolation valve operability, and reactor coolant inventory loss. A plant-specific analysis indicates that the expected rates of reactor coolant inventory loss under SBO conditions do not result in core uncovery in a SBO of four hours. Therefore, makeup systems in addition to those currently available under SBO conditions are not required to maintain core cooling under natural circulation (including reflux boiling). *Thus, conditions in which restoration of AC power within 4 hours is NOT likely are included in the EAL.*

2. Indications of Inadequate Core Cooling

Calvert Cliffs does not use Critical Safety Function Status Trees. Calvert Cliffs uses Safety Function Status Checks developed by the Combustion Engineering Owners' Group (C-E OG) which are based on logic similar to that used for CSFSTs developed for Westinghouse PWRs. The applicable acceptance criteria for Core and RCS Heat Removal are shown on the Safety Function Status Checks. They are:

Steam Generators Available for RCS Heat Removal

1. Adequate secondary side liquid inventory in at least one steam generator as indicated by level between -170 and +30 inches, and

2. Adequate source of feedwater available to assure continued liquid inventory available as indicated by Condensate Storage Tank level greater than 5 feet, and

3. Steam Generators acting as effective heat sink as indicated by Cold Leg Temperatures ($T_{COLD}$) constant or lowering.

Primary Side Conditions for Core and RCS Heat Removal

1. Adequate core heat removal as indicated by Core Exit Thermocouple readings less than superheated, and

2. Either of the following:
   - Natural circulation established as indicated by the temperature difference between Hot Leg Temperature ($T_{HOT}$) and $T_{COLD}$ of between 10 °F and 50 °F, or
   - Forced circulation effective as indicated by $T_{HOT}$ - $T_{COLD}$ less than 10 °F.

Per CEN-152, superheated conditions indicate core uncovery and inadequate core cooling.

Thus, the EAL is written as:

EOP-7, **Station Blackout**, is Implemented AND Any of the Following:
- Restoration of Power to ANY Vital 4kV Bus is NOT Likely Within 4 Hours
- Valid CET Readings Indicate Superheat Temperatures
- Core and RCS Heat Removal Using Steam Generators Can NOT Meet Acceptance Criteria

*Valid* means that the indication is from instrumentation determined to be operable in accordance with the Technical Specifications or has been verified by other indications displayed on the control panels.

*Can NOT* is used because the ability to meet the final acceptance criteria is the appropriate concern, not whether intermediate acceptance criteria are not being achieved at any given moment.

Source Documents/References/Calculations:

1. Emergency Operating Procedures
   - EOP-7, Station Blackout
   - EOP-8, Functional Recovery Procedure

2. CEN-152, Emergency Procedure Guidelines

3. Letter, Daniel G. MacDonald (US Nuclear Regulatory Commission) to G.C. Creel (BG&E), Response to Station Blackout Rule - Calvert Cliffs Nuclear Power Plant, Units 1 and 2, TAC Numbers 68525 (Unit 1) and 68256 (Unit 2), October 10, 1990

SECURITY

Emergency Classification Level: UNUSUAL EVENT

Applicable Operational Modes: ALL

Calvert Cliffs Initiating Condition:

## TU1 Confirmed Security Event With Potential Degradation in the Level of Safety of the Plant

NUMARC Recognition Category: Hazards and Other Conditions Affecting Plant Safety

NUMARC Initiating Condition:

HU4 Confirmed Security Event Which Indicates a Potential Degradation in the Level of Safety of the Plant

Barrier: Not Applicable

NUMARC Generic Basis:

This EAL is based on (Site-specific) Site Security Plan. Security events which do not represent at least a potential degradation in the level of safety of the plant are reported under 10 CFR 73.71 or in some cases under 10 CFR 50.72. The plant Protected Area Boundary is typically that part within the security isolation zone and is defined in the (Site-specific) security plan. Bomb devices discovered within the plant Vital Area would result in <> escalation <to a higher emergency classification level via other Security Event ICs>.

Plant-Specific Information:

The Calvert Cliffs EALs address the generic areas of concern and include the ISFSI. Thus, EAL 1 is written as:

"Security Emergency" or "Security Alert" Declared for:
- Sabotage Within or to Plant Protected Area
- Intrusion Into or Attempted Intrusion in Plant Protected Area

EAL 2 is written as:

"Security Event" Declared for:
- Sabotage Within or to ISFSI Protected Area
- Perimeter Intrusion Into ISFSI Protected Area

Source Documents/References/Calculations:

1. BG&E Internal Memorandum, Tom Forgette (Emergency Planning Unit) to PORC, July 29, 1986

Emergency Classification Level: ALERT

Applicable Operational Modes: ALL

Calvert Cliffs Initiating Condition:

## TA1 Security Event in the Plant Protected Area

NUMARC Recognition Category: Hazards and Other Conditions Affecting Plant Safety

NUMARC Initiating Condition:

HA4 Security Event in a Plant Protected Area

Barrier: Not Applicable

NUMARC Generic Basis:

This class of security events represents an escalated threat to plant safety above that contained in the Unusual Event. For the purposes of this IC, a civil disturbance which penetrates the protected area boundary can be considered a hostile force. Intrusion into a vital area by a hostile force will escalate this event to a Site <Emergency>.

Plant-Specific Information:

The Calvert Cliffs EALs address the generic areas of concern. Thus, EAL 1 is written as:

| |
|---|
| Forced Entry of Unauthorized Personnel Into the Vital Area Affecting the Ability to Achieve or Maintain Safe Shutdown |

EAL 2 is written as:

| |
|---|
| Sabotage of Vital Area Equipment in Progress Affecting the Ability to Achieve or Maintain Safe Shutdown |

The list of areas of concern for Safe Shutdown are shown below and are prominently displayed on the EAL Table.

| Areas of Concern for Safe Shutdown | |
|---|---|
| • Control Room<br>• Control Room HVAC Room<br>• Cable Spreading Room<br>• Cable Chases<br>• Switchgear Room<br>• ECCS Pump Room<br>• Service Water Pump Room<br>• Component Cooling Pump Room<br>• Main Steam Penetration Room | • Electrical Penetration Rooms<br>• Auxiliary Feedwater Pump Room<br>• Charging Pump Rooms<br>• Diesel Generator Rooms<br>• Refueling Water Tank (RWT) 11(21)<br>• Condensate Storage Tank (CST) 12<br>• Pretreated Water Storage Tank (PWST) 11(21)<br>• Fuel Oil Storage Tank (FOST) 12 |
| This list of Safe Shutdown areas is displayed on the EAL Tables to assure that all areas related to Safe Shutdown are considered by the SEC. | |

Source Documents/References/Calculations:

1. BG&E Internal Memorandum, Tom Forgette (Emergency Planning Unit) to POSRC, July 29, 1986

Emergency Classification Level: **SITE EMERGENCY**

Applicable Operational Modes: **ALL**

Calvert Cliffs Initiating Condition:

## TS1 Security Event in a Plant Vital Area

NUMARC Recognition Category: Hazards and Other Conditions Affecting Plant Safety

NUMARC Initiating Condition:

HS1 Security Event in Plant Vital Area

Barrier: Not Applicable

NUMARC Generic Basis:

This class of security events represents an escalated threat to plant safety above that contained in the Alert IC in that a hostile force has progressed from the Protected Area to the Vital Area. < >

Plant-Specific Information:

The Calvert Cliffs EALs address the generic areas of concern.

Thus, the EAL is written as:

| |
|---|
| Security Threat Resulting in Imminent Loss of Ability to Achieve And Maintain Safe Shutdown of Either Reactor |

The list of areas of concern for Safe Shutdown are shown below and are prominently displayed on the EAL Table.

| Areas of Concern for Safe Shutdown | |
|---|---|
| • Control Room | • Electrical Penetration Rooms |
| • Control Room HVAC Room | • Auxiliary Feedwater Pump Room |
| • Cable Spreading Room | • Charging Pump Rooms |
| • Cable Chases | • Diesel Generator Rooms |
| • Switchgear Room | • Refueling Water Tank (RWT) 11(21) |
| • ECCS Pump Room | • Condensate Storage Tank (CST) 12 |
| • Service Water Pump Room | • Pretreated Water Storage Tank (PWST) 11(21) |
| • Component Cooling Pump Room | • Fuel Oil Storage Tank (FOST) 12 |
| • Main Steam Penetration Room | |
| This list of Safe Shutdown areas is displayed on the EAL Tables to assure that all areas related to Safe Shutdown are considered by the SEC. | |

Source Documents/References/Calculations:

1. BG&E Internal Memorandum, Tom Forgette (Emergency Planning Unit) to POSRC, July 29, 1986

Emergency Classification Level: GENERAL EMERGENCY

Applicable Operational Modes: ALL

Calvert Cliffs Initiating Condition:

## TG1 Security Event Resulting in Loss of Ability to Reach AND Maintain Cold Shutdown

NUMARC Recognition Category: Hazards and Other Conditions Affecting Plant Safety

NUMARC Initiating Condition:

HG1 Security Event Resulting in Loss of Ability to Reach and Maintain Cold Shutdown

Barrier: Not Applicable

NUMARC Generic Basis:

This IC encompasses conditions under which a hostile force has taken physical control of vital area required to reach and maintain safe shutdown. < >

Plant-Specific Information:

The Calvert Cliffs EALs address the generic areas of concern. Thus, the EAL is written as:

| |
|---|
| Security Threat Resulting in Loss of Ability to Achieve and Maintain Safe Shutdown of Either Reactor |

This would include areas where any switches that transfer control of safe shutdown equipment to outside the control room are located.

The list of areas of concern for Safe Shutdown are shown below and are prominently displayed on the EAL Table.

| Areas of Concern for Safe Shutdown | |
|---|---|
| • Control Room | • Electrical Penetration Rooms |
| • Control Room HVAC Room | • Auxiliary Feedwater Pump Room |
| • Cable Spreading Room | • Charging Pump Rooms |
| • Cable Chases | • Diesel Generator Rooms |
| • Switchgear Room | • Refueling Water Tank (RWT) 11(21) |
| • ECCS Pump Room | • Condensate Storage Tank (CST) 12 |
| • Service Water Pump Room | • Pretreated Water Storage Tank (PWST) 11(21) |
| • Component Cooling Pump Room | • Fuel Oil Storage Tank (FOST) 12 |
| • Main Steam Penetration Room | |
| This list of Safe Shutdown areas is displayed on the EAL Tables to assure that all areas related to Safe Shutdown are considered by the SEC. | |

Source Documents/References/Calculations:

1. BG&E Internal Memorandum, Tom Forgette (Emergency Planning Unit) to PORC, July 29, 1986

FIRE

Emergency Classification Level: UNUSUAL EVENT

Applicable Operational Modes: ALL

Calvert Cliffs Initiating Condition:

## IU1 Fire Within Protected Area Boundary Not Extinguished Within 15 Minutes of Detection

NUMARC Recognition Category: Hazards and Other Conditions Affecting Plant Safety

NUMARC Initiating Condition:

HU2 Fire Within Protected Area Boundary Not Extinguished Within 15 Minutes of Detection

Barrier: Not Applicable

NUMARC Generic Basis:

The purpose of this IC is to address the magnitude and extent of fires that may be potentially significant precursors to damage to safety systems. This excludes such items as fires within administration buildings, waste-basket fires, and other small fires of no safety consequence. This IC applies to buildings and areas contiguous to plant vital areas or other significant buildings or areas. The intent of this IC is not to include buildings (*i.e.*, warehouses) or areas that are not contiguous or immediately adjacent to plant vital areas. Verification of the alarm in this context means those actions taken in the control room to determined that the control room alarm is not spurious.

Escalation to a higher emergency class is by IC <1A1, Fire or Explosion Affecting Safe Shutdown>. <>

Plant-Specific Information:

Each Calvert Cliffs unit uses the Abnormal Operating Procedures (AOP) 9A through 9S to address fires within the plant protected and vital areas that are of particular concern because they contain equipment required for safe shutdown. Fire in the Control Room HVAC Room may lead to power being lost to the alternate shutdown panels. Thus, the Control Room HVAC Room (Room 512) has been added to the areas of concern for safe shutdown.

| Areas of Concern for Safe Shutdown | |
|---|---|
| • Control Room<br>• Control Room HVAC Room<br>• Cable Spreading Room<br>• Cable Chases<br>• Switchgear Room<br>• ECCS Pump Room<br>• Service Water Pump Room<br>• Component Cooling Pump Room<br>• Main Steam Penetration Room | • Electrical Penetration Rooms<br>• Auxiliary Feedwater Pump Room<br>• Charging Pump Rooms<br>• Diesel Generator Rooms<br>• Refueling Water Tank (RWT) 11(21)<br>• Condensate Storage Tank (CST) 12<br>• Pretreated Water Storage Tank (PWST) 11(21)<br>• Fuel Oil Storage Tank (FOST) 12 |
| This list of Safe Shutdown areas is displayed on the EAL Tables to assure that all areas related to Safe Shutdown are considered by the SEC. | |

Thus, the EAL is written as:

| Fire Within An Area Containing Safe Shutdown Equipment Lasting GREATER THAN 15 Minutes |
|---|

Source Documents/References/Calculations:

1. Abnormal Operating Procedures
   - AOP-9A through 9S, Alternate Safe Shutdown/Control Room Evacuation procedure series

2. Issue Report IR0-012603, Fire in Room 512..., 10-23-92

Emergency Classification Level: ALERT

Applicable Operational Modes: ALL

Calvert Cliffs Initiating Condition:

## IA1 Fire or Explosion Affecting Safe Shutdown

NUMARC Recognition Category: Hazards and Other Conditions Affecting Plant Safety

NUMARC Initiating Condition:

HA2 Fire or Explosion Affecting the Operability of Plant Safety Systems Required to Establish or Maintain Safe Shutdown

Barrier: Not Applicable

NUMARC Generic Basis:

(Site-specific) Areas containing functions and systems required for the safe shutdown of the plant should be specified. (Site-Specific) Safe Shutdown Analysis should be consulted for equipment and plant areas required for the applicable mode. This will make it easier to determine if the fire or explosion is potentially affecting one or more trains of safety systems. Escalation to a higher emergency class, if appropriate, will be based on <Equipment Failure, Electrical, Fission Product Barrier Degradation, Radioactivity Release, or SEC Judgement ICs>. <>

With regard to explosions, only those explosions of sufficient force to damage permanent structures or equipment required for safe operation within the identified plant area should be considered. As used here, an explosion is a rapid, violent, unconfined combustion, or a catastrophic failure of pressurized equipment, that potentially imparts significant energy to near-by structures and materials. The inclusion of a "report of visible damage" should not be interpreted as mandating a lengthy damage assessment before classification. No attempt is made in this <Generic> EAL to assess the actual magnitude of the damage. The occurrence of the explosion with reports of evidence of damage (*e.g.*, deformation, scorching) is sufficient for the declaration. The declaration of an Alert and the activation of the TSC will provide the <SEC> with the resources needed to perform these damage assessments. The <SEC> also needs to consider any security aspects of the explosions, if applicable.

Plant-Specific Information:

Each Calvert Cliffs unit uses the Abnormal Operating Procedures (AOP) 9A through 9S to address fires within the plant protected and vital areas that are of particular concern because they contain equipment required for safe shutdown.

Thus, the EAL is written as:

| Fire or Explosion Affecting the Ability to Achieve Or Maintain Safe Shutdown |
|---|

Determination of whether the fire is *affecting* ability to achieve or maintain safe shutdown is determined by physical observation, or by Control Room/local control station indications. Damage to one train of safe shutdown equipment when other redundant equipment/trains are operable does not affect the ability to achieve or maintain safe shutdown (*e.g.*, damage to an auxiliary feedwater pump when at least one other auxiliary feedwater pump is operable).

Fire in the Control Room HVAC Room may lead to power being lost to the alternate shutdown panels. Thus, the Control Room HVAC Room (Room 512) has been added to the areas of concern for safe shutdown. The list of areas of concern for Safe Shutdown are shown below and are prominently displayed on the EAL Table.

| Areas of Concern for Safe Shutdown | |
|---|---|
| • Control Room | • Electrical Penetration Rooms |
| • Control Room HVAC Room | • Auxiliary Feedwater Pump Room |
| • Cable Spreading Room | • Charging Pump Rooms |
| • Cable Chases | • Diesel Generator Rooms |
| • Switchgear Room | • Refueling Water Tank (RWT) 11(21) |
| • ECCS Pump Room | • Condensate Storage Tank (CST) 12 |
| • Service Water Pump Room | • Pretreated Water Storage Tank (PWST) 11(21) |
| • Component Cooling Pump Room | • Fuel Oil Storage Tank (FOST) 12 |
| • Main Steam Penetration Room | |
| This list of Safe Shutdown areas is displayed on the EAL Tables to assure that all areas related to Safe Shutdown are considered by the SEC. | |

Source Documents/References/Calculations:

1. Abnormal Operating Procedures
   - AOP-9A through 9S, Alternate Safe Shutdown/Control Room Evacuation procedure series

2. Issue Report IR0-012603, Fire in Room 512..., 10-23-92

# NATURAL PHENOMENA

Emergency Classification Level: UNUSUAL EVENT

Applicable Operational Modes: ALL

Calvert Cliffs Initiating Condition:

## NU1 Natural Phenomena

NUMARC Recognition Category: Hazards and Other Conditions Affecting Plant Safety

NUMARC Initiating Condition:

HU1 Natural and Destructive Phenomena Affecting the Protected Area

Barrier: Not Applicable

NUMARC Generic Basis:

The protected area boundary is typically that part within the security isolation zone and is defined in the site security plan.

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

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

<Generic> EAL 2 is based on the assumption that a tornado striking (touching down) within the protected boundary may have potentially damaged plant structures containing functions or systems required for safe shutdown of the plant. If such damage is confirmed visually or by other in-plant indications, the event may be escalated to Alert.

<Generic> EAL 3 allows for the control room to determine that an event has occurred and take appropriate action based on personal assessment as opposed to verification (*i.e.*, an earthquake is felt but does not register on any plant-specific instrumentation, etc.)

*Generic EALs 4, 5, and 6 are addressed under IC OU3, Destructive Phenomena.*

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

Plant-Specific Information:

Calvert Cliffs EALs are based directly on NUMARC and include the Independent Spent Fuel Storage Installation (ISFSI).

EAL 1 addresses seismic activity. This EAL is based on the acceleration level which causes actuation of the seismic monitor and is verified to be the result of an earthquake, or the presence of a "felt earthquake" as described in the NUMARC generic basis above. On the basis of applicable plant procedures, EAL 1 is written as:

| |
|---|
| Earthquake Detected By Seismic Instrumentation per OI-46 Or Based on Shift Supervisor Judgement |

EAL 2 is written as:

| |
|---|
| Nuclear Security Report of a Tornado Striking Switchyard, Plant Protected Area Or Within ISFSI Protected Area |

Per UFSAR Section 2.8.3.4, the design basis hurricane (used for tidal surge estimates) has a maximum wind speed of 124.7 MPH and a forward speed of 23 MPH. EAL 3 uses 75 MPH to be anticipatory of the design basis wind speed.

Thus, EAL 3 is written as:

| |
|---|
| Sustained Wind Speed GREATER THAN 75 MPH (34 Meters/Second) for AT LEAST 15 Minutes |

The duration of 15 minutes is selected to indicate sustained winds and to preclude wind gusts. An increase in sustained speed above 90 mph (40 meters/second) is cause for escalation to an Alert. Wind speeds are also provided here in meters/second for dose assessment input. The conversion equation is as follows:

$$75\frac{\text{miles}}{\text{hour}} \times 5280\frac{\text{feet}}{\text{mile}} \times \frac{1}{3600}\frac{\text{hour}}{\text{seconds}} \times \frac{1}{3.2808}\frac{\text{meter}}{\text{feet}} = 34\frac{\text{meters}}{\text{second}}$$

Per UFSAR Section 2.8.3.6, the still water level used for Intake Structure analysis is 17.6 feet MSL. This is above the top of the range of the Tide Level Recorder (O-LR-5195). The top of the Intake Structure flood lights (located on the east side to the traveling screens) is 15 to 16 feet MSL. EAL 4 is anticipatory of the design water level.

Thus, EAL 4 is written as:

| |
|---|
| Bay Water Level Above the Top of the Intake Structure Flood Lights On East Side of Traveling Screens |

Per UFSAR Section 2.8.3.7, the predicted extreme low tide is -3.6 feet MSL and normal operation can continue with the bay level as low as -4.0 feet MSL.

Thus, EAL 5 is written as:

| |
|---|
| Bay Water Level is AT LEAST 3.6 Feet Below Mean Sea Level as Indicated by O-LR-5195 Tide Level Recorder Or by Physical Measurement |

Physical measurements may be required if the Tide Level recorder is out of service. For example, the Surveillance Test Procedures provide a way to determine Bay level using a rope.

Source Documents/References/Calculations:

1. Updated Final Safety Analysis Report

2. Operating Instruction (OI) 46, Seismic Measurement Equipment

3. BG&E Drawing 60-220-E (M-31), Equipment Location Service Building, Water Treatment Area & Intake Structure Section "J-J"

4. BG&E Drawing 83-278-E, Plan Auxiliary Building Restricted Access Area El. (-)8'-0", (-)10'-0" And (-)15'-0"

5. BG&E Internal Memorandum, J.E. Thorp to R.E. Denton, Emergency Action Level Review Criteria, June 1, 1990

6. Letter, G.C. Creel (BG&E) to U.S. Nuclear Regulatory Commission Document Control Desk, Emergency Action Level Revision, September 24, 1992

Emergency Classification Level: ALERT

Applicable Operational Modes: ALL

Calvert Cliffs Initiating Condition:

## NA1 Natural Phenomena Affecting Safe Shutdown

NUMARC Recognition Category: Hazards and Other Conditions Affecting Plant Safety

NUMARC Initiating Condition:

HA1 Natural and Destructive Phenomena Affecting the Plant Vital Area

Barrier: Not Applicable

NUMARC Generic Basis:

<Generic> EAL 1 should be based on (site-specific) FSAR design basis. Seismic events of this magnitude can cause damage to safety functions.

<Generic EAL 3> should be based on (site-specific) FSAR design basis. Wind loads of this magnitude can cause damage to safety functions.

<Generic EAL 2> should specify (site-specific) structures containing systems and functions required for safe shutdown of the plant.

*Generic EALs 4, 5, and 6 are addressed under IC OA3, Destructive Phenomena Affecting Safe Shutdown.*

<Generic> EAL 7 covers other (Site-Specific) phenomena such as flood.

Each of these <generic> EALs is intended to address events that may have resulted in a plant vital area being subjected to forces beyond design limits, and thus damage may be assumed to have occurred to plant safety systems. The initial "report" should not be interpreted as mandating a lengthy damage assessment before classification. No attempt is made in th<ese Generic> EAL<s> to assess the actual magnitude of the damage. Escalation to a higher emergency class, if appropriate, will be based on <Equipment Failure, Electrical, Fission Product Barrier Degradation, Radioactivity Release, or SEC> Judgement ICs.
< >

Plant-Specific Information:

Calvert Cliffs EALs are based directly on NUMARC and include the Independent Spent Fuel Storage Installation (ISFSI), as appropriate.

EAL 1 is written as:

| Seismic Event Causing Ground Acceleration GREATER THAN 0.08g Horizontal Or 0.053g Vertical |
|---|

This EAL addresses the Operating Basis Earthquake (OBE) as described in UFSAR Section 2.6.5.2.

EAL 2 is written as:

| |
|---|
| Verified Report to Control Room of Visible Damage to Safe Shutdown Equipment |

Verification of damage can be by physical observation, or by indications of degraded equipment performance in the Control Room or at local control stations.

EAL 3 uses a sustained wind speed of 90 MPH to address high winds striking the Plant Vital Area as recommended by NUMARC. This speed is chosen to assure that the wind speed is within the design capability of the meteorological tower.

Thus, EAL 3 is written as:

| |
|---|
| Sustained Wind Speed GREATER THAN 90 MPH (40 Meters/Second) for AT LEAST 15 Minutes |

The duration of 15 minutes is selected to indicate sustained winds and to preclude wind gusts. Wind speeds are also provided here in meters/second for dose assessment input. The conversion equation is as follows:

$$90\frac{\text{miles}}{\text{hour}} \times 5280\frac{\text{feet}}{\text{mile}} \times \frac{1}{3600}\frac{\text{hour}}{\text{seconds}} \times \frac{1}{3.2808}\frac{\text{meter}}{\text{feet}} = 40\frac{\text{meters}}{\text{second}}$$

Per UFSAR Section 2.8.3.6, the still water level used for Intake Structure analysis is 17.6 feet MSL. This is above the top of the range of the Tide Level Recorder (0-LR-5195). The top of the Traveling Screen cover housings is about 18 feet MSL. EAL 4 indicates achieving the design water level.

Thus, EAL 4 is written as:

| |
|---|
| Bay Water Level At Or Above the Top of the Traveling Screen Cover Housing |

Per UFSAR Section 2.8.3.7, the predicted extreme low tide is -3.6 feet MSL and the plant is designed to safely operate at an extreme low water level of -6.0 feet MSL. EAL 5 is based on the lower elevation.

Thus, EAL 5 is written as:

| |
|---|
| Bay Water Level Is AT LEAST 6 Feet Below Mean Sea Level as Indicated by 0-LR-5195 Tide Level Recorder Or Physical Measurement |

Physical measurements may be required if the Tide Level recorder is out of service. For example, the Surveillance Test Procedures provide a way to determine Bay level using a rope.

Source Documents/References/Calculations:

1. Updated Final Safety Analysis Report
2. Operating Instruction (OI) 46, Seismic Measurement Equipment
3. BG&E Drawing 60-220-E (M-31), Equipment Location Service Building, Water Treatment Area & Intake Structure Section "J-J"
4. BG&E Internal Memorandum, J.E. Thorp to R.E. Denton, Emergency Action Level Review Criteria, June 1, 1990

# OTHER HAZARDS

Emergency Classification Level: UNUSUAL EVENT

Applicable Operational Modes: ALL

Calvert Cliffs Initiating Condition:

## OU1 SEC Judgement

NUMARC Recognition Category: Hazards and Other Conditions Affecting Plant Safety

NUMARC Initiating Condition:

HU5 Other Conditions Existing Which in the Judgement of the Emergency Director Warrant Declaration of an Unusual Event

Barrier: Not Applicable

NUMARC Generic Basis:

This <Generic> Eal is intended to address unanticipated conditions not addressed explicitly elsewhere but that warrant declaration of an emergency because conditions exist which are believed by the <SEC> to fall under the Unusual Event emergency class.

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

Specific examples of actual events that may require <SEC> judgement for Unusual Event declaration are listed here for consideration. However, this list is by no means all inclusive and is not intended to limit the discretion of the site to privide further examples.

- Aircraft crash on-site
- Train derailment on-site
- Near-site explosion which may adversely affect normal site activities.
- Near-site release of toxic or flammagle gas which may adversely affect normal site activities
- Uncontrolled RCS cooldown due to Secondary Depressurization

It is also intended that the <SEC's> judgement not be limited by any list of events as defined here or as augmented by the site. This list is provided solely as examples for consideration and it is recognized that actual events may not always follow a pre-conceived description.

Plant-Specific Information:

Site Emergency Coordinator (SEC) is the title for the emergency director function at Calvert Cliffs. Thus, the EAL is written as:

| |
|---|
| Any Condition Which in the SEC's Judgement Indicates Potential Degradation in the Level of Safety of the Plant |

In this manner, the EAL addresses conditions that fall under the Notification of Unusual Event emergency classification description contained in NUREG-0654, Appendix 1 that is retained under the NUMARC methodology.

Source Documents/References/Calculations:

1. Emergency Response Plan

2. NUREG-0654/FEMA-REP-1, Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants, Revision 1, October 1980, Appendix 1

Emergency Classification Level: UNUSUAL EVENT

Applicable Operational Modes: ALL

Calvert Cliffs Initiating Condition:

## OU2 Toxic or Flammable Gases

NUMARC Recognition Category: Hazards and Other Conditions Affecting Plant Safety

NUMARC Initiating Condition:

HU3 Release of Toxic or Flammable Gases Deemed Detrimental to Safe Operation of the Plant

Barrier: Not Applicable

NUMARC Generic Basis:

This IC is based on releases in concentrations within the site boundary that will affect the health of plant personnel or affecting the safe operation of the plant with the plant being within the evacuation area of an offsite event (*i.e.*, tanker truck accident releasing toxic gases, etc.) The evacuation area is as determined from the DOT Evacuation Tables for Selected Hazardous Materials, in the DOT Emergency Response Guide for Hazardous Materials. < >

Plant-Specific Information:

For the purposes of this IC, Halon (such as is discharged by the fire suppression system) is not toxic. Fire suppressant discharge can be lethal if it reduces oxygen to low concentrations that are immediately dangerous to life and health (IDLH). *Fire suppressant discharge into an area is not basis for emergency classification under this IC unless: (1) Access to the affected area is required, and (2) Fire suppressant concentration results in conditions that make the area inaccessible (i.e., IDLH).*

EAL 1 is written as:

| |
|---|
| On-Site Toxic or Flammable Gas Release Which in the Shift Supervisor's Judgement Could Potentially Degrade the Level of Safety of the Plant |

EAL 2 is written as:

| |
|---|
| Notification of a Near-Site Release That May Require Evacuation of Plant Personnel |

This EAL addresses releases that could originate from the Cove Point Liquid Natural Gas Plant.

Source Documents/References/Calculations:

1. Abnormal Operating Procedures
   - AOP-11, Control Room Evacuation and Safe Shutdown Non-Fire Conditions
2. Updated Final Safety Analysis Report

Emergency Classification Level: UNUSUAL EVENT

Applicable Operational Modes: ALL

Calvert Cliffs Initiating Condition:

## OU3 Destructive Phenomena

NUMARC Recognition Category: Hazards and Other Conditions Affecting Plant Safety

NUMARC Initiating Condition:

HU1 Natural and Destructive Phenomena Affecting the Plant Protected Area

Barrier: Not Applicable

NUMARC Generic Basis:

The protected area boundary is typically that part within the security isolation zone and is defined in the site security plan.

*Generic EALs 1, 2, and 3 are addressed by IC NU1, Natural Phenomena.*

<Generic> EAL 4 is intended to address such items as plane or helicopter crash, or on some sites, train crash, or barge crash that may potentially damage plant structures containing functions and systems required for safe shutdown of the plant. If the crash is confirmed to affect a plant vital area, the event may be escalated to Alert.

For <generic> EAL 5, only those explosions of sufficient force to damage permanent structures or equipment within the protected area should be considered. As used here, an explosion is a rapid, violent, unconfined combustion, or a catastrophic failure of pressurized equipment, that potentially imparts significant energy to nearby structures and materials. No attempt is made in this EAL to assess the actual magnitude of the damage. The occurrence of the explosion with reports of evidence of damage (*e.g.*, deformation, scorching) is sufficient for the declaration. The <SEC> also needs to consider any security aspects of the explosion, if applicable.

<Generic> EAL 6 is intended to address main turbine rotating component failures of sufficient magnitude to cause observable damage to the turbine casing or to the seals of the generator. Of major concern is the potential for leakage of combustible fuels (lubricating oils) and gases (hydrogen cooling) to the plant environs. Actual fires and flammable gas buildup are appropriately classified via <ICs IU1 and OU2>. This <generic> EAL is consistent with the definition of an Unusual Event while maintaining the anticipatory nature desired and recognizing the risk to non-safety related equipment. Escalation of the emergency classification is based on potential damage done by missiles generated by the failure <>, or in conjunction with a steam generator tube rupture, for a PWR. These latter events would be classified by the <Radioactivity Release, Equipment Failure, or Fission Product Barrier Degradation> ICs.

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

Plant-Specific Information:

These EALs are based directly on NUMARC and include the Independent Spent Fuel Storage Installation (ISFSI). Releases of flammable gases and fires within the protected area, are addressed by other EAL and are thus not separately addressed due to turbine failure.

EAL 1 is written as:

| |
|---|
| Nuclear Security Report of an Explosion Within the Plant Protected Area Or Within the ISFSI Protected Area |

EAL 2 is written as:

| |
|---|
| Visible Damage to Safe Shutdown Equipment Or to Permanent Equipment or Structures Within the ISFSI Protected Area |

EAL 3 is written as:

| |
|---|
| Turbine Failure Causing Observable Casing Damage |

*Observable* is used to indicate that such damage can be readily seen and does not require special equipment or techniques to see or measure.

EAL 4 is written as:

| |
|---|
| Vessel or Vehicle Collision Causing Observable Damage to Safe Shutdown Equipment |

EAL 5 is written as:

| |
|---|
| Vessel or Vehicle Collision Causing Observable Damage to Structures Containing Dry Stored Spent Fuel |

EALs 4 and 5 address airplane, helicopter, barge, boat, train, car, or truck collisions into equipment required to achieve or maintain safe shutdown or with the Horizontal Storage Modules and their associated structural supports. These EALs do not include vehicle crashes with each other, damage to office structures, damage to equipment not required to achieve or maintain safe shutdown, or damage to structures that are not required to maintain the integrity of the dry spent fuel stored in the ISFSI. Safe Shutdown areas and equipment of concern are identified below.

| Areas of Concern for Safe Shutdown | |
|---|---|
| • Control Room | • Electrical Penetration Rooms |
| • Control Room HVAC Room | • Auxiliary Feedwater Pump Room |
| • Cable Spreading Room | • Charging Pump Rooms |
| • Cable Chases | • Diesel Generator Rooms |
| • Switchgear Room | • Refueling Water Tank (RWT) 11(21) |
| • ECCS Pump Room | • Condensate Storage Tank (CST) 12 |
| • Service Water Pump Room | • Pretreated Water Storage Tank (PWST) 11(21) |
| • Component Cooling Pump Room | • Fuel Oil Storage Tank (FOST) 12 |
| • Main Steam Penetration Room | |
| This list of Safe Shutdown areas is displayed on the EAL Tables to assure that all areas related to Safe Shutdown are considered by the SEC. | |

EAL 6 is written as:

| |
|---|
| Flooding of Rooms Containing Safe Shutdown Equipment |

*Flooding* indicates that the net water flow into the room results in elevated water levels, may be more than available drain capacity, and if continued, can prevent operation of equipment in the room. Thus, minor water level increases that may result in wet floors and do not pose a challenge to equipment operation are not included in this EAL. Areas containing equipment required for Safe Shutdown are listed above. The rooms located below MSL include the ECCS Pump Rooms and the Charging Pump Rooms. The Shutdown Cooling Heat Exchangers are also located in the ECCS Pump Rooms. Such flooding can result in a potential degradation in the level of safety of the Calvert Cliffs plant and is therefore included in this EAL.

Source Documents/References/Calculations:

1. Updated Final Safety Analysis Report
2. BG&E Drawing 60-220-E (M-31), Equipment Location Service Building, Water Treatment Area & Intake Structure Section "J-J"
3. BG&E Drawing 83-278-E, Plan Auxiliary Building Restricted Access Area El. (-)8'-0", (-)10'-0" And (-)15'-0"
4. Letter, G.C. Creel (BG&E) to U.S. Nuclear Regulatory Commission Document Control Desk, Emergency Action Level Revision, September 24, 1992

Emergency Classification Level: ALERT

Applicable Operational Modes: ALL

Calvert Cliffs Initiating Condition:

## OA1 SEC Judgement

NUMARC Recognition Category: Hazards and Other Conditions Affecting Plant Safety

NUMARC Initiating Condition:

HA6 Other Conditions Exist Which in the Judgement of the Emergency Director Warrant Declaration of an Alert

Barrier: Not Applicable

NUMARC Generic Basis:

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

Plant-Specific Information:

Site Emergency Coordinator (SEC) is the title for the emergency director function at Calvert Cliffs.

Thus, EAL 1 is written as:

| |
|---|
| Any Condition Which in the SEC's Judgement Indicates That Safety Systems May Be Degraded AND Which Requires Emergency Response Organization Staffing |

In this manner, the EAL addresses conditions that fall under the Alert emergency classification description contained in NUREG-0654, Appendix 1 that is retained under the NUMARC methodology.

At Calvert Cliffs, the emergency response organization would be activated on entry into EOP-8; thus, it is included here as an EAL.

Thus, EAL 2 is written as:

| |
|---|
| EOP-8, Functional Recovery Procedure, is Implemented |

Source Documents/References/Calculations:

1. Emergency Response Plan

2. NUREG-0654/FEMA-REP-1, Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants, Revision 1, October 1980, Appendix 1

3. Emergency Operating Procedures
   - EOP-8, Functional Recovery Procedure

Emergency Classification Level: ALERT

Applicable Operational Modes: ALL

Calvert Cliffs Initiating Condition:

## OA2 Toxic or Flammable Gases Affecting Safe Shutdown

NUMARC Recognition Category: Hazards and Other Conditions Affecting Plant Safety

NUMARC Initiating Condition:

HA3 Release of Toxic or Flammable Gases Within a Facility Structure Which Jeopardizes Operation of Systems Required to Maintain Safe Operations or to Establish or Maintain Cold Shutdown

Barrier: Not Applicable

NUMARC Generic Basis:

This IC is based on gases that have entered a plant structure affecting the safe operation of the plant. This IC applies to buildings and areas contiguous to plant Vital Areas or other significant buildings or areas (*i.e.*, Service Water Pumphouse). The intent of this IC is not to include buildings (*i.e.*, warehouses) or other areas that are not contiguous or immediately adjacent to plant Vital Areas. It is appropriate that increased monitoring be done to ascertain whether consequential damage has occurred. Escalation to a higher emergency class, if appropriate, will be based on <Electrical, Equipment Failure, Radioactivity Release, Fission Product Barrier Degradation, or SEC Judgement ICs.> <>

Plant-Specific Information:

For the purposes of this IC, Halon (such as is discharged by the fire suppression system) is not toxic. Fire suppressant discharge can be lethal if it reduces oxygen to low concentrations that are immediately dangerous to life and health (IDLH). *Fire suppressant discharge into an area is not basis for emergency classification under this IC unless: (1) Access to the affected area is required, and (2) Fire suppressant concentration results in conditions that make the area inaccessible (i.e., IDLH).*

Thus, the EAL is written as:

| |
|---|
| Toxic or Flammable Gas Making Safe Shutdown Areas Inaccessible |

This EAL also addresses releases that could originate from the Cove Point Liquid Natural Gas Plant.

The areas of concern for safe shutdown are identified below.

| Areas of Concern for Safe Shutdown | |
|---|---|
| • Control Room<br>• Control Room HVAC Room<br>• Cable Spreading Room<br>• Cable Chases<br>• Switchgear Room<br>• ECCS Pump Room<br>• Service Water Pump Room<br>• Component Cooling Pump Room<br>• Main Steam Penetration Room | • Electrical Penetration Rooms<br>• Auxiliary Feedwater Pump Room<br>• Charging Pump Rooms<br>• Diesel Generator Rooms<br>• Refueling Water Tank (RWT) 11(21)<br>• Condensate Storage Tank (CST) 12<br>• Pretreated Water Storage Tank (PWST) 11(21)<br>• Fuel Oil Storage Tank (FOST) 12 |
| This list of Safe Shutdown areas is displayed on the EAL Tables to assure that all areas related to Safe Shutdown are considered by the SEC. | |

Source Documents/References/Calculations:

1. Updated Final Safety Analysis Report

Emergency Classification Level: ALERT

Applicable Operational Modes: ALL

Calvert Cliffs Initiating Condition:

## OA3 Destructive Phenomena Affecting Safe Shutdown

NUMARC Recognition Category: Hazards and Other Conditions Affecting Plant Safety

NUMARC Initiating Condition:

HA1 Natural and Destructive Phenomena Affecting the Plant Vital Area

Barrier: Not Applicable

NUMARC Generic Basis:

*Generic EALs 1, 2, and 3 are addressed under IC NA1, Natural Phenomena Affecting Safe Shutdown.*

<Generic> EAL 4 should specify the types of instrumentation or indications including judgement which are to be used to assess occurrence.

<Generic> EAL 5 is intended to address such items as plane or helicopter crash, or on some sites, train crash, or barge crash into a plant vital area.

<Generic> EAL 6 is intended to address the threat to safety-related equipment imposed by missiles generated by main turbine rotating component failures. This (site-specific) list of areas should include all safety-related equipment, their controls, and their power supplies. This EAL is, therefore, consistent with the definition of an ALERT in that if missiles have damaged or penetrated areas containing safety-related equipment the potential exists for substantial degradation of the level of safety of the plant.

<Generic> EAL 7 covers other (Site-Specific) phenomena such as flood.

Each of these <generic> EALs is intended to address events that may have resulted in a plant vital area being subjected to forces beyond design limits, and thus damage may be assumed to have occurred to plant safety systems. The initial "report" should not be interpreted as mandating a lengthy damage assessment prior to classification. No attempt is made in th<ese> EAL<s> to assess the actual magnitude of the damage. Escalation to a higher emergency class, if appropriate, will be based on <Equipment Failure, Electrical, Fission Product Barrier Degradation, Radioactivity Release, or SEC> Judgement ICs.

Plant-Specific Information:

The Calvert Cliffs EALs are based on report to the control room of damage affecting safe shutdown functions.

EAL 1 addresses airplane, helicopter, barge, boat, train, car, or truck collisions. This EAL does not include vehicle crashes with each other, damage to office structures, or damage to structures that are not safety-related.

Thus, EAL 1 is written as:

| |
|---|
| Vessel or Vehicle Collision Affecting the Ability to Achieve Or Maintain Safe Shutdown |

EAL 2 is written as:

| |
|---|
| Missiles Affecting the Ability to Achieve Or Maintain Safe Shutdown |

EAL 3 is written as:

| |
|---|
| Flooding Affecting the Ability to Achieve Or Maintain Safe Shutdown |

Determination of whether the collision, missiles, or flooding are *affecting* ability to achieve or maintain safe shutdown is determined by physical observation, or by Control Room/local control station indications. Damage to one train of safe shutdown equipment when other redundant equipment/trains are operable does not affect the ability to achieve or maintain safe shutdown (*e.g.*, damage to an auxiliary feedwater pump when at least one other auxiliary feedwater pump is operable).

The list of areas of concern for Safe Shutdown are shown below and are prominently displayed on the EAL Table.

| Areas of Concern for Safe Shutdown | |
|---|---|
| • Control Room<br>• Control Room HVAC Room<br>• Cable Spreading Room<br>• Cable Chases<br>• Switchgear Room<br>• ECCS Pump Room<br>• Service Water Pump Room<br>• Component Cooling Pump Room<br>• Main Steam Penetration Room | • Electrical Penetration Rooms<br>• Auxiliary Feedwater Pump Room<br>• Charging Pump Rooms<br>• Diesel Generator Rooms<br>• Refueling Water Tank (RWT) 11(21)<br>• Condensate Storage Tank (CST) 12<br>• Pretreated Water Storage Tank (PWST) 11(21)<br>• Fuel Oil Storage Tank (FOST) 12 |
| This list of Safe Shutdown areas is displayed on the EAL Tables to assure that all areas related to Safe Shutdown are considered by the SEC. | |

Source Documents/References/Calculations:

1. Updated Final Safety Analysis Report

Emergency Classification Level: ALERT

Applicable Operational Modes: ALL

Calvert Cliffs Initiating Condition:

## OA4 Control Room Being Evacuated

NUMARC Recognition Category: Hazards and Other Conditions Affecting Plant Safety

NUMARC Initiating Condition:

HA5 Control Room Evacuation Has Been Initiated

Barrier: Not Applicable

NUMARC Generic Basis:

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

Plant-Specific Information:

This EAL addresses events requiring evacuation of the Control Room such as fire or toxic gas release that make the Control Room uninhabitable and transferring of control to local stations outside the control room. ADP-9A (fire conditions) and ADP-11 (non-fire conditions) control actions for Control Room evacuation and re-establish control of the plant.

Thus, the EAL is written as:

| Control Room Evacuation Initiated per ADP-9A or ADP-11 |
|---|

Source Documents/References/Calculations:

1. Abnormal Operating Procedures
   - ADP-9A, Control Room Evacuation and Safe Shutdown Due to a Severe Control Room Fire
   - ADP-11, Control Room Evacuation and Safe Shutdown Non-Fire Conditions

Emergency Classification Level: SITE EMERGENCY

Applicable Operational Modes: ALL

Calvert Cliffs Initiating Condition:

## OS1 SEC Judgement

NUMARC Recognition Category: Hazards and Other Conditions Affecting Plant Safety

NUMARC Initiating Condition:

HS3 Other Conditions Existing Which in the Judgement of the Emergency Director Warrant Declaration of Site <E>mergency

Barrier: Not Applicable

NUMARC Generic Basis:

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

Plant-Specific Information:

Site Emergency Coordinator (SEC) is the title for the emergency director function at Calvert Cliffs.

Thus, the EAL is written as:

| |
|---|
| Any Condition Which in the SEC's Judgement Indicates Loss or Potential Loss of Two Fission Product Barriers |

In this manner, the EAL addresses conditions that fall under the Site Emergency classification and is consistent with the Fission Product Barrier Degradation EAL Table.

*Loss* means that a severe challenge to a fission product barrier (Fuel Clad, RCS, or CNTMT) exists such that the barrier is considered incapable of performing its safety function.

*Potential loss* means that a challenge to a fission product barrier (Fuel Clad, RCS, or CNTMT) exists such that the barrier is considered degraded in its ability to perform its safety function.

Source Documents/References/Calculations:

1. Emergency Response Plan
2. NUREG-0654/FEMA-REP-1, Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants, Revision 1, October 1980, Appendix 1

Emergency Classification Level: SITE EMERGENCY

Applicable Operational Modes: ALL

Calvert Cliffs Initiating Condition:

## OS2 Control Room Has Been Evacuated AND Timely Plant Control Can NOT Be Established

NUMARC Recognition Category: Hazards and Other Conditions Affecting Plant Safety

NUMARC Initiating Condition:

HS2 Control Room Evacuation Has Been Initiated And Plant Control Can Not Be Established

Barrier: Not Applicable

NUMARC Generic Basis:

Expeditious transfer of safety systems has not occurred but fission product barrier damage may not yet be indicated. (Site-Specific) time for transfer based on analysis or assessments as to how quickly control must be reestablished without core uncovering and/or core damage. This time should not exceed 15 minutes. In cold shutdown and refueling modes, operator concern is directed toward maintaining core cooling such as is discussed in Generic Letter 88-17, "Loss of Decay Heat Removal". In power operation, hot standby, and hot shutdown modes, operator concern is primarily directed toward maintaining critical safety functions and thereby assuring fission product barrier integrity. Escalation of this event, if appropriate, would be by <Fission Product Barrier Degradation, Radioactivity Release, or SEC> Judgement ICs. <>

Plant-Specific Information:

This EAL addresses events requiring evacuation of the Control Room such as fire or toxic gas release that make the Control Room unhabitable and transferring of control to local stations outside the control room. ADP-9A (fire conditions) and ADP-11 (non-fire conditions) control actions for Control Room evacuation and re-establish control of the plant.

An analysis was performed of how quickly control must be re-established at Calvert Cliffs without core uncovery or damage to develop an appropriate site-specific EAL. A RETRAN simulation shows that the steam generators go dry at about 47 minutes for the ADP-9 (station fire) scenario. RCS pressure reaches the lowest pressurizer safety valve setpoint soon thereafter. Restoring feedwater within 45 minutes assures that RCS pressure remains below the safety valve setpoint thus avoiding inventory loss. The maximum time allowable to restore RCS inventory for Appendix R (station fire) scenarios is 90 minutes. Site Emergency declaration at 30 minutes and 60 minutes for inability to restore feedwater and RCS make-up respectively thus constitutes a conservative action for emergency response.

Thus, the EAL is written as:

Control Room Evacuation Initiated AND Either of the Following:
- Inability to Establish Auxiliary Feedwater to AT LEAST One Steam Generator Within 30 Minutes
- Inability to Establish Reactor Coolant Make-up (Charging Pump Flow) Within 60 Minutes

Source Documents/References/Calculations:

1. Abnormal Operating Procedures
   - AOP-9A, Control Room Evacuation and Safe Shutdown Due to a Severe Control Room Fire
   - AOP-11, Control Room Evacuation and Safe Shutdown Non-Fire Conditions

2. Letter, L.B. Russell (BG&E) to James H. Joyner (U.S. Nuclear Regulatory Commission Region I), Emergency Action Level Review Meeting, June 6, 1991

Emergency Classification Level: GENERAL EMERGENCY

Applicable Operational Modes: ALL

Calvert Cliffs Initiating Condition:

## OG1 SEC Judgement

NUMARC Recognition Category: Hazards and Other Conditions Affecting Plant Safety

NUMARC Initiating Condition:

HG2 Other Conditions Existing Which in the Judgement of the Emergency Director Warrant Declaration of General Emergency

Barrier: Not Applicable

NUMARC Generic Basis:

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

Plant-Specific Information:

Site Emergency Coordinator (SEC) is the title for the emergency director function at Calvert Cliffs. Thus, the EAL is written as:

> Any Condition Which in the SEC's Judgement Indicates Potential for Radiological Releases Requiring Off-Site Protective Actions

In this manner, the EAL addresses conditions that fall under the General Emergency classification description contained in NUREG-0654, Appendix 1.

Source Documents/References/Calculations:

1. Emergency Response Plan
2. NUREG-0654/FEMA-REP-1, Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants, Revision 1, October 1980, Appendix 1