REGULATORY ANALYSIS[1]

REVISION 4 OF REGULATORY GUIDE 1.101

TO ACCEPT THE GUIDANCE IN

NEI 99-01 AS AN ALTERNATIVE METHODOLOGY FOR THE

DEVELOPMENT OF EMERGENCY ACTION LEVELS

1. STATEMENT OF THE PROBLEM

1.1 Background

Paragraph (a)(1) of Section 50.47, *Emergency Plans*, of 10 CFR Part 50 states that no operating license for a nuclear power reactor will be issued unless a finding is made by the Nuclear Regulatory Commission (NRC) that the state of onsite and offsite emergency preparedness provides reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency. Section 50.47 also establishes standards that must be met by the onsite and offsite emergency response plans for NRC staff to make a positive finding that there is reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency. One of these standards, i.e., 50.47(b)(4), stipulates that emergency plans include a standard emergency classification and action level scheme. 10 CFR Part 50, Appendix E, Section IV.B provides that emergency plans are to include emergency action levels (EALs), which are to be used as criteria for determining the need for notification and participation of local and State agencies and which are to be used for determining when and what type of protective measures should be considered both onsite and offsite to protect health and safety. EALs are to be based on inplant conditions and instrumentation, and also on onsite and offsite monitoring. Section IV.B of Appendix E also provides that EALs shall be discussed and agreed on by the applicant and State and local authorities and be approved by NRC; and be reviewed annually with State and local authorities. 10 CFR Part 50, Appendix E, Section IV.C provides that there are emergency classification levels (ECLs) that determine the extent of the participation of the emergency response organization; and that the ECLs include: (1) Notification of Unusual Event; (2) alert; (3) Site Area Emergency; and (4) General Emergency. EALs are used by plant personnel in determining the appropriate ECL to declare.

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[1]This regulatory analysis conforms to the guidance specified in NUREG/BR-0058, Rev. 2, “Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission.”

Revision 1 to NUREG-0654/FEMA-REP-l, *Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants,* (NUREG-0654) was published in November 1980 to provide specific acceptance criteria for complying with the standards set forth in Section 50.47 of 10 CFR Part 50. Appendix 1 of NUREG-0654 contains example initiating conditions (ICs) for each of the four ECLs that are used to initiate different levels of emergency response onsite and offsite. Section 2.I of NUREG-0654 states that plant parameter values or other information which correspond to the example ICs in Appendix I are to be identified. The ICs, in conjunction with the associated parameter values (and other information), make up the EAL scheme.

Revision 2 of Regulatory Guide 1.101, *Emergency Planning and Preparedness for Nuclear Power Reactors*, published in 1981, endorsed NUREG-0654 as an acceptable method for complying with the standards in 10 CFR 50.47, including planning standard 50.47(b)(4) for development of an EAL scheme.

The purpose of declaring an ECL is to initiate an emergency response. Appendix 1 to NUREG-0654 contains a description and the purpose of each ECL, and licensee and offsite emergency response authority actions which may be initiated or ongoing at each ECL. The higher the ECL, the greater the effort (and the cost) required of the licensee and offsite emergency response authorities to respond to the ECL.

A goal of ECLs is to have offsite emergency response authorities prepared to take actions to protect the health and safety of the public in the event of a radiological release offsite. These “protective actions” are usually to evacuate, or to shelter-in-place, the population in parts of, or in all of, an emergency planning zone (EPZ) with a radius of about 10 miles centered on the nuclear plant. If ECLs are declared too early or when not warranted by plant conditions, licensees and offsite emergency response authorities may incur unnecessary expenses. On the other hand, if ECLs are declared later than when appropriate or are not declared, there may be unnecessary risk of radiation exposure to the public. There may be large costs to the public in taking protective actions, especially the economic costs of evacuation (e.g., businesses in the evacuated area would be shut down). However, these economic costs would not depend on precisely when ECLs are declared.

In January 1992, the nuclear industry, under the sponsorship of the Nuclear Utilities Management Council (NUMARC), published NUMARC/NESP-007, Revision 2, *Methodology for Development of Emergency Action Levels*. NUMARC/NESP-007 provides more detailed guidance for the development of EAL schemes than that provided in NUREG-0654 and was based upon insights gained from more than 10 years of developing EAL schemes. NUMARC/NESP-007 provided: (1) definitions to ECLs, ICs and EALs, and indicated the relationship between these concepts; (2) provided a set of ICs which closely corresponded, in most instances, to those provided in NUREG-0654; (3) provided specific example EALs under individual ICs; (4) provided the bases for the ICs and EALs; and (5) delineated the operating mode for

which the ICs and EALs were applicable.

In 1992, NRC staff endorsed, in Revision 3 to Regulatory Guide 1.101, the NUMARC/NESP-007 methodology as an acceptable alternative method to that described in NUREG-0654 for developing EALs to meet the standard in 10 CFR 50.47(b)(4) and the requirements in Appendix E to 10 CFR Part 50 for EALs. The staff's rationale for endorsing the NUMARC/NESP-007 guidance is contained in the Regulatory Analysis associated with Revision 3 of Regulatory Guide 1.101.

1.2 Need for Further Guidance

NRC has endorsed two guidance documents for developing EAL schemes, i.e., NUREG-0654 (endorsed in 1980) and NUMARC/NESP-007, Rev. 2, (endorsed in 1992).

The need for further guidance for developing EALs applicable in the shutdown and refueling modes of operation was identified in Revision 3 to Regulatory Guide 1.101. In Revision 3 to Regulatory Guide 1.101, the NRC noted that the results of ongoing risk studies relating to shutdown operations may necessitate revision of both the NRC EAL guidance (NUREG-0654) and NUMARC/NESP-007 guidance. In September 1993, the NRC issued NUREG-1449, "Shutdown and Low-Power Operation at Commercial Nuclear Power Plants in the United States," which provided the results of the NRC's evaluation of shutdown and low-power operations at commercial nuclear power plants. In NUREG-1449, the NRC noted that:

> *Because initiating conditions contained in Appendix 1 to NUREG-0654 were not intended to be directly and fully applicable to shutdown and refueling conditions and their unique characteristics, their use by the licensees has resulted in inconsistencies and oftentimes excess conservatism in the classification of emergencies during shutdown or refueling conditions . . . NUMARC has developed a system similar to that in NUREG-0654 for classifying abnormal occurrences at nuclear power plants . . . NUMARC has recognized initiating conditions are more accurately defined when the plant's mode of operation is considered . . . Although the NUMARC methodology includes initiating conditions for nuclear plants during shutdown and refueling conditions, it is not considered to be complete in that regard.*

In addition to the need for guidance for shutdown and refueling mode of plant operations, the industry determined it to be beneficial to develop EALs for classifying events at permanently shutdown nuclear power plants and at Independent Spent Fuel Storage Installations (ISFSIs) located at nuclear power plants.

Lastly, the NRC and industry have determined it to be beneficial to revise guidance on a

number of EALs provided in NUMARC/NESP-007 in order to incorporate lessons-learned from the development and review of more than thirty EAL schemes developed in accordance with the NUMARC/NESP-007 guidance. Many of the industry-identified improvements were captured in NUMARC's June 1993[2] "Question and Answer" (Q&A) document. In addition, during its review of EAL schemes developed in accordance with NUMARC/NESP-007, the NRC noted areas where the guidance could be improved to provide for less resource intensive reviews. These improvements would result in more uniform application of the guidance and, therefore, result in less of a need for justification of deviations from the generic guidance by licensees and analysis of these deviations by the NRC.

On January 11, 1999, NEI submitted NEI 97-03, *Methodology for Development of Emergency Action Levels*, December 1998, which incorporated these lessons-learned from use of NUMARC. On February 28, 2000, NEI submitted NEI 99-01, *Methodology for Development of Emergency Action Levels*, February 2000, which incorporated new EAL guidance for (1) shutdown and refueling modes of plant operations, (2) permanently defueled plants, and (3) ISFSIs. In addition, NEI 99-01 adopted all the EAL guidance changes incorporated in NEI 97-03. Note, however, that documentation of the rationale for changes made to EALs in NEI 97-03 (contained in Section 2 of NEI 97-03) was not provided in NEI 99-01.

1.3 Objective

The objective of this action is to endorse updated industry guidance on development of EALs that are required by 10 CFR 50.47(b)(4) and 10 CFR Part 50, Appendix E, Section IV.B. The industry and NRC recognized the need for improved guidance on EALs applicable in the shutdown and refueling modes of plant operation. The objective of DG-1075 is to inform 10 CFR Part 50 applicants and licensees of NRC's regulatory position and to seek public comment on this position.

2. IDENTIFICATION AND PRELIMINARY ANALYSIS OF ALTERNATIVES

The alternatives to be considered are: (1) to take no action (i.e., to maintain the status quo); and (2) to adopt the regulatory position that the guidance contained in NEI 99-01 is considered to be an acceptable alternative to that described in NUREG-0654 and NUMARC/NESP-007 for developing EALs.

It should be remembered that neither alternative mandates any particular methodology for developing EALs. According to 10 CFR Part 50, Appendix E, Section IV.B, EALs developed by licensees must be agreed on by offsite emergency response authorities and approved by NRC. NEI 99-01 is a published report and licensees may use it to

[2]In a letter dated June 10, 1993, the NRC concluded that the "answers" in the Q&A document met the intent Revision 3 of Regulatory Guide 1.101.

develop EALs that are agreeable to offsite emergency response authorities and acceptable to NRC, regardless of which alternative is chosen. However, adoption of alternative 2 would be expected to foster use of the NEI 99-01 methodology by eliminating uncertainty as to whether the methodology is acceptable to NRC and to expedite review of EAL revisions by allowing NRC to focus its review on only deviations to the guidance.

The currently approved EAL guidance documents are briefly described below, followed by a brief description of the new EAL guidance provided in NEI 99-01. A detailed evaluation of the values and impacts of endorsing the guidance in NEI 99-01 is contained in Section 3 of this Regulatory Analysis.

2.1 Description of the NUREG-0654 Methodology

For each ECL (Notification of Unusual Event[3], Alert, Site Area Emergency, and General Emergency), Appendix 1 to NUREG-0654 contains a list of example ICs. NUREG-0654 specifies that these ICs "are to form the basis for establishment by each licensee of the specific plant instrumentation readings (as applicable) which, if exceeded, will initiate the emergency class." NUREG-0654 does not provide example EALs corresponding to the ICs nor does it specify the operating modes in which the ICs should be applicable.

2.2 Description of the NUMARC/NESP-007 Methodology

The NUMARC/NESP-007 methodology provides guidance on ICs and example EALs (for each IC) and a basis for each IC and EAL. NUMARC/NESP-007 has three types of ICs and EALs: (1) symptom-based; (2) event-based; and (3) barrier-based. The symptom-based EALs refer to those indicators that are measurable over a continuous spectrum, e.g., core temperature, coolant level, radiation meter readings. Off-normal readings on such indicators are symptoms of problems. The seriousness of a symptom depends on such factors as the degree to which technical specifications are exceeded and the capability of licensed operators to gain control and bring the indicators back to safe levels. Event-based ICs and EALs refer to discrete occurrences with potential safety significance such as a fire or severe weather. Barrier-based ICs and EALs utilize indications of the level of challenge to the principal barriers used to assure containment of radioactive materials within a nuclear power plant. For the most important type of radioactive material, i.e., fission products, there are three principal barriers: fuel cladding, reactor coolant system (RCS) pressure boundary, and containment. Barrier-based EALs are a subset of symptom-based EALs that are related to indications of challenges to fission product barriers,

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[3]The term “Notification of Unusual Event” is frequently shortened to “Unusual Event.” Both terms are used interchangeably in this document.

In the NUMARC/NESP-007 methodology, the operating modes (power operation, startup, hot standby, hot shutdown, cold shutdown, refueling, and defueled) to which individual ICs apply are specified. As a plant moves from power operation through the decay heat removal process toward cold shutdown and refueling, barriers to the release of fission products may be reduced, instrumentation to detect symptoms may not be fully effective and partial disabling of safety systems may be permitted by technical specifications. For such operations, ICs and EALs tend, therefore, to be event-based rather than symptom-based or barrier-based.

The ICs and EALs are divided into four "recognition categories" in NUMARC/NESP-007:

- A - Abnormal Rad Levels/Radiological Effluent
- F - Fission Product Barrier Degradation
- H - Hazards or Other Conditions Affecting Plant Safety
- S - System Malfunction

For recognition categories A, H, and S, ICs and associated EALs are developed for each ECL. For these recognition categories, ICs are identified by a three-character acronym (recognition category, ECL[4], and sequence number). For example, AU2 is the second Unusual Event IC in the Abnormal Radiation Level recognition category and SS3 is the third Site Area Emergency IC in the Systems Malfunction recognition category.

For recognition category F (fission product barrier degradation), there are three ICs: (1) loss or potential loss of the containment barrier; (2) loss or potential loss of the fuel clad barrier; and (3) loss or potential loss of the RCS barrier. The EALs for each of these ICs depend on whether the reactor is a pressurized water reactor (PWR) or a boiling water reactor (BWR). The ECL is a function of the number (and extent) of fission product barrier degradation, as shown below.

UNUSUAL EVENT	Any loss or potential loss of containment
ALERT	Any loss or any potential loss of either fuel clad or RCS
SITE AREA EMERGENCY	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

[4]The letter U is used for the Unusual Event ECL, A for alert, S for Site Area Emergency, and G for General Emergency.

GENERAL EMERGENCY	Loss of any two barriers and potential loss of the third barrier

2.3 Description of the NEI 99-01 Methodology

As discussed in Section 1, the NEI 99-01 methodology is very similar to the NUMARC/NESP-007 methodology with guidance provided on ICs, example EALs (for each IC), and a basis for each IC and EAL. Changes made to NUMARC/NESP-007 in NEI 99-01 include: (1) addition of EALs for shutdown and refueling modes of plant operations, (2) addition of EALs for permanently shutdown reactors, (3) addition of EALs for ISFSIs at nuclear power plants and (4) clarification of some of the NUMARC/NESP-007 EALs to facilitate consistent application of the guidance[5].

Each EAL added or changed in NEI 99-01(including changes to the basis for the EALs) is evaluated in Appendix C to this Regulatory Analysis. In addition, new guidance provided in NEI 99-01 for classifying transient events, the interface between activation of emergency response facilities and event classification, and operating mode applicability is evaluated in Appendix C.

3.0 ESTIMATION AND EVALUATION OF VALUES AND IMPACTS

3.1 Alternative 1 -- Do not endorse NEI 99-01

This alternative is the base case for this regulatory analysis. One of the conventions of regulatory analyses is that costs and benefits are defined in terms of changes from the status quo. Alternative 1 would continue the status quo; application of the convention means that there are neither costs nor benefits associated with Alternative 1.

3.2 Alternative 2 -- Endorse NEI 99-01

This alternative has two effects. First, it may influence licensees' decision on whether or not to adopt the EAL methodology (i.e., persuade licensees to revise their EAL schemes). Second, it will expedite review and approval of site-specific EAL schemes which have been developed according to the guidance in NEI 99-01.

As discussed in Section 2, regardless of whether NRC decides on Alternative 1 or Alternative 2, licensees may propose use of the NEI 99-01 methodology. If a licensee

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[5]The most significant changes made to clarify the NUMARC/NESP-007 guidance were in the following areas: (1) effluent monitor EALs, (2) logic for classifying a Site Area Emergency using the fission product barrier table, (3) addition of EALs related to internal flooding and inadvertent criticality.

uses the NEI 99-01 methodology to develop a comprehensive set of EALs, those EALs could only be incorporated into the licensee's emergency plan if offsite emergency response authorities agree to them and NRC approves them. NRC's approval of site-specific EALs is not dependent upon adoption of Alternative 2.

Therefore, it cannot be said with certainty that adoption of Alternative 2 will have any consequences. However, for the purposes of exploring further in this regulatory analysis the potential consequences of endorsing the NEI methodology, it will be assumed that one or more licensees would switch from a set of EALs based purely on the NUREG-0654 methodology to a set of EALs based on the NEI 99-01 methodology as a result of a decision in favor of Alternative 2. The potential consequences involved with a licensee switching from a set of EALs based upon the NUREG-0654 methodology to a set of EALs based on the NUMARC/NESP-007 methodology was evaluated as part of the Regulatory Analysis associated with the NRC endorsing NUMARC/NESP-007 in Revision 3 of Regulatory Guide 1.101 ("1992 Regulatory Analysis"). An update of this assessment is contained in Appendix A. This update reflects the changes made to NUMARC/NESP-007 and updates costs to the year 2000 values.

The consequences of licensees changing from NUMARC/NESP-007 to NEI 99-01 will be small in comparison to that for licensees changing from NUREG-0654 to NEI 99-01 since fewer EALs will need to be changed and NEI 99-01 is in a similar format as the NUMARC/NESP-007 guidance. In addition, the consequences for licensees who maintain an EAL scheme based upon NUREG-0654 but add EALs for the shutdown and refueling modes of plant operations should be similar to that for licensees who switch from NUMARC/NESP-007 to NEI 99-01. However, some extra cost may be incurred to ensure proper integration of the new guidance into licensees' existing EAL schemes because of differences in format.

The second effect of the NRC endorsing NEI 99-01 (i.e., expediting review of site-specific EAL changes) is discussed in Appendix B.

As described in Section 1, the purpose of declaring an ECL is to initiate an emergency response. The goal of ECLs is to have the appropriate level of emergency response activated based upon the current degradation of the level of safety of the plant, the prognosis for further degradation of the level of safety of the plant, and the potential for the release of radioactive materials which may warrant the implementation of public protective actions. The 1992 Regulatory Analysis evaluated the changes to NUREG-0654 ICs made in NUMARC. A similar evaluation of NEI 99-01 ICs and EALs is provided in Appendix C.

APPENDIX A

CONSEQUENCE ANALYSIS

The following consequence analysis is an update of the 1992 Regulatory Analysis 4) associated with the NRC endorsing NUMARC/NESP-007 in Revision 3 of Regulatory Guide 1.101. Because the consequence of changing from an EAL scheme based upon the NUREG-0654 to one based upon NEI 99-01 is about the same in nature and magnitude, this consequence analysis is a reproduction of that provided in Section 4 of the 1992 Regulatory Analysis with minor changes made to reflect year 2000 dollars and the slightly larger effort associated with licensees' changing from NUREG-0654 to NEI 99-01 (compared to licensees changing from NUREG-0654 to NUMARC). Note: the consequences of licensees changing from NUMARC/NESP-007 to NEI 99-01 will be small in comparison to that for licensees changing from NUREG-0654 to NEI 99-01 since fewer EALs will need to be changed and NEI 99-01 is in a similar format as the NUMARC/NESP-007 guidance.

CONSEQUENCES (Adapted from Section 4 of Regulatory Analysis associated with Revision 3 of Regulatory Guide 1.101)

As was discussed in Section 3 of this Regulatory Analysis, regardless of whether NRC decides on Alternative 1 or Alternative 2, licensees may propose use of the NEI 99-01 methodology. If a licensee uses the NEI 99-01 methodology to develop a comprehensive set of EALs, those EALs would be effective only if offsite emergency response authorities agree to them and NRC approves them. NRC's approval of site-specific EALs is not linked to adoption of Alternative 2. Therefore, it cannot be said with certainty that adoption of Alternative 2 will have any consequences (even if a licensee uses the NEI methodology, one cannot be certain it was attributable to NRC's decision to find the NEI 99-01 methodology to be an acceptable alternative to the NUREG-0654 methodology).

The purpose of an EAL is to trigger the declaration of an emergency classification level (ECL), which, in turn, triggers a certain level of emergency response. Appendix 1 to NUREG-0654 identifies the onsite and offsite activities initiated by or ongoing at each ECL. These licensee actions are directed toward providing information to offsite emergency response authorities and federal agencies (e.g., plant conditions, meteorological conditions, radiological field monitoring results). Licensees' actions to respond directly to the onsite situation are governed by emergency operating procedures (EOPs). In the NEI 99-01methodology, EALs are defined to be consistent with EOPs, but EOPs are not affected by EALs. The course of the accident, and the existence of plant damage and offsite releases may depend on the quality of EOPs and how well they are implemented, but not on EALs. Therefore, several of the attributes as defined in the NUREG/BR-0184, "Regulatory Analysis Technical Evaluation Handbook," ("Handbook") related to how the regulatory action affects accident

frequency and accident severity, are not relevant. The relevant attributes are: occupational exposure (both routine and accidental), offsite property, onsite property, regulatory efficiency, improvements to knowledge, and NRC development.

It is not feasible to assess quantitatively the consequences of a licensee switching a pure NUREG-0654 system of EALs to a pure NEI 99-01 system of EALs, with only generic information. Consider a scenario in which an accident escalates through the four classification levels under both EAL methodologies and culminates in a release, and an evacuation. The only effect of the EAL methodology on the offsite emergency response would be when the ECLs are declared. As the scope of the emergency response is dependent on the ECL, the cost of the emergency response is dependent on the length of time each ECL is in effect. The public health effects (dose received during evacuation) would depend upon when the evacuation begins relative to when the release begins and the speed of the evacuation. Both of these factors depend on the offsite response organization's preparedness, which is affected by when ECLs are declared. To quantitatively assess consequences, it would be necessary to estimate the public health and offsite property costs under the NUREG system and the NEI 99-01 system of EALs for each possible accident scenario, weight these consequences by the probability of the scenario and then add the scenarios. The scenarios would have to be extremely detailed and specify the times when indicator readings that exceed EAL thresholds would occur. Clearly, this is not feasible.

Instead, in Section 1 of this Appendix, the consequences of NRC choosing Alternative 2 or a licensee adopting a set of EALs based on the NEI 99-01 methodology are discussed qualitatively in terms of how consequence attributes could be affected. Also, some rough cost estimates are made.

1. How Consequence Attributes Could Be Affected

1.1 Public Health

Public health could be affected by exposure to offsite releases of radioactive material from an accident at a licensed nuclear power plant. The exposure can be mitigated by sheltering-in-place or evacuating before the plume passes. Exposure from the ingestion pathway comes from drinking contaminated water, eating contaminated fruits and vegetables, eating dairy products or meat from cattle that have eaten contaminated vegetation, or eating contaminated aquatic foods. Exposure from the plume is contemporaneous with the release; exposure from the ingestion pathway occurs weeks after the release. The EAL system used would be expected to affect the timing of declaration of ECLs by minutes, or at the most a few hours. Because of the expanded ingestion pathway time scale, exposure from the ingestion pathway, and its mitigation, are only weakly affected, if at all, by the exact time that ECLs are declared. Therefore, it is assumed that the EAL system does not affect exposure from the ingestion pathway.

The effectiveness of evacuation in minimizing exposure to the airborne plume depends

on when it begins relative to a significant release and the speed of the evacuation. For example, NUREG-1150 (Dec. 1990), *Severe Accident Risks: An* Assessment *for Five U.S. Nuclear Power Plants,* considers the offsite consequences of such accidents. Table 13-5 of NUREG-1150 contains estimates of the probability of exceeding 200-rem red marrow dose (a dose likely to result in an early fatality) for early containment failure at the Zion nuclear plant (a typical large pressurized water reactor design). The table shows that this probability is strongly dependent upon when the evacuation begins relative to the release for residents within 5 miles of the plant. For this particular site, it was estimated that if the evacuation begins an hour before the release, evacuation is more effective (lower probability of 200-rem red bone marrow dose) than either sheltering in basements or in large buildings; however, if evacuation were to begin at the release or 1 hour after the release began, evacuation would be only slightly more effective than sheltering in basements and would be less effective than sheltering in large buildings.

Chapter 11 of NUREG-1150 considers the sensitivity of early fatality complementary cumulative distribution function (CCDF) to emergency response for early containment failure accidents. Table 11.6 gives estimates of early fatalities for four different emergency responses as a function of the exceedance frequency of the CCDF. For Zion, for an exceedance frequency of 10^{-7}/reactor-yr, the difference between the number of early fatalities for sheltering and a timely evacuation is 500 persons. For an exceedance frequency of 10^{-8} per reactor-yr, the difference between the number of early fatalities for sheltering and a timely evacuation is 3,000 persons. These estimates indicate that if evacuation is the most effective protective action in protecting public health and safety, and if sheltering is implemented instead, there could be significant numbers of extra early fatalities for incredibly rare, high-consequence accidents.

Note: Event classification also activates the onsite response organization to an extent appropriate for the emergency classification. This typically involves activation of the onsite support center (at an Alert or higher), technical support center (at an Alert ECL or higher) and emergency operations facility (at a Site Area Emergency or higher). These facilities support the control room in mitigating the event, implementing onsite protective actions for emergency workers, and communicating with offsite officials. The benefits and costs of these organizations were not considered in this regulatory analysis, but are considered to be small in comparison to that attributable to the offsite emergency response.

<u>Effect of Declaration of the General Emergency ECL Being Overdue</u>
Appendix 1 of NUREG-0654 notes that the General Emergency ECL is declared when there is actual or imminent substantial core degradation or melting with potential for loss of containment, and releases can reasonably be expected to exceed protective action guides (PAGs) developed by the U.S. Environmental Protection Agency (EPA) for mitigation of exposure of the public to the plume (see EPA/400-R-92-001(1992), *Manual of Protective Action for Nuclear Incidents).* NUREG-0654 notes that the immediate action for this class is sheltering-in-place (within 2 miles of the plant in all

directions and within 5 miles of the plant downwind) until an assessment can be made that (1) an evacuation is indicated and (2) an evacuation, if indicated, can be completed prior to significant release and transport of radioactive material to the affected areas[1].

If the declaration of the General Emergency EAL is overdue, the public health could be compromised in several ways. The sheltering-in-place may be late so it cannot be completed before some members are exposed to the passing radioactive plume. Emergency workers should be dispatched to duty stations to ensure that a prompt and orderly evacuation can be accomplished and that relocation centers are staffed to receive evacuees. If the declaration of the General Emergency EAL is overdue, the ability to affect an orderly evacuation when evacuation is indicated could be impaired. As a consequence, the less efficacious sheltering-in-place protective action could be decided upon; or if evacuation is decided upon, its start could be delayed and dose to evacuees could increase.

Effect of Declaration of Lower Level ECLs Being Overdue

The purpose of each ECL is for the offsite emergency organization to take actions appropriate to the risk of a significant release. If declaration of a higher ECL is overdue in a rapidly developing accident, the offsite emergency response organization may not be prepared to carry out the actions required by the higher ECL. For example, during the Site Area Emergency ECL, emergency workers should be on stand-by status so that they can be dispatched in the event that the situation worsens. These emergency workers include law enforcement officers who would set up traffic control points on evacuation routes; highway department personnel who would use heavy duty vehicles to remove traffic impediments on evacuation routes; and bus drivers who would be dispatched to staging areas preliminary to the evacuation of school children and transit-dependent persons. Also, at the Site Area Emergency ECL, radiological field monitoring teams are deployed so that they will be in place and able to map the plume if a significant release occurs.

In a rapidly developing accident, an overdue declaration of Site Area Emergency ECL could hinder an emergency response organization's preparedness to implement protective actions. The time at which the offsite organizations would be ready to manage an evacuation could be affected and the evacuation could be slower, especially if the deployment of vehicles to remove traffic impediments is delayed. Again, the decision whether to evacuate or to shelter-in-place could be affected by an overdue declaration of Site Area Emergency ECL.

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[1]The NRC guidance for developing protective action recommendations was updated in Supplement 3 of NUREG-0654 "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plant, Criteria for Protective Action Recommendations for Severe Accidents," July 1996. This document states that evacuation of a 2-mile radius and 5 miles downwind it the preferred protective action unless conditions make evacuation dangerous.

1.2 Offsite Costs

The scope of the offsite emergency response, and therefore its cost, depends on the current ECL. The total cost of each offsite emergency response organization depends on the length of time each ECL is in effect. As the specific system for developing EALs affects when ECLs are declared, it would affect the duration that each ECL is in effect and therefore the costs of offsite emergency response. Because the set of EALs developed by a licensee and agreed to by offsite emergency response authorities must be approved by NRC, it is unlikely that an ECL above a Notification of Unusual Event or Alert ECL would be declared under one system and not under one of the another. It is far more likely that the timing of the declaration would be affected by whether EALs based on the NUREG-0654 methodology or on the NEI 99-01 methodology are used.

Appendix 1 of NUREG-0654 gives the offsite emergency response actions associated with each ECL. A qualitative discussion of these actions for each EAL is given below.

Notification of Unusual Event

For the Notification of Unusual Event ECL to be declared, events are in process or have occurred which indicate a potential degradation of the level of safety of the plant. Releases of radioactive material requiring offsite response are not expected unless there is further degradation of safety systems. Usually, a few key persons in State and county response organizations are notified of the event by the licensee. No action is required of the offsite emergency response organization other than providing fire and security assistance to the licensee, if requested. There is very little, if any, expense to offsite authorities in responding to this ECL.

Alert

For an Alert ECL to be declared, an event should be in process or have occurred that involves an actual or potential substantial degradation of the plant. Releases of radioactive material are expected to be limited to small fractions of the EPA PAGs. Each offsite jurisdiction with emergency response responsibilities (e.g, States, Tribal Nations, counties, and municipalities) would set up or activate an emergency operations center (EOC) and at the Alert ECL would notify key members of the staff of the EOC to report. Other EOC staff would be put on standby notice and field emergency workers would be alerted of the incident. Activation of a joint news center where public information officer from the licensee and offsite emergency response authorities would compose messages to be broadcast on the emergency alert system (EAS), and news releases could begin. Also, media briefing would take place at the joint media center. Confirmatory radiological field monitoring may be required if there is an actual release.

Depending on the number of jurisdictions involved, as many as 100 persons, mainly at State and county EOCs, could be working on the emergency response and many other emergency workers could have been notified of the incident. If it is assumed that the cost of the workers is $50/hour, then cost of the actions for the Alert ECL could be as high as $5,000/hr.

Site Area Emergency

For a Site Area Emergency ECL to be declared, events should be in progress or have occurred that involve actual or likely major failures of plant functions needed for protection of the public. Any releases are not expected to exceed EPA PAGs. After this ECL is declared, State and local EOCs and the joint news center should be fully staffed. Emergency workers who would be needed for an evacuation would be alerted to a standby status. Any of these emergency workers who work some distance from the plume exposure emergency planning zone EPZ (e.g., state police officers) would be dispatched to near-site duty stations. Activation of facilities for radiological monitoring and decontamination of evacuees and their vehicles (reception centers) and activation of facilities for congregate care of evacuees after they leave reception centers could begin. Because of special concern for the safety of children, there may be a precautionary evacuation of schools during the Site Area Emergency ECL. Also, evacuating schools early could free up school buses to evacuate the transit-dependent general population, if an evacuation of the general population is recommended if the accident worsens.

As emergency workers needed for an evacuation start to become involved at the Site Area Emergency ECL, the effort required for offsite actions would depend primarily on the number of persons who might be evacuated as well as on the number of jurisdictions involved. There could be 2-3 times as many emergency workers involved as during the Alert ECL, or up to 200-300 persons (the effort required for offsite actions would depend primarily on the number of persons who might be evacuated as well as on the number of jurisdictions involved). At a cost of $50/hour, the cost of offsite emergency response organizations responding to a Site Area Emergency could be as high as $15,000/hr.

General Emergency

For a General Emergency ECL to be declared, events are in progress or have occurred which involve actual or imminent substantial core degradation or melting with potential for loss of containment integrity. Releases can be reasonably expected to exceed EPA Protection Action Guideline exposure levels offsite for beyond the immediate site area. After the General Emergency EAL is declared, emergency workers needed for evacuation should be at their duty stations. These include: traffic control points, radiological field monitoring points, reception centers, congregate care centers, emergency worker decontamination centers, and staging areas for general population evacuation buses and emergency vehicles to keep evacuation routes clear (e.g., tow trucks and snow plows).

The cost of preparedness at the General Emergency ECL for an evacuation could be substantial, especially for a jurisdiction with a high population. The reception centers should have the capability to monitor 20% of the population of the EPZ for radiological contamination within 12 hours of arrival. Emergency workers to monitor and decontaminate vehicles, to decontaminate evacuees, to record monitoring readings, to register evacuees, and to direct vehicular traffic are also needed at reception centers.

After declaration of a General Emergency ECL at a high population site, several thousand emergency workers could be involved. At many sites, at least a thousand emergency workers would be involved. If 1,000 workers are involved at $50/hr per worker, then the cost of responding to a General Emergency could be as high as $50,000 per hour.

Agreement with Modified EALs

Section IV.B of Appendix E to 10 CFR Part 50 provides that the licensee and State and local authorities shall agree to EALs, and that the EALs shall be reviewed annually with State and local authorities. Adoption of a set of EALs based on the NEI 99-01 methodology would require review and agreement by the offsite authorities. Although these EALs could be proposed and reviewed in the context of the annual review, the review effort would be magnified when a completely new set of EALs are under consideration. Offsite emergency response authorities have health physics expertise that is used in accident assessment (i.e., assessing doses from release, meteorological, and other information). However, offsite authorities may not have staff with expertise in nuclear power plant safety, and may have to rely on consultants to review and give advice on a proposed set of EALs. A comprehensive review may require 2 to 4 weeks of consultant effort. If the cost of an expert consultant in nuclear safety is $150/hr, then agreeing to a set of EALs based on the NEI 99-01 methodology may cost offsite authorities $12,000 to $24,000.

1.3 Industry Implementation

Implementation of a set of EALs based on the NEI 99-01 methodology by a licensee would involve: (1) developing a comprehensive set of site-specific EALs from the generic guidance in NEI 99-01; (2) getting offsite emergency response authorities to agree to them and NRC to approve them; and (3) retraining reactor plant staff. The cost of developing a comprehensive set of EALs can be considered to be akin to developing a complex and lengthy operating procedure. Abstract 2.2.2 of the 1988 update to NUREG/CR-4627, *Generic Cost Estimates,* considers the costs to industry to write or rewrite procedures. It estimates that the cost of revision of 10 pages of an operating procedure that requires considerable research and some innovative analysis ranges on the average from $3,100 to $4,100. Developing a set of ECLs could be considered an activity requiring considerable research and some innovative analysis. However, the effort involved would be far greater than involved in revising 10 pages. In NEI 99-01, about 100 pages are required to describe generic EAL guidance for operating reactors. This guidance includes statements of initiating events, example EALs indicating the need for site-specific indicator readings, and comments discussing the basis of the EALs. Adopting the NEI 99-01 methodology would involve transforming the generic guidance into site-specific EALs and comments. It is estimated that the length of a document describing the site-specific set of EALs would be twice the length of the description of the generic guidance, or about 190 pages. The cost of developing an EAL document 200 pages in length is assumed to cost 20 times the cost of writing or rewriting 10 pages of text for a complex change in operating procedures, or $62,000 to

$82,000. However, the costs in Abstract 2.2.2 are based on 1986 salaries. Escalating these salaries to 2000 at 5%/yr would increase the cost by 98% to $120,000 to $160,000.

A second cost to the licensee in adopting a comprehensive set of EALs is the expense in getting offsite emergency response authorities to agree to them and NRC to approve them. Public Law 101-508, *The Omnibus Budget Reconciliation Act of 1990,* requires that the NRC to recover 100% of its Budget authority (less the amount appropriated from the DOE administered Nuclear Waste Fund) by assessing license, inspection, and annual fees (NRC's statement of consideration for its final rule implementing that Act is found at 56 FR 31472). Review and approval of EALs for a nuclear plant is an activity that is directly attributable to the nuclear plant and therefore is the type of approval for which the licensee would be expected to be billed for the full cost under 10 CFR 170.12(e). The fee for NRC's review and approval (for FY 1999) is based on the professional staff-hr rate of $124/hr. We estimate that 2-4 weeks of professional staff effort are required for NRC's review and approval of the EALs. There is also the cost of the licensee's staff effort involved in getting agreement to the EALs from offsite authorities and approval from NRC. It is estimated that this requires 2-4 weeks of effort of reactor engineers. In ONRL/Th-10071/RI, *Cost Estimate Guidelines for Advanced Nuclear Power Technologies,* the annual salary for a reactor engineer is estimated to be $51,000 in 1987. Adding 70% for fringe benefits and 5%/yr for salary increases, the cost of a reactor engineer-year of effort in 2000 would be $160,000. If a year of the effort is 48 weeks, then the cost of supervising the agreement and approval process would be $6,800 to $13,600, in 2000. The costs associated with retraining offsite authorities would be absorbed in the annual EAL training program that is already required by Appendix C for State and local authorities.

A third cost in implementing a set of EALs based on the NEI 99-01 methodology is that of retraining affected plant staff on the use of the new EALs. Assuming that the training about EALs is incorporated into a periodic retraining program. The cost of training would be the cost providing the training plus the cost of the trainees attending the training. It will be assumed that because EALs are associated with indicator readings that the means of instruction is an in-house simulator. For this means of instruction, Abstract 2.2.3 *of Generic Cost Estimates,* estimated the costs per student in 1986 to be in the range of $29 to $37 per hour. Assuming 5% escalation in costs per year, the price range in 2000 would be $57 to $73 per student-hr. Assuming that there are 50 trainees (5 supervisors and 45 operators) then there would be 400 student-hrs, and the cost of training would range between $23,000 and $29,000. Attending the incremental training would involve 1 week of supervisor effort and 9 weeks of operator effort. *Cost Estimates Guidelines for Advanced Nuclear Power Technologies* estimates that in 1987 operations supervisors were paid $51,000 and shift operators $43,000. Adding 70% of fringe benefits and 5%/yr for increase in salary, the annual costs in 2000 for operations supervisors and shift operators would be $160,000 and $136,000, respectively. If a working year is assumed to be 48 weeks, then the cost of plant personnel attending the incremental training would be $160,000/48 for supervisors and $136,000 x 9/48 for shift

operators, or $17,800. The total training costs would then be between $50,800 and $56,800.

1.4 Industry Operations

As was discussed earlier, most onsite activities during an accident are directed toward bringing the situation under control and minimizing plant damage. These activities are governed by emergency operating procedures. Onsite activities that may be affected by EALs are described as Licensee Actions in Appendix 1 of NUREG-0654. Just as the extent of offsite authority actions (see Section 1.2) are dependent on ECL, so is the extent of licensee actions. Therefore, the cost of industry operations could be affected by the duration that each EAL is in effect. A qualitative discussion of licensee actions at each ECL and rough estimates of the licensee's hourly costs are given below. It should be remembered that differences in the duration of ECLs resulting from the use of EALs based on one methodology rather than the other would probably be measured in minutes, not hours.

Notification of Unusual Event

The only action required of the licensee is to promptly inform offsite emergency response authorities of the nature of the unusual conditions (A similar notification is required for each ECL). This action has negligible cost.

Alert

Besides notifying offsite authorities of the declaration of the Alert ECL the licensee should provide periodic plant status updates and meteorological assessments. Onsite radiological monitoring teams should be deployed to help determine if there is a release. If any releases are occurring, offsite authorities should be provided with dose estimates. These actions require activation of radiological monitoring teams and a dose assessment capability. It is assumed that the radiological monitoring team members are 4 health physicists and that the dose assessment is done by 4 reactor engineers. From Abstract 2.1.6 of *Generic Costs Estimates,* the cost of utility health physicists including fringe benefits was $35/hr in 1984. Assuming this cost escalates by 5% per year, the cost in 2000 would be $76/hr. The annual cost of a reactor engineer in 2000 was estimated earlier to be $160,000. Assuming a working year is 48 weeks, or 1,920 hours, the cost per hour for a reactor engineer would be $83. The cost to the licensee for its actions would, at a minimum, be that of 4 health physicists and 4 reactor engineers, or approximately $636/hr.

Site Area Emergency

During the Site Area Emergency ECL, the licensee would, at a minimum, take the following additional actions: dispatch offsite radiological monitoring teams; dedicate an individual for plant status updates to offsite authorities; have staff at the joint news center; provide release and dose projections based on available plant condition information and foreseeable contingencies; and make senior technical and management staff available for consultant with NRC and offsite authorities. Lets

assume that 4 health physicists are dispatched to do radiological monitoring offsite, that 2 public relations specialists and a reactor engineer are dispatched to the joint news center, that 2 reactor engineers are added to the dose assessment capability; that the equivalent of a full-time senior technical or management person is dedicated for consultation; that an operations supervisor (or reactor engineer) is dedicated to giving plant updates that 4 administrative services persons become involved; and that 4 communications specialists are dedicated to maintaining communications with offsite authorities and monitoring teams. Therefore, during the Site Area Emergency, licensee personnel involved with the offsite response would minimally be: 8 health physicists ($76/hr each), 8 reactor engineers ($83/hr), 4 administrative services persons; and 4 communications technicians, 2 public relations specialist, and a senior technical or management person. The hourly costs in 2000 of these positions are estimated from the information *in Cost Estimates Guidelines for Advanced Nuclear Power Technologies* on annual salaries in 1987, and the assumptions of fringe benefits of 70% of base salary, salary escalations of 5% per year, and 1,920 working hours in a year. The 1987 annual salaries and 2000 hourly costs for the positions not previously considered are public relations specialists ($44,000/yr, $73/hr); and technicians ($36,000/yr, $60/hr). The cost of the licensee's personnel devoted to actions related to the Site Area Emergency ECL would then be;

$$8x(\$76 + \$83) + 4x(\$73 + \$60) + 2 \times \$65/hr + \$116/hr = \$2050/hr$$

General Emergency

The licensee actions indicated in Appendix 1 of NUREG-0654 for the General Emergency ECL are the same as for the Site Area Emergency ECL. However, one would expect some intensification of the effort (e.g., more senior utility officers becoming involved). We will assume that the licensee effort is augmented by 2 senior persons, to bring the cost to about $2,382/hr.

1.5 NRC Costs

Costs to the NRC from adoption of Alternative 2 would be two types: (1) the costs to notify licensees, and possible offsite authorities of its action; and (2) the cost of reviewing and approving the set of EALs developed by a licensee. The draft of Revision 3 to Regulatory Guide 1.101 is 4 pages in length. Acceptance of Revision 3 (Alternative 3) would reasonably involve cost involved in issuing a public notice and mailing a copy of Revision 3 to each licensee and State emergency response authority. Assuming that 200 copies are mailed, then the cost of notifying licensees and offsite authorities is estimated as $200.

If a licensee decides to adopt a set of EALs based on the NEI 99-01 methodology and that decision is attributable to NRC's adoption of Revision 3 of Regulatory Guide 1.101, then the cost of NRC's review and acceptable of the set of EALs is relevant. This process was estimated to involve 80 to 160 hours of professional staff effort at a cost of $124/professional staff-hr (for a total cost of $9900 to $19800). However, as acceptance of a set of EALs appears to be a type of acceptance for which NRC can

charge a fee to the licensee that covers its full costs under 10 CFR 170.12(e), this cost was discussed under the industry implementation attribute in Section 1.3.

1.6 Summary of Consequences

There are two classes of cost-related consequences associated with adoption of a set of EALs. One class contains those costs incurred to adopt the NEI 99-01 guideline. Estimates of the dollar amounts for this class are: cost to a licensee to develop EALs ($120,000 to $160,000); cost to licensee for NRC review and approval ($9,900 to $19,800); cost to a licensee to train plant personnel on new EALs ($50,800 to $56,800); and cost to offsite emergency response authorities to review proposed EALs ($12,000 to $24,000). The total costs of a licensee adopting a new set of EALs is then estimated to be between $193,000 to $261,000.

The second class of costs is that associated with the actions required by offsite emergency response authorities and the licensee for each EAL. These costs are contingent on there being an accident and depend on the length of time each EAL is in effect. They are also strongly site dependent as they depend on the size of the population within the plume exposure EPZ and the number of offsite emergency response organizations. Some rough estimates of the cost per hour to the offsite authorities and the licensee have been made. For both the offsite authorities and the licensee, the cost of responding to the Notification of Unusual Event EAL is negligible. The cost of responding to an Alert ECL was estimated to be as high as $5,000/hr for offsite authorities and about $600/hr for a licensee. The cost of responding to a Site Area Emergency ECL was estimated to be as high as $15,000/hr for offsite authorities and about $2,100 for a licensee. Finally, the cost of responding to a General Emergency ECL was estimated to be about $50,000/hr for offsite authorities and about $2,400 for a licensee. It should be remembered that these costs are not consequences of adopting EALs based on the NEI 99-01 methodology. Consequences are associated with differences in the duration of ECLs under the two methodologies. For example, if for a given accident scenario, the only difference in the timing of the declaration of ECLs, is that the Site Area Emergency is declared 20 minutes sooner under the NEI 99-01 system, then the consequences would be $5,400 weighted by the probability of the scenario. Finally, the choice of EAL system potentially can have public health consequences if there is a significant radiological release that extends beyond the site boundary. There would be public health consequences if an evacuation is delayed or is slower as a result of offsite emergency response having reduced preparedness because the declaration of the ECLs was overdue.

Implementation of the NEI 99-01 guidance by licensees is strictly on a voluntary basis, therefore, the information provided above is available for licensee consideration.

APPENDIX B

IMPACT OF ENDORSING NEI 99-01 RELATED TO EXPEDITING NRC REVIEW OF SITE-SPECIFIC EAL SCHEMES

This appendix discusses the impact of the NRC endorsing NEI 99-01 as it relates to expediting NRC review of site-specific EAL schemes. As discussed in Section 2 of this Regulatory Analysis, licensees may propose use of the NEI 99-01 methodology whether or not NRC decides to formally endorse it in a Regulatory Guide. However, endorsing NEI 99-01 will expedite NRC review of the EAL changes by allowing the NRC to focus its review on those EALs which deviate from the guidance. The majority of the revised EALs will simply be checked to ensure the guidance was properly adopted. This will result in resource savings to the NRC which in turn (since the NRC effort is fee recoverable) will result in cost savings to licensees.

If the NRC does not endorse NEI 99-01, then the NRC would evaluate each EAL against existing guidance or, if applicable guidance is not available, based upon the capability of the EAL to classify the event at the correct classification level and the manner in which the EAL is integrated with other EALs in the scheme. Existing guidance for developing EALs is contained in NUREG-0654 and NUMARC/NESP-007.

To estimate the resource savings associated with NRC adopting NEI-99-01, it is assumed that a licensee makes an EAL scheme revision from one based on NUREG-0654 to one based on NEI 99-01.

The NRC experience with review of EAL schemes modified from a NUREG-0654 based EAL scheme to a NUMARC/NESP-007 based EAL scheme has been that it takes approximately 200 staff-hours to complete the review. Typically the NRC review involves issuing a “Request for Additional Information” to support deviations from the guidance, holding one or more telephone conversations with the licensee to resolve issues, and issuing a safety evaluation which primarily provides the rationale for the NRC accepting deviations from the NUMARC/NESP-007 guidance.

Most of the NEI 99-01 EALs are the same as the NUMARC/NESP-007 EALs, so no resource savings will be associated with the review of these EALs (since NUMARC/NESP-007 has already been endorsed by the NRC). However, NEI 99-01 revised guidance for those EALs which had required the most resources to develop and review site-specific EALs (because the guidance was not clear or was difficult to implement on a site-specific basis). In addition, NEI 99-01 provided new guidance for EALs applicable in the shutdown and refueling modes of plant operation, dry cask storage, and permanently shutdown reactors. The resource savings related to the development and review of site-specific EALs developed in accordance with the revised guidance is discussed in the next paragraph. This is followed by a discussion of the

resource savings associated with development of site-specific EALs developed in accordance with the new guidance for EALs applicable in the shutdown and refueling modes of plant operation, dry cask storage, and permanently shutdown reactors.

About 1/3 of NUMARC/NESP-007 EALs were modified in NEI 99-01 to clarify the EALs and make site-specific implementation of the guidance easier. It is estimate that, prior to development of NEI 99-01, the review of each one of these EALs on average took about 10 times as much effort as the review of one of the NUMARC/NESP-007 EALs which were not revised in NEI 99-01. If each one of these EALs are now considered to take the same effort to review as one of the NUMARC/NESP-007 EALs which were not revised in NEI 99-01, then the total review effort is reduced by a factor of four with the adoption of the NEI 99-01 guidance. Therefore, the resource savings to the NRC is estimated as 150 staff-hours.

The cost of reviewing the new EAL guidance is evaluated separate from the cost associated with the revised NUMARC/NESP-007 EALs because there is no existing guidance upon which to support the NRC review. Therefore, the NRC reviewer would need to evaluate the adequacy of each site-specific EAL based upon whether the EAL classifies the event at the correct classification level, is logically integrated with other EALs in the EAL scheme and the resulting EAL scheme is complete (i.e., classifies all potential emergency conditions.) The new guidance for developing EALs applicable in the shutdown and refueling modes of operation is more extensive than guidance related to dry cask storage and permanently shutdown reactors. Therefore resource savings for developing these EALs will bound that for developing the dry cask storage and permanently shutdown reactor EALs and only these savings are discussed in this Appendix (in addition, the shutdown and refueling EALs are applicable to a larger number of reactors).

The experience gained from NRC evaluation of the NEI 99-01 guidance for EALs applicable in the shutdown and refueling modes of plant operation indicates that it is difficult to develop this type of EAL due to the number of potential plant configurations and decay heat loads which may exist. Due to the complex nature of these EALs, it is estimated that the review effort (without endorsing NEI 99-01) would be on the order of one-half of the effort to review an entire EAL scheme revision (i.e., one-half of 200 hours or 100 hours). By endorsing NEI 99-01, the review effort is estimated to be one-fourth of that if NEI 99-01 was not endorsed (i.e., 25 hours). Therefore, the resource savings is estimated as 75 staff-hours per review. Note that this savings would be expected for either a complete EAL scheme revision (i.e., from a NUREG-0654 based to a NEI 99-01 based) or for a revision which just incorporates the new EAL guidance in NEI 99-01 for shutdown and refueling modes of plant operation.

The total resource savings is then estimated at 175 staff-hours for a complete EAL scheme revision or 75 staff hours for an EAL revision to incorporate EALs for the shutdown and refueling modes of plant operation.

APPENDIX C
EVALUATION OF SPECIFIC CHANGES MADE TO NUMARC/NESP-007 EAL GUIDANCE IN NEI 99-01

1. Introduction

This appendix evaluates specific changes to the NUMARC/NESP-007 EAL guidance made in NEI 99-01. The changes are discussed in the following order: (1) new EAL guidance provided for cold shutdown and refueling modes of plant operations, (2) new EAL guidance for permanently shutdown reactors, (3) new EAL guidance for ISFSIs and (4) refinements to NUMARC/NESP-007 EALs[1].

The three character acronym used to identify ICs in the NUMARC/NESP-007 document is referred to in this evaluation. The first character refers to the "Recognition Category," the second to the classification level, and the third the sequential ordering of ICs under a given category and classification level. Four Recognition Categories were identified in NUMARC/NESP-007:

- Abnormal Rad Levels/Radiological Effluent (acronym starts with letter A)
- Fission Product Barrier Degradation (acronym starts with letter F)
- Hazards and Other Conditions Affecting Plant Safety (acronym starts with letter H)
- System Malfunction.(acronym starts with letter S)

NEI 99-01 includes these Recognition Categories and, in addition, provides the following three new Recognition Categories:

- Cold Shutdown/Refueling System Malfunction (acronym starts with letter C)
- Permanently Defueled Station Malfunction (acronym starts with letter D)
- Events Related to ISFSIs (acronym starts with letter E)

For the purpose of this evaluation, a fourth character (number) is added to the acronym to identify a specific EAL under a given IC.

[1]These refinements were introduced in NEI 97-03. Initially, the NRC intended to endorse NEI 97-03. However, due to delays in NRC endorsing NEI 97-03 and progress made by the industry in completing NEI 99-01, the NRC determined that it was more efficient to only endorse NEI 99-01 (since the guidance in NEI 97-03 is also contained in NEI 99-01).

2. New EAL guidance for System Malfunctions which are Initiated in the Cold Shutdown and Refueling Modes of Plant Operations

2.1 Background on EAL Guidance for Cold Shutdown and Refueling Modes of Plant Operations

As discussed in Section 3 of the main text of this Regulatory Analysis, the NRC concluded, in NUREG-1449, that existing EAL guidance (NUREG-0654 and NUMARC/NESP-007) did not completely address potential conditions that warrant classification in the shutdown and refueling modes of plant operations. Licensees' EAL schemes include general "judgement EALs" and EALs based upon radiological releases that classify events in any mode of plant operation. However, EALs based upon specific system malfunctions (i.e., plant conditions) rather than "judgement" will likely result in more timely and accurate classifications. Similarly, classifying events on plant conditions, rather than on measurements of radiological releases, results in more timely classifications.

NUREG-0654 did not specify mode applicability for the ICs[2]. NUMARC/NESP-007 did provide mode applicability for ICs and EALs and identified several ICs and EALs that were only applicable in the cold shutdown and refueling modes or for which the classification level was reduced if the event occurred in the cold shutdown or refueling modes (e.g., loss of power event). However, because risk studies were ongoing, the task force developing NUMARC/NESP-007 did not complete its effort to identify shutdown and refueling ICs and EALs. NEI resumed this effort and developed a comprehensive set of "system malfunction" ICs and EALs applicable in the cold shutdown and refueling modes of operations.

The following aspects of plant shutdown and refueling modes were considered in developing the NEI 99-01 EAL guidance.

A. Variability of Initial Conditions

There will be a wide variability of initial conditions for the events due to different plant configurations that could occur during shutdown periods.

B. Redundancy and Diversity of Instruments

The redundancy and diversity of instruments typically available during power operations may be unavailable during shutdown periods.

C. Available Decay Heat

Events that occur earlier in shutdown will have higher levels of decay heat. In this condition events may progress faster.

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[2]Two Site Area Emergency ICs did limit their applicability to "not in cold shutdown."

D. Radionuclide Inventory

The decay of short-lived radionuclides decrease the magnitude of radionuclides available for release to the environment.

The EALs are designed to address system malfunctions (e.g., loss of decay heat removal) in conjunction with plant conditions related to vessel level, reactor coolant system integrity, and containment status. The IC matrix, contained on page 5-C-1, provides a good overview of these EALs and is shown in Table C1 at the end of this Appendix. NUMARC/NESP-007 ICs and EALs for internal and external hazards (e.g., tornados and sabotage) and radiological releases are applicable in all modes and were not modified in the NEI 99-01 guidance. In addition, the following system malfunction ICs were taken from NUMARC/NESP-007 without modification (except for change in acronym designation).

NUMARC Designation	NEI 99-01 Designation	IC
SU1	CU3	Loss of all Offsite Power to Essential Busses for Greater than 15 minutes
SU4	CU5	Fuel Clad Degradation
SU5	CU1	RCS Leakage
SU6	CU6	UNPLANNED Loss of all Onsite or Offsite Communications Capabilities
SU7	CU7	UNPLANNED Loss of Required DC Power for Greater than 15 Minutes
SA1	CA3	Loss of all Offsite Power and Loss of all Onsite AC Power to Essential Busses

The adequacy of these EALs is discussed in the 1992 Regulatory Analysis.

The new system malfunction ICs and EALs were reviewed to determined whether:

- The classification level (e.g., Alert, Site Area Emergency, etc) is commensurate with the degradation in plant safety as reflected in the IC and EALs

- All potential indications of the plant condition of concern were used in the EALs

- The ICs/EALs escalate/de-escalate in classification level in a logical manner

The details of this evaluation follow.

2.2 Evaluation New ICs/EALs for Cold Shutdown and Refueling Modes

2.2.1 CU2 Loss of RCS Inventory

The NEI 99-01 IC is:

Unplanned loss of RCS Inventory with Irradiated Fuel in the RPV

The NEI 99-01 EALs under this IC are:

CU1-1 UNPLANNED RCS level decrease below the RPV flange for ≥15 minutes

CU2-2 Loss of RPV inventory as indicated by unexplained {site-specific} sump and tank level increase AND RPV level cannot be monitored

This IC was included as a Notification of an Unusual Event because it may be a precursor of more serious conditions and, as a result, is considered a potential degradation of the level of safety of the plant. The EALs under this IC consider both the case when RPV inventory indication is available and when it may not be available. The IC escalates to CA2 if the loss of decay heat removal results in a significant level decrease (e.g., the point where the low-low ECCS Actuation setpoint is reached in a BWR) or if the loss of indication is prolonged. This IC, and the EALs under it, provides an effective threshold for indication of a potential degradation in the level of safety of the plant consistent with the definition of an Notification of an Unusual Event. This EAL utilizes all indications which may be available for the plant condition. Finally the EAL logically escalates upon worsening plant conditions. This guidance is appropriate for developing site-specific EALs meeting the intent of 10 CFR 50.47(b)(4) and Appendix E to 10 CFR Part 50.

2.2.2 CU4 Loss of Decay Heat Removal

The NEI 99-01 IC is:

Unplanned loss of Decay Heat Removal Capability with Irradiated Fuel in the RPV

The NEI 99-01 EALs under this IC are:

CU4-1 An UNPLANNED event results in RCS temperature exceeding the Technical Specification cold shutdown temperature limit

CU4-2 Loss of all RCS temperature and RPV level indications for > 15 minutes

This IC was included as a Notification of an Unusual Event because it may be a precursor of more serious conditions and, as a result, is considered a potential

degradation of the level of safety of the plant. The EALs under this IC consider both the case when RCS temperature indication is available and may not be available. The IC escalates to CA3 if the containment is not closed or to CA2 if the loss of decay heat removal results in a significant level decrease (e.g., the point where the low-low ECCS Actuation setpoint is reached in a BWR). This IC, and the EALs under it, provides an effective threshold for indication of a potential degradation in the level of safety of the plant consistent with the definition of an Notification of an Unusual Event. This EAL includes all indications which may be available for the plant condition. Finally the EAL logically escalates upon further degradation of the safety of the plant. Note: in NUREG-0654 and NUMARC/NESP-007 an EAL comparable to CU4-1 was provided which was to be classified at the Alert level (i.e., EAL SA3-1). Experience from actual classified events of this type indicates that the plant condition is more appropriately classified as an Notification of an Unusual Event. EALs CA4-1,2 and 3 (which are classified as an Alert) are provided in NEI 99-01 to cover situations where the loss of decay heat is prolonged, the RCS is not intact, or the containment is not closed. This guidance is appropriate for developing site-specific EALs meeting the intent of 10 CFR 50.47(b)(4) and Appendix E to 10 CFR Part 50.

2.2.3 CA1 Loss of RCS Inventory

The NEI 99-01 IC is:

Unplanned loss of RCS Inventory with Irradiated Fuel in the RPV

The NEI 99-01 EALs under this IC are:

CA1-1 Loss of RCS inventory as indicated by RPV level less than {site-specific level}
(low-low ECCS actuation setpoint) (BWR)
(bottom ID of the RCS loop) (PWR)

CA1-2 Loss of RPV inventory as indicated by unexplained {site-specific} sump and tank level increase AND RPV level cannot be monitored for > 15 minutes

This IC is only applicable in the cold shutdown mode of operation. A similar IC (CA2) is provided for the refueling mode of operation. These ICs and associated EALs could be combined in a site-specific EAL scheme developed from NEI 99-01.

The first EAL represents conditions where makeup water systems have been ineffective and may not prevent further level decrease and potential core uncovery. The second EAL represents a situation where there is an RCS leak which cannot be monitored for an extended period of time. These conditions represent a potential substantial degradation in the level of safety of the plant. The EALs under this IC consider both the case when RPV inventory indication is available and may not be available. The IC and

EALs escalate to the Site Area Emergency ECL via CS1 if level decrease continues to the point where the heat removal from the fuel is jeopardized or if level decrease continues and the containment is not closed.

These EALs represent a substantial degradation in the level of safety of the plant consistent with the definition of an Alert. The EALs include all available indications for the plant condition. The IC logically escalates upon worsening plant conditions. This guidance is appropriate for developing site-specific EALs meeting the intent of 10 CFR 50.47(b)(4) and Appendix E to 10 CFR Part 50.

2.2.4 CA2 Loss of RPV Inventory

The NEI 99-01 IC is:

Unplanned loss of RCS Inventory with Irradiated Fuel in the RPV

The NEI 99-01 EALs under this IC are:

CA2-1 Loss of RPV inventory as indicated by RPV level less than {site-specific level}.
(low-low ECCS actuation setpoint) (BWR)
(bottom ID of the RCS loop) (PWR)

CA2-2 Loss of RPV inventory as indicated by unexplained {site-specific} sump and tank level increase AND RPV level cannot be monitored for > 15 minutes

This IC is only applicable in the refueling mode of operation. A similar IC (CA1) is provided for the cold shutdown mode of operation. These ICs and associated EALs could be combined in a site specific EAL scheme developed from NEI 99-01.

The first EAL represents a condition where the makeup water system have been ineffective and may not prevent further level decrease and potential core uncovery. The second EAL represents a situation where there is an RCS leak that cannot be monitored for an extended period of time. These conditions represent a potential substantial degradation in the level of safety of the plant. The EALs under this IC consider both the case when RPV inventory indication is available and may not be available. The IC escalates to the Site Area Emergency ECL via CS2 if level decrease continues to the point where the heat removal from the fuel is jeopardized or if level decrease continues and the containment is not closed.

These EALs represent a potential substantial degradation in the level of safety of the plant consistent with the definition of an Alert. The EALs include all available indications for the plant condition. The EAL logically escalates upon worsening plant condition. This guidance is appropriate for developing site-specific EALs meeting the

intent of 10 CFR 50.47(b)(4) and Appendix E to 10 CFR Part 50.

2.2.5 CA4 Inability to Maintain Plant in Cold Shutdown with Irradiated Fuel in the RPV

The NEI 99-01 IC is:

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

The EAL under this IC is:

CA4-1 With CONTAINMENT CLOSURE and RCS integrity not established an UNPLANNED event results in RCS temperature exceeding the Technical Specification cold shutdown temperature limit

CA4-2 With CONTAINMENT CLOSURE established and RCS not established or RCS inventory reduced an UNPLANNED event results in RCS temperature exceeding the Technical Specification cold shutdown temperature limit for greater than 20 minutes

CA4-1 An UNPLANNED event results in RCS temperature exceeding the Technical Specification cold shutdown temperature limit for greater than 60 minutes or results in an RCS pressure increase of greater than {site-specific} psig.

This IC is an escalation from CU4 and represents a potential substantial degradation in the safety of the plant. The plant condition represents further degradation in safety from that indicated in CU4 due to either the extended loss of cooling or condition of the RCS or Containment. This IC escalates to the Site Area Emergency ECL via CS1 or CS2 if boiling in the RCS results in significant RPV level decrease.

This EAL represents a substantial degradation in the level of safety of the plant consistent with the definition of an Alert. The EAL includes all available indications for the plant condition. The EAL logically escalates upon worsening plant condition. This guidance is appropriate for developing site-specific EALs meeting the intent of 10 CFR 50.47(b)(4) and Appendix E to 10 CFR Part 50.

2.2.6 CS1 Loss of RPV Inventory

The NEI 99-01 IC is:

Loss of RPV Inventory Core Affecting Decay Heat Removal Capability

The NEI 99-01 EALs under this IC are:

CS1-1 With CONTAINMENT CLOSURE not established

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

OR

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

CS1-2 With CONTAINMENT CLOSURE established

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

This IC is only applicable in the cold shutdown mode of operation. A similar IC (CS2) is provided for the refueling mode of operation. These ICs and associated EALs could be combined in a site-specific EAL scheme developed from NEI 99-01.

The first EAL represents a condition where there is a significant potential for losing decay heat removal from the core in a short period of time with the containment not closed. The second EAL represents a significant potential for imminent loss of decay heat removal from the core. However, in this second EAL the containment is closed therefore providing an additional barrier to the release of radioactive material. Both of these EALs also include conditions which account for the loss of RPV indication. The IC escalates to CG1 if core uncovery is prolonged and the containment is not closed.

These EALs represent a major failure of plant functions needed to protect the public consistent with the definition of a Site Area Emergency. The EALs include all available indications for the plant condition. The EAL logically escalates upon worsening plant condition. This guidance is appropriate for developing site-specific EALs meeting the intent of 10 CFR 50.47(b)(4) and Appendix E to 10 CFR Part 50.

2.2.7 CS2 Loss of RPV Inventory

The NEI 99-01 IC is:

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

The NEI 99-01 EALs under this IC are:

CS2-1 With CONTAINMENT CLOSURE not established

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

OR

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

CS2-2 With CONTAINMENT CLOSURE established

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

This IC is only applicable in the refueling mode of operation. A similar IC (CS1) is provided for the cold shutdown mode of operation. These ICs and associated EALs could be combined in a site specific EAL scheme developed from NEI 99-01.

The first EAL represents a condition where there is a significant potential for losing decay heat removal from the core in a short period of time with the containment not closed. The second EAL represents a significant potential for imminent loss of decay heat removal from the core. However, in this second EAL the containment is closed therefore providing an additional barrier to the release of radioactive material if the decay heat removal was lost. Both of these EALs also include conditions which account for the loss of RPV level indication. The conditions used for classifying this event when there is a loss of RPV level indication are different than those used in EALs

under IC CS1 to reflect that in the decay heat load will be larger when a plant enters cold shutdown from power operation than when the plant is in the refueling mode of operation. The IC escalates to CG1 core if uncovery is prolonged and the containment is not closed.

These EALs represent a major failure of plant functions needed to protect the public consistent with the definition of a Site Area Emergency. The EALs include all available indications for the plant condition. The EAL logically escalates upon worsening plant condition. This guidance is appropriate for developing site-specific EALs meeting the intent of 10 CFR 50.47(b)(4) and Appendix E to 10 CFR Part 50.

2.2.8 CG1 Loss of RPV Inventory Affecting Fuel Clad Integrity

The NEI 99-01 IC is:

> *Loss of RPV Inventory Fuel Clad Integrity with Containment Challenged with Irradiated Fuel in the RPV*

The NEI 99-01 EAL under this IC is:

CG1-1

1. Loss of RPV inventory as indicated by unexplained {site-specific} sump and tank level increase
   AND
2. RPV level:
   a. Less than TOAF for > 30 minutes
      OR
   b. cannot be monitored with Indication of core uncovery for >30 minutes as evidenced by one or more of the following:
      - Containment High Range Radiation Monitor reading > {site-specific} setpoint
      - Erratic Source Range Monitor Indication
      - Other {site-specific} indications

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

This EAL represents a condition where there is a loss of the RCS barrier, a potential loss of the fuel clad barrier (due loss of heat removal from the fuel) and a loss or

potential loss of containment. This condition meets the definition of a General Emergency. The EALs include all indications which are available for the plant condition. This guidance is appropriate for developing site-specific EALs meeting the intent of 10 CFR 50.47(b)(4) and Appendix E to 10 CFR Part 50.

2.3 Summary

The guidance in NEI 99-01 for developing EALs for the cold shutdown and refueling modes of operation based upon system malfunctions covers the potential spectrum of malfunctions which warrant classification at each of the four classification levels. These EALs, in conjunction with EALs based upon internal and external hazards and abnormal radiation releases, provide assurance that operators will properly classify events which are initiated in the cold shutdown and refueling modes at nuclear power plants. This guidance is appropriate for developing site-specific EALs meeting the intent of 10 CFR 50.47(b)(4) and Appendix E to 10 CFR Part 50.

3. New EAL Guidance for Permanently Shutdown Reactors

NEI 99-01 provide guidance for developing EALs for permanently shutdown reactors. This guidance is contained under Section 5.0, Recognition Category D. The EALs included in Recognition Category D were taken from the EALs for operating plants (Categories A,C,F,S, and H) after screening out those which were not applicable to permanently shutdown reactors. The remaining ICs applicable to permanently shutdown reactors are shown in Table C2.

These ICs and EALs are applicable for permanently shutdown reactors which have been exempted from offsite emergency planning. The NRC exempts licensees from offsite emergency planning when it has determined that an accident causing a release of radioactive material exceeding EPA PAGs offsite is not possible. Since accidents at these sites cannot exceed the EPA PAG, there is not a need for actions to protect the public health and safety. Therefore there is no need to activate offsite emergency response facilities. Considering these circumstances limiting the classification levels to the Notification of an Unusual Event and Alert classes is appropriate. The ICs cover all postulated plant conditions warranting event classification and, as discussed previously, classify events at the appropriate classification level. Therefore, this guidance is appropriate for developing site-specific EALs meeting the intent of 10 CFR 50.47(b)(4) and Appendix E to 10 CFR Part 50.

4. New EAL Guidance for Independent Spent Fuel Storage Installations

NEI 99-01 provides guidance for developing site-specific EALs for ISFSIs located on an operating reactor site. In accordance with 10 CFR 72.32, ISFSIs must have emergency plans. 10 CFR 72.32(c) states that, for ISFSIs located on an operating reactor site, the emergency plan required by 10 CFR 50.47 satisfies the requirements for the ISFSI

Emergency plan[3].

NUREG-1140, “Regulatory Analysis on Emergency Preparedness for Fuel Cycle and Other Radioactive Material Licensees,” evaluated potential consequences from the accidental release of radioactive material from an ISFSI. The conclusion in NUREG-1140 was that the postulated worst-case accident involving an ISFSI has insignificant consequences to public health and safety.

Current NRC guidance on EALs for ISFSIs is contained in NUREG-1567, “Standard Review Plan for Spent Fuel Dry Storage Facilities (Draft Report for Comment). Additional guidance is contained in Regulatory Guide 3.67, “Standard Format and Content for Emergency Plans for Fuel Cycle and Materials Facilities.” However, these guidance documents are not specific to ISFSIs located at the site of an operating power reactors where the licensees utilizes the operating plants emergency plans. One difficulty in utilizing these guidance documents for ISFSIs located at the site of an operating reactor, results from the restriction of emergency classification in NUREG-1567 to the Alert classification. Another is that the definition of (and emergency response actions associated with) the Alert classification for an ISFSI-specific emergency plan and an operating plant emergency plan are different. Considering these differences and the analysis of potential accidents at ISFSI, NEI 99-01 developed guidance for developing the following EALs (all of which are classified at the Notification of an Unusual Event level).

IC		EAL
E-AU1	Unexpected Increase in ISFSI Radiation	Valid (site-specific) radiation reading for irradiated spent fuel in dry storage $\geq$ 2 times the ISFSI Technical Specification limits
E-HU1	Damage to a loaded cask Confinement Boundary	1. Natural phenomena events affecting a loaded cask confinement boundary 2. Accident conditions affecting a loaded cask confinement boundary 3. Any condition in the opinion of the Emergency Director that indicates loss of loaded fuel storage cask confinement boundary
E-HU2	Confirmed Security Event with potential loss of level of safety of the ISFSI	1. Security Event as determined from (site-specific) Security Plan and reported by the (site-specific) security shift supervision

[3]10 CFR 72.32(a) provides emergency plan requirements for ISFSIs not located on an operating reactor site.

These ICs and EALs reflect conditions at the ISFSI which warrant emergency response actions consistent with an Unusual Event classification level at an operating plant. These EALs include all available indications for the degradation of the level of safety of the ISFSI. This guidance is appropriate for developing site-specific EALs meeting the intent of 10 CFR 50.47(b)(4) and Appendix E to 10 CFR Part 50.

5. Refinements to NUMARC/NESP-007 EALs

NEI 99-01 included a number of refinements in the EAL guidance provided for operating reactors. These improvements were identified during the development of site-specific EALs using the NUMARC/NESP-007 guidance.

The organization of the evaluation of these changes is: (1) the existing NUMARC/NESP-007 EAL is identified, (2) corresponding NEI 99-01 EAL is identified, and (3) an evaluation of the change is provided.

The three character acronym used to identify ICs in the NUMARC/NESP-007 document was discussed in the introduction to this Appendix. In addition, for the purpose of this evaluation, a fourth character (number) is added to the acronym to identify the specific EAL under a given IC. For recognition category F a different identification scheme is needed because the EALs are listed under given barriers (e.g., reactor coolant system) instead of ICs. In addition, there are separate fission product EALs for PWRs and BWRs. The following acronym is used to identify fission product EALs.

First letter:	F for fission product barrier
Second letter:	P for PWR, B for BWR
Next three or four letters	RCS for reactor coolant system barrier, FUEL for fuel barrier, CONT for containment barrier
Number:	Number for the EAL under a given barrier

In some cases, the same basic EAL (with different thresholds) is used for classifying events at multiple classification levels (e.g, Alert and Site Area Emergency). When a change in NEI 97-03 affects multiple EALs at different classification levels, the EAL designation for the multiple EALs are shown in parentheses and only the change for the lowest level EAL is discussed.

5.1 AU1-1 (AA1-1, AS1-1, AG1-1) Clarify Use of Dose Assessment EAL

NUMARC/NESP-007 EAL

1. *A valid reading on one or more of the following monitors that exceeds the "value shown" (site specific monitors) indicates that the release may have exceeded the above criterion and indicates the need to assess the release with (site-specific procedure):*

(site-specific list)

Note: If the monitor reading(s) is sustained for longer than 60 minutes and the required assessments cannot be completed within this period, then declaration must be made based on the valid reading.

NEI 99-01 EALs (Unusual Event and Alert)

1. *VALID reading on any effluent monitor that exceeds two times the alarm setpoint established by a current radioactivity discharge permit for 60 minutes or longer*
   OR
2. *VALID reading on one or more of the following radiation monitors that exceeds the reading shown for 60 minutes or longer:*
   (site-specific list)

NEI 99-01 EALs (Site Area Emergency and General Emergency)

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

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

REGULATORY ANALYSIS OF CHANGE

It was not clear in the NUMARC/NESP-007 guidance whether the intent of the NUMARC/NESP-007 EAL was to initiate a dose assessment. Furthermore it was not clear whether the event should be classified on the radiation monitor readings if the dose assessment indicated that the release did not exceed the IC threshold.

The NEI 99-01 guidance removes this ambiguity. The basis for AU1-1 (AA1-1, AS1-1, AG1-1) in NEI 99-01 identifies that dose assessments are required to be performed for unplanned releases of radioactive material in accordance with NUREG-0654 criteria for meeting the emergency planning standard 10 CFR 50.47(b)(9) and that emergency response procedures (other than the classification procedure) should dictate the performance of a dose assessment upon recognition of an unplanned release of radioactive material.

For the Unusual Event and Alert level EALs, classification is based solely on exceeding the monitor setpoint. However, as discussed in the previous paragraph, dose assessments should be performed in accordance with plant procedures for any release exceeding the Unusual Event threshold to ensure that higher classification level EALs are not exceeded due to adverse meteorological conditions.

A new note is added to the Site Area Emergency and General Emergency EALs to specify that:

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

The intent of this note is to permit classification on dose assessment results, rather than predetermined monitor setpoints, if the dose assessment results are available within 15 minutes of exceeding monitor thresholds. The dose assessment is to use real-time meteorology. This will result in more accurate classification since the monitor setpoint(s) is determined based upon average meteorological conditions and an assumed (Final Safety Analysis Report or Operation Dose Calculation Manual based) source term which are not likely to match actual conditions if a release were to occur.

In addition, the EAL at the Unusual Event and Alert level was modified to delineate the use of two types of monitors for classifying the event. The first EAL is for a pathway monitor where alarms are set relative to discharge permit limits. The second is intended for licensees that have established effluent monitoring on non-routine release pathways where a discharge permit would not normally be prepared.

The intent of the changed EAL is consistent with the original EAL and clarifies how this EAL is to be implemented on a site-specific basis.

5.2 AS1-1 (AG1-1) -- Change Dose Units to Total Effective Dose Equivalent

NUMARC/NESP-007 EAL

> *Boundary Dose Resulting from 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 Using Actual Meteorology.*

NEI 99-01 EAL

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

REGULATORY ANALYSIS OF CHANGE

NESP-007 ICs AS1 and AG1 provide dose criteria in terms of whole body dose. NEI 99-01 provides dose criteria in terms of Total Effective Dose Equivalent (TEDE). This revision is consistent with the dose criteria provided in the EPA PAG manual

(EPA 400-R92-001). In addition, the IC was modified to revise the criteria for the thyroid dose to no longer refer to dose to a child's thyroid. Rather the dose is the thyroid committed dose equivalent (to an adult's thyroid). This is also consistent with the EPA PAG which is based upon dose to an adult's thyroid.

The intent of the changed EAL is consistent with the original EAL and updates it to be consistent with current EPA guidance.

5.3 AS1-4 (AG1-4) -- Included "closed window" in field team measurement EAL

NUMARC/NESP-007 EAL

Field survey results indicate site boundary dose rates exceeding 100 mR/hr expected to continue for more than one hour; or analyses of field survey samples indicate child thyroid dose commitment of 500 mR for one hour of inhalation.

NEI 99-01 EAL

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

REGULATORY ANALYSIS OF CHANGE
This revision was made to eliminate confusion regarding the site-specific implementation of this EAL where some licensee's proposed using a specified TEDE-rate for this EAL. This modification does not change the intent of the EAL.

5.4 AA2-2 -- Observation of Uncovered Fuel

NUMARC/NESP-007 EAL

Report of visual observation of irradiated fuel uncovered.

NEI 99-01 EAL
None.

REGULATORY ANALYSIS OF CHANGE
This EAL was deleted because visual observation of fuel uncovery would not be possible due to radiation dose levels associated with this event. This change is appropriate.

5.5 Definition of Site Area Emergency Based upon Combinations of Degraded Fission Product Barriers

NUMARC/NESP-007 EAL

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

NEI 99-01 EAL

Loss or Potential Loss of any two Fission Product Barriers

REGULATORY ANALYSIS OF CHANGE

A significant revision was made to the criterion for a Site Area Emergency used in the fission product barrier matrix. The new criterion specifies that the loss or potential loss of ANY two barriers is a Site Area Emergency. The previous criterion was found to be unnecessarily complex, and a review of the possible combinations of EALs that could result in a Site Area Emergency, indicated that the same endpoint would be reached with the revised criterion. For PWRs, this change in criterion required some restructuring of the steam generator related EALs. These changes are discussed below:

5.6 FP-RCS-L3, FP-RCS-PL3, FP-CONT-L4: Steam Generator Rupture EALs

A comparison of the NUMARC/NESP-007 and the NEI 99-01 Steam generator EALs is provided in the following table.

Barrier	NUMARC/NESP-007	NEI 99-01
RCS 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 contaminated secondary coolant is occurring from the affected SG to the environment	SGTR that results in an ECCS (SI) Actuation
RCS Potential Loss	(Site-specific) indication that a SG is ruptured and the primary-to-secondary leak rate exceeds the capacity of one charging pump in the normal charging mode.	na
Containment Loss	Release of secondary side to atmosphere with primary-to-secondary leakage GREATER THAN tech spec allowable	RUPTURED S/G is also FAULTED outside of containment or Primary-to-Secondary leakrate greater than 10 gpm with nonisolable steam release from affected S/G to the environment

REGULATORY ANALYSIS OF CHANGE

Containment Loss

NESP-007 specified that “primary-to-secondary leakage GREATER THAN tech spec allowable” was indication of a loss of containment. In NEI 99-01, the magnitude of the leak was specified as 10 gpm. The rationale for this change was that, subsequent to the development of NUMARC/NESP-007, many plants have implemented reduced steam generator technical specification limits (e.g., 150 gpd). The 150 gpd is deemed too low to be used as an emergency threshold. The 10 gpm leak rate is consistent with the value used in IC SU5 for RCS leakage. In addition, the condition “RUPTURED S/G is also FAULTED outside of containment” was added to this EAL. This condition would be encompassed by the 10 gpm leak rate condition and, therefore, is redundant to this condition. It was added by NEI because the terms “ruptured S/G” and “faulted S/G” are commonly used in emergency operating procedures and, therefore, may be used by some licensee to classify this type of event.

RCS Loss

The EALs for the Loss and Potential Loss of the RCS were modified to clarify how steam generator tube rupture events were to be classified at the Alert and Site Area Emergency levels. In NUMARC/NESP-007, conditions related to the release to atmosphere (which are more indicative of a loss of containment than loss of RCS) were included in the RCS loss EALs. These conditions have been removed in NEI 99-01. In addition, due to the change in the manner in which barriers are combined for classifying events at the Site Area Emergency level, it was no longer necessary to specify a potential loss of RCS barrier EAL for SGTR events. NEI choose to use the condition “SGTR that results in an ECCS (SI) Actuation” as indication of loss of RCS inventory instead of “loss of RCS subcooling” (as is used as an indication of the loss of RCS for other events) because loss of coolant from a pressurized steam generator will most likely result in safety injection to maintain pressurize level prior to achieving a loss of RCS subcooling.

Summary of Classification of SGTR Events

The classification of SGTR events is not significantly changed due to these modifications. The classification progression is as follows:

A primary-to-secondary leak greater than 10 gpm with a non-isolable steam release to the environment would be classified as an Unusual Event (due to the loss of the containment barrier). If the leakage rate was large enough cause enough mass to be removed to affect RCS pressure or level and actuate safety injection, then the event would be classified as an Alert (due to the loss of the RCS barrier). If this event involved a non-isolable steam release to the environment, it would be classified as a Site Area Emergency. Finally, the event would be classified as a General Emergency if, in addition to the above indications, there was indication of fuel clad damage.

The fission product barrier based EALs for classifying steam generator tube rupture

events provided in NEI 99-01 appropriately classify steam generator tube events. The changes from NUMARC/NESP-007 to NEI 99-01 are appropriate considering the change in the manner in which the Site Area Emergency is classified based upon combinations of barriers lost or potentially lost.

5.7 FB-RCS-L1 Main Steam Line Break EAL

NUMARC/NESP-007 EAL

(site-specific) Indication of Main Steamline Break

NEI 99-01 EAL (renumbered as FB-RCS-L3)

(Site-specific) Indication of an unisolable Main Steamline Break

REGULATORY ANALYSIS OF CHANGE
The term unisolable was added because an isolated main steam line break does not constitute a loss of the RCS barrier. This change is appropriate. In the June 1993 Q&A, it was determined that inclusion of an isolated main steam line break as an EAL (as a system malfunction EAL rather than a fission product barrier EAL) was appropriate because of the puff release associated with this event. The NEI Issue Task Force developing NEI 99-01 determined that the threat to the public due to the puff release will be evaluated and appropriately classified under the abnormal radiological effluent EALs because the release would be monitored.

The NEI 99-01 guidance is adequate for developing site-specific EALs for classifying main steam line break events.

5.8 FB-CONT-PL4 Change from Maximum Core Uncovery Time to Primary Containment Flooding

NUMARC/NESP-007 EAL (FB-CONT-PL4)

Reactor vessel water level LESS THAN (site-specific) value and the maximum core uncovery time limit is in the UNSAFE region

NEI 99-01 EAL (renumbered as FB-CONT-PL2)

Primary containment flooding required

REGULATORY ANALYSIS OF CHANGE
This EAL is used to classify events where there is a potential for containment failure due to severe accident phenomena associated with core melt progression. At this stage of ant event, the plant should be in an Site Area Emergency ECL, and this EAL is

intended provide a reasonable period to allow emergency operating procedures (EOPs) to arrest core melt sequence prior to declaring a General Emergency.

In NUMARC/NESP-007, the maximum core uncovery time (as used in EOPs) is utilized to specify the time available to take corrective action before core damage when there is a loss of indication and the core is assumed to be completely uncovered. During the development of site-specific EALs, licensees questioned whether this condition was the most appropriate indication of the potential loss of the containment barrier. In response to these concerns, NEI revised this EAL to specify "Primary containment flooding required," as its threshold.

The entry into the Primary Containment Flooding emergency procedure indicates reactor vessel water level cannot be restored and that a core melt sequence is in progress. EOPs direct the operators to enter Primary Containment Flooding when reactor vessel water level cannot be restored to greater than a site-specific value (generally, 2/3 core height) or is unknown. The conditions in this potential loss EAL represent imminent core melt sequences that could lead to vessel failure and increased potential for containment failure. In conjunction with reactor vessel level EALs in the Fuel and RCS barrier columns, this EAL would result in the declaration of a General Emergency due to the loss of two barriers and the potential loss of a third.

The revised EAL is an appropriate indicator for the potential loss of the containment barrier.

5.9 FB-FUEL-L1 (also FP-FUEL-L2) Basis Revision

NUMARC/NESP-007 EAL (NEI 99-01 is the same)

Coolant Activity GREATER THAN (site-specific) value

REGULATORY ANALYSIS OF CHANGE

NEI 99-01 modified the basis as follows (the text that has been added in NEI 99-01 appears in bold and the text that has been deleted is struck out):

> *This (site-specific) value corresponds to 300 µCi/gm I_{131} equivalent. Assessment by the NUMARC EAL Task Force indicates that this amount of coolant activity is well above that expected for iodine spikes and corresponds to ~~about 2% to~~* ***less than*** *5% fuel clad damage. This amount of ~~clad damage~~* ***radioactivity*** *indicates significant clad ~~heating~~* ***damage*** *and thus the Fuel Clad Barrier is considered lost.* ***The value expressed can be either in mR/hr observed on the sample or as µCi/gm results from analysis.***

This revision is a minor clarification of the basis which provides flexibility in the manner in which this guidance is applied on a site-specific basis. The changes are appropriate.

5.10 FB-FUEL-L3 Basis Revision

NUMARC/NESP-007 EAL (NEI 99-01 is the same)

Drywell Radiation Monitor reading GREATER THAN (site-specific) R/hr

REGULATORY ANALYSIS OF CHANGE

NEI 99-01 added the following (shown in bold) to the NUMARC/NESP-007 basis:

> *... The reading should be calculated assuming the instantaneous release and dispersal of the reactor coolant noble gas and iodine inventory associated with a concentration of 300 µCi/gm dose equivalent I-131* ***or the calculated concentration equivalent to the clad damage used in EAL #1*** *into the drywell atmosphere...*
>
> *Caution: it is important to recognize that in the event the radiation monitor is sensitive to shine from the reactor vessel or piping, spurious readings will be present and another indicator of fuel clad damage is necessary* ***or compensated for in the threshold value.***

This revision provides additional guidance for developing the drywell radiation monitor setpoint so that it will be based upon indication of fuel clad damage at the level consistent with other fuel clad EALs in the fission product barrier matrix. The changes are appropriate.

5.11 FB-RCS-L2 Basis Revision

NUMARC/NESP-007 EAL (NEI 99-01 is the same, renumbered as FB-RCS-L1))

Drywell Pressure greater than (site-specific) psig

REGULATORY ANALYSIS OF CHANGE
NEI 99-01 modified the basis as follows (the text that has been added appears in bold and the text that has been removed is struck out):

> *The (site-specific) Drywell pressure is based on the Drywell high pressure alarm set point ~~and~~* ***which*** *indicates a LOCA* ***by automatically initiating the ECCS or equivalent makeup system****. ~~A higher value may be used if supporting documentation is provided which indicates the chosen value is less than the pressure which would be reached for a 50 gpm Reactor Coolant System Leak.~~*

This revision provides clarification to which drywell pressure set point is to be used to implement the EAL. The revision also clarifies the basis by eliminating confusing and

unnecessary verbiage about leakage. The changes are appropriate.

5.12 FB-RCS-PL1 Basis Revision

NUMARC/NESP-007 EAL FB-RCS-PL1B (NEI 99-01 is the same, renumbered as FB-RCS-PL3B)

> *Unisolable primary system leakage outside drywell as indicated by area temperature or area radiation alarm*

REGULATORY ANALYSIS OF CHANGE
NEI 99-01 modified the basis for this EAL as follows (the text that has been added appears in bold and the text that has been removed is struck out):

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

NEI changed the basis to differentiate between the magnitude of the leak outside of containment which represents a potential loss of RCS from that which constitutes a loss of containment. This results in an Alert classification for a small leak of RCS outside of containment and a Site Area Emergency classification for a large leak of RCS outside of containment. This change results in an escalation of the classification of bypass events based upon the significance of the leak outside of containment. This change is appropriate.

5.13 FP-CONT-PL6 Basis Revision

NUMARC/NESP-007 EAL FP-CONT-PL6 (NEI 99-01 is the same, renumbered as FB-CONT-PL3)

> *Core exit thermocouples in excess of 1200 degrees and restoration procedures not effective within 15 minutes....*

REGULATORY ANALYSIS OF CHANGE
NEI 99-01 added the following (shown in bold) to the basis for this EAL:

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

This change provides additional background information which does not adversely affect the development of site-specific EALs.

5.14 HU1-2 Addition of High Wind Condition

NUMARC/NESP-007 EAL

Report by plant personnel of tornado striking within protected area boundary.

NEI 99-01 EAL

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

REGULATORY ANALYSIS OF CHANGE
The NUMARC/NESP-007 EAL was modified in NEI 99-01 to include the condition "or high winds greater than (site-specific) mph striking within PROTECTED AREA boundary."

This condition was added because high winds within the protected area may damage plant structures containing systems required for safe shutdown of the plant. This event meets the definition of an Unusual Event, i.e., “events are in process or have occurred which indicate a potential degradation of the level of safety of the plant. No releases of radioactive material requiring offsite response or monitoring are expected unless further degradation of safety systems occurs.” In addition, the NEI 99-01 EAL is an appropriate precursor to the Alert level high winds EAL (HA1-2). Therefore, the addition of this condition to this EAL is appropriate.

5.15 HU1-3 Removal of General Assessment EAL

NUMARC/NESP-007 EAL

Assessment by the control room that an event has occurred.

NEI 99-01 EAL
none

REGULATORY ANALYSIS OF CHANGE
This EAL was deleted in NEI 99-01. It was determined to be unnecessary to include this statement in this specific EAL because, for every IC and EAL, the control room staff would provide input to the Emergency Director to determine whether the event met the conditions specified in the IC or EAL.

5.16 HU1-7 Clarification of EAL to Specify Affected Areas

NUMARC/NESP-007 EAL

(Site-specific) occurrences

NEI 99-01 EAL

(Site-Specific) occurrences affecting the PROTECTED AREA.

REGULATORY ANALYSIS OF CHANGE
The EAL was modified to include the condition that the event affects the protected area. This is consistent with the IC for this EAL. This change is appropriate.

5.17 New EAL to Classify Internal Flooding Events added to IC HU1

NUMARC/NESP-007 EAL
none

NEI 99-01 EAL
The following EAL was added in IC HU1:

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

REGULATORY ANALYSIS OF CHANGE
This EAL addresses the effect of flooding caused by internal events such as component failures, equipment misalignment, or outage activity mishaps. The site-specific areas include those areas that contain systems required for safe shutdown of the plant, that are not designed to be wetted or submerged. This type of flooding event puts the plant in a condition which meets the definition of an Unusual Event. Escalation of the emergency classification is based on the damage caused or by access restrictions that prevent necessary plant operations or systems monitoring. This additional EAL is appropriate.

5.18 HU2 Basis Revision

NUMARC/NESP-007 EAL HU2-1 (NEI 99-01 is the same)

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

REGULATORY ANALYSIS OF CHANGE
The basis for this EAL was revised to clarify the meaning of fire detection and identify those actions appropriate for verification of an alarm prior to classifying the event. These changes do not change the intent of the EAL and are appropriate.

5.19 HU3 Basis Revision

NUMARC/NESP-007 EAL HU3-1 and HU3-2

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

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

REGULATORY ANALYSIS OF CHANGE
The bases for these EALs were modified to provide guidance on releases that may affect normal plant operations. In addition, the bases were modified to remove guidance on the relationship of "DOT Evacuation Tables" to "evacuation areas." The DOE Evacuation Tables were not used to evaluate classification criteria for hazardous materials and therefore removing this reference from the basis clarifies the basis and does not adversely affect the development of site-specific EALs.

5.20 HU4-1 EAL Deleted

NUMARC/NESP-007 EAL

Bomb device discovered within plant protected area and outside the plant vital area

NEI 99-01 EAL
None

REGULATORY ANALYSIS OF CHANGE
The NRC had raised questions regarding whether this EAL was more appropriately classified at the Alert level because a bomb device discovered within the plant protected area appears to be more closely aligned with IC HA4, i.e., "Confirmed Security Event in a Plant PROTECTED AREA." In reviewing this issue, NEI determined that it was more appropriate to include this type of event as an indication of a hostile force entering the protected area. This type of event would then be classified as an

Alert. Deletion of this specific EAL and including it as part of the more general "hostile intrusion" EAL meets the intent of the IC (HA4). Therefore the change in the guidance to remove this specific EAL is appropriate.

5.21 HU4-2 Added Condition for Security EAL

NUMARC/NESP-007 EAL

> *Other security events as determined from (site-specific) Safeguards Contingency Plan.*

NEI 99-01 EAL

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

REGULATORY ANALYSIS OF CHANGE
The NUMARC/NESP-007 EAL was modified to add the condition "and reported by the (site-specific) security shift supervision." Reference is made to the security shift supervisor because these individuals are the designated personnel on-shift qualified and trained to confirm that a security event is occurring or has occurred. This change is acceptable.

5.22 HU4 Basis Revision

NUMARC/NESP-007 EAL (NEI 99-01 is the same)

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

REGULATORY ANALYSIS OF CHANGE
The basis for IC HU4 was revised to add the following:

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

This change provides additional guidance to assist in evaluating a security event to make a determination whether classification should be made. This additional guidance enhances the EAL and is appropriate.

5.23 HU5-1 -- Addition of Condition Related to the Release of Radioactive Material

NUMARC/NESP-007 EAL

> *Other conditions exist which in the judgment of the Emergency Director indicate that events are in process or have occurred which indicate a potential degradation of the level of safety of the plant.*

NEI 99-01 EAL
This EAL was modified to add the condition:

> *No releases of radioactive material requiring offsite response or monitoring are expected unless further degradation of safety systems occurs.*

REGULATORY ANALYSIS OF CHANGE
This change is in accordance with definition of an Unusual Event provided in NUREG-0654 and is appropriate. In addition, the basis for this EAL was modified to remove the following examples of events that may require Emergency Director judgement.

- Aircraft crash on-site
- Train derailment on-site
- Near-site explosion which may adversely affect normal site activities
- Near-site release of toxic or flammable gas which may adversely affect normal site activities
- Uncontrolled RCS cooldown due to Secondary Depressurization

NEI determined that including these examples of initiating conditions (ICs) was redundant because the examples were closely related to existing ICs and are therefore not necessary. It is more appropriate to provide ICs which cover these types of events than to provide a list of them under the ED judgement IC. Each of the above initiating conditions was relocated to other ICs. The “Uncontrolled RCS cooldown due to Secondary Depressurization” appears to not fit into an existing IC as straight forwardly as other ICs listed under ED judgement. However, further evaluation by the staff, as discussed below, determined that the effect of this IC is adequately covered under existing ICs.

The “Uncontrolled RCS cooldown due to Secondary Depressurization,” deals with a steam line break, and is covered by other initiating conditions which will result in entry into the appropriate EAL. For example, a SGTR with ECCS actuation is included in the fission product barrier mix as is a SG secondary side release with primary to secondary leakage. A steam line break which would cause an uncontrolled RCS cooldown, is bounded by its impact on public health and safety and is adequately covered by AU-1 “unplanned release of gaseous or liquid radioactivity to the environment that exceed two times the radiological effluent technical specifications for 60 minutes or longer.” This EAL can be elevated to the next higher classifications per the EAL scheme.

Emergency Director judgement can be used to determine whether the plant condition specified in an IC is met (even if a specific EAL has not been met). This change is appropriate.

5.24 HA1-2 (also HA1-5) Relocation of list of Safety-Related Structures to Specific EALs

NUMARC/NESP-007 EAL

> *Tornado or high winds striking plant vital areas: tornado or high winds greater than (site-specific) mph strike within protected area boundary.*

NEI 99-01 EAL

> *Tornado or high winds greater than (site-specific) mph within PROTECTED AREA boundary and resulting in VISIBLE DAMAGE to any of the following plant structures or equipment therein or control room indication of degraded performance of those systems.*

REGULATORY ANALYSIS OF CHANGE
This EAL has been modified to include the list of safety-related structures which must be damaged for the EAL to be met and to reference control room indications. This list of safety-related structures and reference to control room indications were previous included as EALs HA1-3 and HA1-4. These EALs were deleted in NEI 99-01. These changes corrected a formatting error made in NUMARC/NESP-007. This same type of change was made to EAL HA1-5. These changes are appropriate.

5.25 HA2 Basis Revision

NUMARC/NESP-007 EAL

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

The basis section for this IC was modified to provide additional detail on the intent of this EAL. This modification does not change the intent of the EAL or IC and is appropriate.

5.26 HA3 Clarification of Threshold for Toxic or Flammable gases

NUMARC/NESP-007 IC/EAL
NESP-007 IC HA3 is:

> *Release of Toxic of Flammable Gases within a facility structure which*

jeopardizes operation of systems required to maintain safe operations or to establish or maintain cold shutdown

The NUMARC/NESP-007 EALs under this IC are:

Report or detection of toxic gases within a facility structure in concentrations that will be life threatening to plant personnel.

Report or detection of flammable gases within a facility structure in concentrations that will affect the safe operation of the plant.

NEI 99-01 EAL

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

Report or detection of gases in concentration greater than the lower flammability limit within or contiguous to a VITAL AREA .

REGULATORY ANALYSIS OF CHANGE
This revision provides more detail to the EALs which will ease the development of site-specific EALs. This revision does not change the intent of the EALs and is appropriate.

5.27 HA5 Basis Revision

NUMARC/NESP-007 IC

Control Room Evacuation Has Been Initiated

REGULATORY ANALYSIS OF CHANGE
Minor modifications were made to the basis section for this IC/EAL. These modifications do not change the intent of the EAL or the manner in which the event would be classified.

5.28 HA6 -- Modification of Emergency Director Judgement EAL

NUMARC/NESP-007 IC/EAL
NESP-007 IC HA6 is:

Other Conditions Existing which in the judgement of Emergency director warrant declaration of an Alert

The NUMARC/NESP-007 EAL under this IC is:

Other conditions exist which in the judgement of the emergency director indicate that plant safety systems may be degraded and that increased monitoring of plant functions is warranted

NEI 99-01 EAL

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

REGULATORY ANALYSIS OF CHANGE
This EAL was modified to match the description of an Alert provided in NUREG-0654. This change is appropriate.

5.29 HS2 Basis Revision

NUMARC/NESP-007 IC/EAL
NESP-007 IC HS2 is:

Control Room Evacuation Has Been Initiated and Plant Control Cannot Be established

The EAL for this IC is:

The following conditions exist:

a. *Control room evacuation has been initiated.*
AND
b. *Control of the plant cannot be established per (site-specific) procedure within (site-specific) minutes.*

REGULATORY ANALYSIS OF CHANGE
The basis for this EAL was modified to clarify guidance on determining the site-specific time for establishing this control in developing the site-specific EAL and clarifying guidance on how the Emergency Director is to determine whether plant control has been established. This revision is appropriate.

5.30 HS3 -- Modification of Emergency Director Judgement EAL

NUMARC/NESP-007 EAL

Other conditions exist which in the judgement of the emergency director indicate

actual or likely major failures of plant functions needed form protection of the public

NEI 99-01 EAL

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

REGULATORY ANALYSIS OF CHANGE
This EAL was modified to match the description of the Site Area Emergency provided in NUREG-0654. This change does not change the intent of the EAL and, therefore, should not affect the ability of the Emergency Director to classify events based upon his/her judgement.

5.31 HG1 Security Event Resulting in Loss of Physical Control of the Facility

NUMARC/NESP-007 IC/EAL

NUMARC/NESP-007 IC HG is:

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

The NUMARC/NESP-007 EALs under IC HG1 are:

Loss of physical control of the control room due to security event.

Loss of physical control of the remote shutdown capability due to security event.

NEI 99-01 IC/EAL
NEI 99-01 IC HG1 is:

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

The EAL under this IC is:

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

REGULATORY ANALYSIS OF CHANGE
The IC was modified to more closely reflect the plant condition of concern (as reflected

in the EALs under this IC). The EAL was modified to recognize that a loss of physical control of the plant varies based upon plant specific configurations of equipment and controls. The basis section of this EAL was modified to provide additional guidance on the site-specific implementation of this EAL. The intent of the IC and EAL was not changed. The NEI 99-01 guidance is appropriate for classifying this type of event.

5.32 HG2 -- Modification of Emergency Director Judgement EAL

NUMARC/NESP-007 EAL
NESP-007 IC HG2 is:

> *Other Conditions Existing which in the judgement of Emergency director warrant declaration of an General Emergency*

The NUMARC/NESP-007 EAL under this IC is:

> *Other conditions exist which in the judgement of the emergency director indicate 1) actual or imminent substantial core degradation with potential for loss of containment, or 2) potential for uncontrolled radionuclide releases. These releases can reasonably be expected to exceed EPA PAG plume exposure levels outside the site boundary.*

NEI 99-01 EAL

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

REGULATORY ANALYSIS OF CHANGE
This EAL was modified to match the description of a General Emergency provided in NUREG-0654. This revision provides appropriate EAL guidance for developing site-specific EALs for classifying events based upon emergency judgement.

5.33 SU1 Loss of Offsite Power -- Basis Revision

NUMARC/NESP-007 EAL

> *Loss of power to (site-specific) transformers for greater than 15 minutes*

REGULATORY ANALYSIS OF CHANGE
The basis section was modified to add the following:

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

REGULATORY ANALYSIS OF CHANGE

This change allows a licensee to develop a site-specific EAL which includes a condition for providing offsite AC power via a cross tie. Since this condition will provide AC power to the plant, the condition, "loss of all offsite power to essential busses," does not exist. Therefore, this revised EAL guidance is appropriate.

5.34 SU3-1 Restructuring of Loss of Annunciator EAL

NUMARC/NESP-007 EAL

1. *The following conditions exist:*

   a. *Loss of most or all (site-specific) annunciators associated with safety systems for greater than 15 minutes.*

   AND

   b. *Compensatory non-alarming indications are available.*

   AND

   c. *In the opinion of the Shift Supervisor, the loss of the annunciators or indicators requires increased surveillance to safely operate the units(s)*

   AND

   d. *Annunciator or Indicator loss does not result from planned action.*

NEI 99-01 EAL

This EAL was revised in NEI 99-01 to include only condition "a" modified to include the term "unplanned," i.e.:

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

REGULATORY ANALYSIS OF CHANGE

The removal of condition "b" is appropriate because it is not necessary to include statements in an EAL related to the availability of equipment. Higher classification level EALs address the loss of this equipment. The removal of condition "c" is appropriate because, if most safety system annunciators were lost, then increased monitoring would be needed. Condition "d" was incorporated into the new EAL. In addition, the condition "or indicators" was added to this EAL. The addition of this condition makes the EAL consistent with the IC. These changes are appropriate.

5.35 SU5 RCS Leakage -- Basis Revision

NUMARC/NESP-007 EAL

The following conditions exist:

a. Unidentified or pressure boundary leakage greater than 10 gpm

b. Identified leakage greater than 25 gpm

REGULATORY ANALYSIS OF CHANGE
The basis section for this IC was modified to remove identification of IC SA3, “Inability to Maintain Plant in Cold Shutdown,” as an escalation path. This is appropriate since this IC not applicable in the same modes as SA3. In addition, the basis section for this IC was modified to remove a description of the operating modes. This modification does not change the IC or cause its site-specific application to be changed.

5.36 SU8 Inadvertent Criticality

NUMARC/NESP-007 EAL
none

NEI 99-01 EAL
NEI 99-01 included a new IC and EAL for inadvertent criticality, i.e.:

IC: *Inadvertent Criticality*

EAL: *An extended and UNPLANNED positive period or sustained positive startup rate observed on nuclear instrumentation*

REGULATORY ANALYSIS OF CHANGE
The basis for adding this EAL comes from studies of criticality events that occur in the Cold Shutdown or Refueling modes (reference NUREG-1449, “Shutdown and Low-Power Operation at Commercial Nuclear Power Plant in the United States”). These events represent a potential degradation of the level of safety of the plant and, therefore, warrant an Unusual Event classification.

5.37 SA1 Loss of AC Power while in Shutdown Mode (also in SS1) -- Basis Revision

NUMARC/NESP-007 EAL

The following conditions exist:

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

b. Failure of (site-specific) emergency generators to supply power to emergency busses.
c. Failure to restore power to at least on emergency bus within 15 minutes from the time of loss of both offsite and onsite AC power

REGULATORY ANALYSIS OF CHANGE
The following statement was added to the basis section for this EAL:

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

This change was made to provide guidance for classifying events where the emergency bus is energized but the loads off of the bus are inoperable. This change is appropriate.

5.38 SA2 Failure of RPS -- Operating Mode Applicability change

NUMARC/NESP-007 EAL

> *(site-specific) indication(s) exist that indicate that reactor protection system setpoint was exceeded and automatic scram did not occur, and a successful manual scram occurred.*

REGULATORY ANALYSIS OF CHANGE
The "operating mode applicability" was modified to include the startup mode of operation for both PWR and BWRs (previously this EAL was applicable in the startup mode BWRs but not for PWRs). The failure to automatically scram the reactor when a setpoint is exceeded has the potential to exceed design limits of the fuel when in the startup mode. Therefore, the addition of this mode for PWRs is appropriate.

5.39 SA5-1 Single AC Power Source

NUMARC/NESP-007 EAL

The following conditions exist:
a. Loss of power to (site-specific) transformers for greater than 15 minutes.
AND
b. Onsite power capability has been degraded to one (train of) Emergency bus(ses) powered from a single onsite power source due to the loss of:

(Site-specific list)

NEI 99-01 EAL

1. a. *AC power capability to site-specific essential busses reduced to a single power source for greater than 15 minutes*
   AND
   b. *Any additional single failure will result in station blackout.*

REGULATORY ANALYSIS OF CHANGE
This EAL was modified to be less complicated (eliminate the need to specify specific combinations of electric power supply losses). In addition, the following statement was removed from the basis section for this EAL to conform to the EAL change:

> *Example EAL 1b should be expanded to identify the control room indication of the status of offsite-specific power....*

This change provides guidance for developing a simpler site-specific EAL for classifying a loss of power event. This modification is appropriate.

5.40 SS2 (SG2) Failure of RPS -- Addition of Applicable Mode

NUMARC/NESP-007 IC

> *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*

REGULATORY ANALYSIS OF CHANGE
The NUMARC/NESP-007 IC was modified to include the startup mode as an applicable mode. This change was made because, when in startup, reactors may be operating at a power level in excess of safety system design heat removal capabilities if a failure to scram occurred. This change is appropriate.

5.41 SS4 Complete Loss of Heat Removal Capability

NUMARC/NESP-007 IC

> *Complete Loss of Function Needed to Achieve or Maintain Hot Shutdown*

NUMARC/NESP-007 EAL

> *Complete loss of any (site-specific) function required for hot shutdown.*

NEI 99-01 IC

Complete Loss of Heat Removal Capability

NEI 99-01 EAL

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

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

REGULATORY ANALYSIS OF CHANGE
This EAL was changed to address design differences between PWRs and BWRs. The new EALs are consistent with loss of heat removal capability as defined and used in EOPs. This change is appropriate.

In addition, the basis was revised to clarify that subcriticality is not addressed in this EAL but rather, is addressed in EAL SS2. This change is appropriate.

5.42 SG1 Prolonged Loss of AC Power

NUMARC/NESP-007 IC

Prolonged Loss of All Offsite Power and Prolonged Loss of All Onsite AC Power

NEI 99-01 IC

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

REGULATORY ANALYSIS OF CHANGE
This IC was slightly modified to specify that the concern is loss of "All Onsite AC Power to Essential Buses" instead of "All Onsite Power." This change is consistent with the intent of the IC and the wording of the EAL under this IC. Therefore, this change is acceptable.

5.43 SG2 Failure of RPS -- Revised Basis

NUMARC/NESP-007 EAL

(Site-specific) Indications exist that automatic and manual scram were not successful
AND
a. *(Site-specific)* indication(s) exist that the core cooling is extremely challenged
OR
b. *(Site-specific)* indication(s) exists that heat removal is extremely challenged.

REGULATORY ANALYSIS OF CHANGE
The basis was modified to change the recommendation for the establishing the "(site-specific)indication for heat removal is extremely challenged" as *2/3 core height* to the *Minimum Steam Cooling Reactor Pressure Vessel (RPV) Water Level* for BWRs. This corresponds to water level provided in the EOPs for BWRs for power control under failure to scram conditions. This modification is appropriate.

6. Modification of General Classification Guidance

In addition to providing guidance for developing site-specific EALs, NEI 99-01 revised NUMARC/NESP-007 to provide recommendations regarding (1) the classification of transient events, (2) the interface between classification and activation of emergency facilities and (3) operating mode applicability. The potential consequence of this new guidance is evaluated below

6.1 Classification of Transient Events

NEI 99-01 describes two approaches for classifying transient events:

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

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

NEI 99-01 recommends:

Option (T1) is believed to be appropriate for events at higher emergency classifications. Option (T2) may be appropriate for events that might have been classified as NOUEs, but might not be sufficient for some events (e.g., ATWS). It is recommended that the program incorporate aspects of both options with examples of when each would be appropriate. Many of the generic event-based

IC's and EAL's have discriminators based on time or magnitude. Generally, if the discriminators is exceeded, the event should be classified. In implementing the generic guidance into site-specific programs, care should be taken to ensure that the ICs and EALs minimize the need for these ad hoc decisions on transient events.

The purpose of classifying events is to initiate the emergency response organization to support actions needed to assess and mitigate the event and determine whether offsite protective actions should be recommended. Therefore the need to classify transient events will be based primarily upon whether action is needed to ensure that the potential effect of the transient does not warrant the additional response resources obtained with the emergency response organization activation to assess the potential consequences and to determine and implement appropriate mitigation actions. This cannot be determine a priori and, therefore, some judgement will need to be used to determine the appropriate action. The NEI guidance specifies that site-specific EAL procedures should contain guidance to minimize the need for ad hoc decisions. The generation of this guidance should provide for better classification of transient events.

6.2 Interface between classification and activation of emergency facilities

NEI 99-01 describes two situations related to classifying events based upon emergency facility activation:

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

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

NEI 99-01 states that the key consideration is not the fact that the facilities were utilized, but rather, the reason for that use. Facilities may be used for events that may not warrant classification of an emergency. This guidance is appropriate.

6.3 Operating Mode Applicability

NEI 99-01 provides guidance regarding mode applicability of EALs and what mode

should be considered applicable when transients or operator actions cause a change in modes. The new guidance is “the plant operating mode that existed at the time that the event occurred, prior to any protective system or operator action initiated in response to the condition, is compared to the mode applicability of the EALs.” This was the intent of the NUMARC/NESP-007 guidance. This revision in NEI 99-01 clearly states this intent. This revision is appropriate.

Table C1 - Cold Shutdown/Refueling System Malfunction INITIATING CONDITION MATRIX

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

Table C2 - Permanently Defueled Reactor INITIATING CONDITION MATRIX

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