REGULATORY ANALYSIS

REVISION OF REGULATORY GUIDE 1.101 TO ACCEPT THE GUIDANCE IN NUMARC/NESP-007, REV. 2. AS AN ALTERNATIVE METHODOLOGY FOR THE DEVELOPMENT OF EMERGENCY ACTION LEVELS

1. STATEMENT OF THE PROBLEM

1.1 Background

Paragraph (a)(1) of § 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 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. 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 within and without the site boundary to protect health and safety. Emergency action levels are to be based on in-plant 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. 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.

Revision 1 to NUREG-0654/FEMA-REP-1, Criteria for Preparation and Evaluation of Radiological *Emergency Response Plans and Preparedness in Support of Nuclear Power Plants*, ("NUREG-0654") was published in October 1980 to provide specific acceptance criteria for complying with the standards set forth in §50.47 of 10 CFR Part 50. Appendix 1 of NUREG-0654 contains example EALs for each of the four emergency classification levels that are used to initiate different levels of emergency response onsite and offsite. Revision 2 of Regulatory Guide 1.101, *Emergency Planning and Preparedness of Nuclear Reactors*, endorsed NUREG-0654.

The purpose of declaring an emergency classification level is to initiate an emergency response. Appendix 1 to NUREG-0654 contains a description and the purpose of each ECL, and which licensee and offsite emergency response authority actions should 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 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 radiological 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.

1.2 Need for Further Guidance

NRC has provided guidance on emergency action levels in only two documents. Revision 2 of Regulatory Guide 1.101 endorsed NUREG-0654. In October of 1981, DRAFT NUREG-0818, "Emergency Action Levels for Light Water Reactors" was published. In DRAFT NUREG-0818, the application of the EALs of NUREG-0654 were studied and improvements were suggested. The nuclear utility industry has now a decade of experience in adapting the NRC guidelines to develop sets of site-specific EALs and in using these EALs in exercises and under actual accident conditions.

During this period, licensees have developed, offsite emergency response authorities have agreed upon, and the NRC has approved sets of EALs that represent broad variations in the ways the guidance in NUREG-0654 can be applied. It is possible that two plants, faced with identical conditions and applying their EAL schemes, would declare different levels of emergency (different ECLs). Also, there have been situations that were not contemplated when the guidelines were written and plant personnel were without specific guidance on which ECL to declare. Appendix 1 of NUREG-0654 does not contain example EALs for each ECL, but rather initiating conditions (i.e., plant conditions that indicate that a radiological emergency, or events that could lead to a radiological emergency, has occurred). NUREG-0654 notes that the initiating conditions (ICs) form the basis for establishment by a licensee of the specific plant instrumentation readings (as applicable) which, if exceeded, would initiate the emergency class. Thus, it is the specific instrument readings that would be the emergency action levels. In some cases, inconsistencies among initiating conditions together with broad ranges of risks with an initiating condition have resulted in some licensees declaring inappropriate ECLs.

In view of this experience, The Nuclear Management and Resource Council, Inc. (NUMARC) formed a task force to conduct a study to develop a systematic approach and support basis for development of emergency action levels. The methodology that was developed from this effort is described in NUMARC NESP-007, Rev. 2, *Methodology for Development of Emergency Action Levels*, January 1992. NRC staff has reviewed the NUMARC methodology and considers it to be an acceptable alternative method to that described in NUREG-0654.

It is noted that there is a likelihood that the results of ongoing risk studies relating to shutdown may necessitate revision of both existing NRC EAL guidance and the new NUMARC guidance as well.

2. OBJECTIVES

The objective of this action is to update NRC's guidance on development of emergency action levels (EALs) that are required by 10 CFR Part 50 Appendix E Section IV.B. The industry perceived the need, based on experience, for an EAL development methodology to provide greater consistency in the identification and reporting of emergencies. NUMARC has published a methodology for development of EALs. NRC staff has reviewed the NUMARC methodology and considers it to be an acceptable alternative method to that described in NUREG-0654. The objective of the proposed revision 3 to Regulatory Guide 1.101 is to inform Part 50 applicants and licensees of NRC's regulatory position.

3. 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 NUMARC/NESP-007 is considered to be an acceptable alternative method to that described in NUREG-0654 for developing emergency action levels (EALs).

It should be remembered that neither alternative mandates any particular methodology for developing emergency action levels. According to 10 CFR Part 50 Appendix E Section IV.B, emergency actions developed by licensees must be agreed on by offsite emergency response authorities and approved by NRC. The NUMARC methodology is in a published report and licensees may use it to 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 NUMARC methodology by eliminating uncertainty as to whether the methodology is acceptable to NRC.

3.1 Description of the NUREG Methodology

For each emergency classification level (notification of unusual event, alert, site area emergency, and general emergency), Appendix 1 to NUREG-0654 contains a list of example initiating conditions. These initiating conditions "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."

3.2 Description of the NUMARC Methodology

The methodology for developing emergency action levels described in NUMARC/NESP-007 ("NUMARC methodology") defines initiating conditions and emergency action levels based on regulatory intent and industry usage. These definitions are:

> **INITIATING CONDITION (IC):** One of a predetermined subset of nuclear power plant conditions where either the potential exists for a radiological emergency, or such an emergency has occurred.
>
> **EMERGENCY ACTION LEVEL (EAL):** A pre-determined, site-specific, observable threshold for a plant initiating condition that places the plant in a given emergency class. An EAL can be: an instrument reading; an equipment status indicator; a measurable parameter (onsite or

offsite); a discrete, observable event; results of analyses; entry into specific emergency operating procedures; or another phenomenon which, if it occurs, indicates entry into a particular emergency class.

The NUMARC methodology has three kinds of ICs and EALs: (1) symptom-based; (2) event-based; and (3) barrier-based. The symptom-based class refers 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 a high-pressure safety injection pump failure. Barrier-based ICs and EALs refer to the level of challenge to the principal barriers used to assure containment of radioactive materials within a nuclear plant. For the most important type of radioactive material, 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.

In the NUMARC 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 through the decay heat removal process toward cold shutdown and refueling, barriers to 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.

Initiating conditions and EALs are divided into four classes, or "recognition categories." These are:

- 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, initiating conditions and associated EALs are developed for each emergency classification level (as in the NUREG scheme): unusual event (U), alert (A), site area emergency (s), general emergency (G). For these recognition categories, initiating conditions are identified by a three-character acronym (recognition category, ECL, sequence number). Thus, AU2 and SS3, are the second unusual event IC in the abnormal radiation level recognition category and the third site area emergency IC in the systems malfunction recognition category, respectively.

For recognition category F (fission product barrier degradation), there are three initiating conditions: (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 reactor coolant system (RCS) barrier. The EALs for each of these initiating conditions depend on whether the reactor is a PWR or a BWR. The ECL resulting from fission product barrier degradation depends upon the number of barriers lost (or potentially lost) and which ones they are:

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

4. CONSEQUENCES

This regulatory analysis follows the guidance found in the NUREG/BR-0058 (May 1984), *Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission,* (the Guidelines) and NUREG/CR-3568 (Dec. 1983), *A Handbook for Value-Impact Analysis,* (the Handbook). 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.

As was discussed in Section 3, regardless of whether NRC decides on Alternative 1 or Alternative 2, licensees may propose use of the NUMARC methodology. If a licensee uses the NUMARC 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 can not be said with certainty that adoption of Alternative 2 will have any consequences (even if a licensee uses the NUMARC methodology, one cannot be certain it was attributable to NRC's decision to find the NUMARC methodology an acceptable alternative to the NUREG methodology for developing EALs). However, for the purposes of exploring further in this regulatory analysis, potential consequences of using the NUMARC methodology, it will be assumed that one or more licensees would switch from a set of EALs based purely on the NUREG methodology to a set of EALs based on the NUMARC methodology as a result of a decision in favor of Alternative 2.

The purpose of an emergency action level (EAL) is to trigger the declaration of an emergency classification level (ECL), which in turn triggers a certain level of emergency response offsite. Appendix 1 to NUREG-0654 identifies the 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). Licensee actions to respond directly to the onsite situation are governed by emergency operating procedures (EOPs). In the NUMARC methodology, EALs are defined to be consistent with EOPs, but EOPs are not affected by EALs. The course of the accident, and the extent 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 Handbook, those related to how the regulatory action affects accident frequency and accident severity, are not relevant. These non-relevant attributes are: occupational exposure (both routine and accidental); offsite property; onsite property; regulatory efficiency; improvements to knowledge; and NRC development.

The Handbook notes that the definition of attributes can be modified or extended if appropriate for the issues being studied. In this case, it is appropriate to extend the definition of the offsite property attribute to include the costs of the offsite emergency response organizations to take the actions required by the ECLs.

It is not feasible to assess quantitatively the consequences of a licensee switching a pure NUREG-0654 system of EALs to a pure NUMARC system of EALs, with only generic information. Site-specific indicator readings that trigger EALs are needed. Even if site-specific EALs were available, it would still be beyond the scope of a regulatory analysis to make quantitative assessments as will now be explained.

Representatives from the NRC staff, NUMARC, and several utilities participated in an exercise on February 5 and 6, 1991 in order to evaluate the emergency classification of nuclear reactor accidents using the NUMARC EAL

Methodology. The review of the emergency classification covered a variety of accident scenarios and determined that the NUMARC EAL Methodology resulted in appropriate and timely classification of the events. A two day workshop was also held at Pennsylvania Power and Light Co. on 9/16/91 and 9/17/91 for representatives of the NRC staff to review the Susquehanna's proposed site specific EALs which were developed based on the NUMARC methodology.

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 on 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 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 depends on 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 NUMARC 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 4.1, the consequences of NRC choosing Alternative 2 or a licensee adopting a set of EALs based on the NUMARC methodology are discussed qualitatively in terms of how consequences attributes could be affected. Also, some rough cost estimates are made.

4.1 How Consequences Attributes Could Be Affected

4.1.1 Public Health

Public health could be affected from exposure to offsite releases of radioactive material from an accident at a licensed nuclear plant. Such

The exposure can be mitigated from sheltering-in-place or evacuating before the plume passes by. 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 days to 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 affected 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, interalia, 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. 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^{-6} 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 the public health, and if the evacuation is delayed or if sheltering is implemented instead, there could be significant numbers of extra early fatalities for incredibly rare, high-consequence accidents.

Effect of Declaration of the General Emergency ECL Being Overdue

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 active guides (PAGs) developed by the U.S. Environmental Protectional Agency (EPA) for mitigation of exposure of the public to the plume (see EPA/520/1-75-001-A (1990), *Manual of Protective Action for Nuclear Incidents)*. NUREG-0654 notes that the immediate action for this class is sheltering-in-place (with in 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.

If the declaration of the general emergency ECL 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 ECL is overdue, the ability to effect 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

One of the purposes of each ECL is for the offsite emergency response 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.

4.1.2 Offsite Costs

The scope of the offsite emergency response, and therefore its cost, depends on the current emergency classification level (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 emergency action

levels (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 the other. 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 NUMARC 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 ECL is given below.

Notification of Unusual Event

For the notification of unusual event ECL to be declared, unusual 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 unusual 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 protective action guidelines. Each offsite jurisdiction with emergency response responsibilities (States and counties, and municipalities in some States) 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 officers from the licensee and offsite emergency response authorities would compose messages to be broadcast on the emergency broadcast system (EBS), 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 protective action guides. 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 EPZ (e.g., state police officers) should 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 recommend if the accident worsens.

As emergency workers needed for 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

As emergency workers needed for 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, on up to 200-300. At a cost of $50/hour, the cost of offsite emergency response organizations responding to a site area emergency ECL could be as high as $15,000/hr.

General Emergency

For a general emergency ECL to be declared, events are in progress to 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 more than the immediate site area. After the general emergency ECL 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, and 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 we assume that 1,000 workers are involved at $50/hr per worker, then the cost of responding to a general

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 NUMARC 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 staff with expertise in nuclear power plant safety, and may have to rely on consultants to review and give advise on a proposed set of EALs. A comprehensive review many require 2 to 4 weeks of consultant effort. If the cost of an expert consultant in nuclear safety is $100/hr, then agreeing to a set of EALs based on the NUMARC methodology may cost offsite authorities $8,000 to $16,000.

4.1.3 Industry Implementation

Implementation of a set of EALs based on the NUMARC methodology by a licensee would involve: (1) developing a comprehensive set of site-specific EALs from the generic guidance in NUMARC NESP-007; (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 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 NUMARC NESP-007, 81 pages are required to describe generic EAL guidance. This guidance includes statement of initiating events, example EALs indicating the need for site-specific indicator readings,

and comments discussing the basis of the EALs. Adopting the NUMARC 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 160 pages. The cost of developing an EAL document 160 pages in length is assumed to cost 16 times the cost of writing or rewriting 10 pages of text for a complex change in operating procedures, or $50,000 to $66,000. However, the costs in Abstract 2.2.2 are based on 1986 salaries. Escalating these salaries to 1992 at 5%/yr, would increase the cost by 34% to $67,000 to $88,000.

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 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 the NRC full cost under 10 CFR §170.12(e). The fee for NRC's review and approval (for FY 1991) is based on the professional staff-hr rate of $115/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/TM-10071/R1, *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 1992 would be $105,000. If a year of the effort is 48 weeks, then the cost of supervising the agreement and approval process would be $4,400 to $8,800, in 1992. The costs associated with retraining offsite authorities would be absorbed in the

annual EAL training program that is already required by Appendix E for state and local authorities.

A third cost in implementing a set of EALs based on the NUMARC methodology is that of retraining affected plant staff on the use of the new EALs. Lets assume 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 "in-house simulator". For this means of instruction, Abstract 2.2.3 *of Generic Cost Estimates*, estimate costs per student in 1986 of $29 to $37. Assuming 5% escalation in costs per year, the price range in 1992 would be $37 to $47 per student-hr. Lets assume that there are 50 trainees, 5 supervisors and 45 operators. Then there would be 400 student-hrs and the cost of providing training would range between $14,800 and $18,800. 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 1992 for operations supervisors and shift operators would be $105,000 and $89,000, respectively. If a working year is assumed to be 48 weeks, then the cost of plant personnel attending the incremental training would be $105,000/48 for supervisors and $83,000 x 9/48 for shift operators, or $17,800. The total training costs would then be between $32,000 and $38,600.

4.1.4 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 those related to the ECLs and offsite emergency response. These activities are described as "Licensee Actions" in Appendix 1 of NUREG-0654. Just as the extent of offsite authority actions (see Section 4.1.2) 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 ECL is in effect. A qualitative discussion of licensee actions at each ECL is given below 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. Lets assume 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 1992 would be $49/hr. The annual cost of a reactor engineer in 1992 was estimated earlier to be $105,000. Assuming a working year is 48 weeks, or 1,920 hours, the cost per hour for a reactor engineer would be $55. The cost to the licensee for its actions would be minimally that of 4 health physicists and 4 reactor engineers, or approximately $400/hr.

Site Area Emergency

During the site area emergency ECL, the licensee would minimally 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 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 ($49/hr each), 7 reactor engineers ($55/hr), 4 administrative services persons; and 4 communications technicians. The hourly costs in 1992 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 1992 hourly costs for the positions not previously considered are public relations specialists ($44,000/hr, $47/hr); and technicians ($36,000/yr, $39/hr). The cost of the licensee's personnel devoted to actions related to the site area emergency ECL would then be;

8 x ($55/hr + $49/hr) + 4 x ($39/hr + $29/hr) + 2 x $44/hr + $75/hr = $1,267/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 $1,400/hr.

4.1.5 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 actions such as publishing notice in NRC's weekly News Release and mailing a copy of Revision 3 to each licensee and State emergency response authority. Assuming that the cost of mailing a copy is $1.00 ($.52 for postage and $.48 for handling) and that 200 copies are mailed, then the cost of notifying licensees and offsite authorities would be approximately $200.

If a licensee decides to adopt a set of EALs based on the NUMARC 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 $115/professional staff-hr. However, as acceptance of a set 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 4.1.3.

4.1.6 Summary of Consequences

There are two classes of cost-related consequences associated with adoption of a set of emergency action levels (EALs). One class contains those costs incurred to adopt the NUMARC guideline. Estimates of the dollar amounts for this class are: cost to licensee to develop EALs ($67,000 to $88,000); cost to licensee for NRC review and approval ($4,400 to $8,800); cost to licensee to train plant personnel on new EALs ($32,000 to $38,600); and cost to offsite emergency response authorities to review proposed EALs ($8,000 to $16,000). The total costs of a licensee adopting a new set of EALs is then estimated to be between $112,000 to $151,000.

The second class of costs are those 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. These costs depend on the length of time each EAL is in effect. They are also strongly site dependent as they depend on 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 ECL 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 $400/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 $1,250 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 $1,400 for a licensee. It should be remembered that these costs are not consequences of adopting EALs based on the NUMARC 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 NUMARC 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 from that offsite emergency response having reduced preparedness because the declaration of the ECLs were overdue. There would also be consequences if evacuation would have been the preferred protection action, but because an evacuation could not be accomplished in a timely manner from ECLs being overdue, sheltering-in-place would be recommended.

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

4.2 Comparison of the NUREG and the NUMARC Methodologies

The Nuclear Management and Resources Council (NUMARC) has developed a system for classifying abnormal occurrences at nuclear power plants which is documented in NUMARC/NESP-007, Rev. 2, "Methodology for Development of Emergency Action Levels." In developing this system, NUMARC identified the initiating conditions (ICs) for each such event and placed the event in one of four categories or "emergency classification levels" (ECLs):

Notification of Unusual Event
Alert
Site Area Emergency
General Emergency

NUMARC then identified the types of plant instrument readings, called Emergency Action Levels (EALs), which would correspond with each IC. The Nuclear Regulatory Commission (NRC) staff reviewed NUMARC's methodology for developing these action levels by performing the following actions:

1. Compared the NUMARC methodology to the guidance in NUREG-0654/FEMA-REP-1, "Criteria for the preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants," Revision 1, November 1980.

2. Considered refinements in the guidance in NUREG-0654 that have been developed based on experience gained and lessons learned in using NUREG-0654.

3. Participated in February 1991 with representatives from NUMARC and the utilities in a "table-top" review of plant events and emergency exercises to determine the classifications that the licensees would most

likely adopt in implementing the NUMARC proposal. The participants reviewed various event scenarios used in past emergency exercises to determine if NUMARC's methodology provided for adequate emergency classification and for properly timed declarations.

NUMARC incorporated in its classification system several improvements suggested from the staff's review. The participants in the table-top exercise agreed that use of the improved classification system would result in higher level emergency classifications (site area and general emergencies) being made at the same time or earlier than they would be based on NUREG-0654 criteria.

After NUMARC made the improvements to its methodology, the NRC staff performed a regulatory analysis of these EAL guidelines by comparing the ICs identified by NUMARC with the examples of ICs shown in Appendix 1 to NUREG-0654. The staff compared the ICs according to the following:

NUMARC's interpretation of emergency class descriptions. (See Sections 3.7, "Emergency Class Descriptions," and 3.8, "Emergency Class Thresholds," of the NUMARC document).

NUMARC's EAL guidance and basis information. (See Section 5.0, "Generic EAL Guidance," of the NUMARC document).

The staff identified NUMARC ICs that corresponded or related to each IC in NUREG-0654. If no equivalent NUMARC IC was found, the staff analyzed NUMARC's basis for the omission to ensure that the NUMARC scheme still met the original intent of NUREG-0654. The staff concluded that, except as noted herein, the NUMARC ICs were more comprehensive than the NUREG-0654 ICs.

The staff is providing its regulatory analysis of the NUMARC methodology, arranged according to IC. The staff organized each section in the following format.

Definition of emergency classification as it appears in NUREG-0654.
the NUMARC's disposition of the NUREG-0654 ICs for that classification.
Title of NUREG-065 IC
Disposition
Regulatory Analysis

Emergency Classification: Notification of Unusual Event

Definition in NUREG-0654:

"Unusual Events are in process or have occurred which indicate a potential degradation of level of the safety of the plant. No releases of radioactive material requiring offsite response or monitoring is expected unless further degradation of safety systems occurs."

Disposition of NUREG-0654 Example ICs Under This Emergency Class:

NUMARC reviewed each of the example ICs in NUREG-0654 against three main criteria:

- Is the event a reasonable precursor to a potential loss or loss of one or more of the fission product barriers?

  NUMARC included in its examples ICs for precursor events. NUMARC made some changes to clarify the ICs.

- Is the event reportable under the requirements to 10 CFR 50.72?

  The similarity between the NUREG-0654 unusual event ICs and the reportable events of 10 CFR 50.72 had previously prompted the staff to consider a modification to the emergency classification guidance of NUREG-0654. However, this similarity remained because the staff did not make this modification. NUMARC included this similarity as part of its justification for not including some NUREG-0654 unusual event ICs in the proposed methodology. Those NUREG-0654 unusual event ICs which have proved not to be precursors to more serious events were removed from the NUMARC

methodology. The reporting requirements of 10 CFR 50.72 will satisfy the NRC's concern that it be notified of these "non-emergency" events. Nonetheless, states will be getting significantly fewer Notifications of Unusual Events in the emergency context as a result of licensees implementing the new NUMARC guidance.

- Is the event addressed within technical specification limiting conditions of operation (LCO)?

  A number of example ICs in NUREG-0654 addressed conditions that are controlled by the plant's technical specifications. NUMARC noted that operation within the boundaries of the technical specifications, including the specified action statements and restoration times, represented an analyzed and approved situation. NUMARC concluded that an emergency condition could only exist if operation occurred outside these boundaries, that is, if required mode changes were not completed in the times specified.

1. "The emergency core cooling system (ECCS) initiated and discharged to the vessel."

Disposition:
The concerns addressed by this Initiating Condition (IC) have been integrated into several NUMARC ICs.

Regulatory Analysis:
NUMARC differentiates between the inadvertent discharge of ECCS into the vessel and the valid discharge of ECCS into the vessel. Inadvertent discharge of the ECCS to the vessel, in and of itself, does not constitute an emergency. ECCS actuation events are reportable under 10 CFR 50.72 b.1.iv and b.2.ii as non-emergency events. However, NUREG-0654 did not distinguish between the inadvertent and the valid discharge of ECCS and thus would classify any discharge of ECCS into the vessel as

an unusual event. Many licensees have recognized the need for this distinction and have submitted modifications to their EALs and NRC has approved EALs with such modifications.

NUMARC has integrated the valid ECCS discharge, which is a response to a (RCS) barrier challenge, into its fission product barrier degradation ICs or system malfunction ICs. The Fission Product Barrier Scheme offers a set of ICs that are connected to consequences of events that may challenge the integrity of the principal barriers. This is better than developing ICs connected to the individual events themselves. The alert IC, FA1, in the NUMARC scheme applies to those conditions in which the RCS or the fuel cladding barrier may be threatened. Under these conditions, NUMARC recognizes the level of severity needed to call for an alert. NUMARC further refined this scheme in ICs SU4 and SU5, where early signs of fuel degradation or RCS leakage would prompt the licensee to declare an unusual event.

Therefore, the NUMARC approach for this IC is acceptable because it provides a more accurate classification which meets the intent of NUREG-0654.

2. "Radiological effluent technical specification limits exceeded"

Disposition:

This IC is listed as an unusual event under NUMARC IC AU1, "Any Unplanned Release of Gaseous or Liquid Radioactivity to the Environment that Exceeds Two Times the Radiological Technical Specifications for 60 Minutes or Longer." The NUMARC IC contains a provision for licensees that have removed effluent limits from their technical specifications. For these, NUMARC specifies the use of the upper limits in the facility's Offsite Dose Calculation Manual (ODCM).

Regulatory Analysis:

10 CFR 50.72 requires a four-hour report whenever gaseous effluents exceed 2 times MPCs for unrestricted areas averaged over a period of an hour. The NUMARC IC considers a release to be an uncontrolled situation meeting the threshold of an unusual event if this release is greater than two times the technical specifications and if it continues unisolated for at least 60 minutes (no averaging). The concern in this IC is the degradation in plant control and not the dose at the site boundary. NUMARC stated in the basis of this IC, that once the Emergency Director recognizes that an uncontrolled situation might exist, the licensee should declare an unusual event before the 60 minutes have elapsed.

The NUMARC IC is acceptable because it defines the threshold for unusual events by discerning clearly between non-emergency, reportable events and those that qualify as potential emergencies.

3. "Fuel damage indication."

Disposition:

This IC is listed as an unusual event in NUMARC IC SU4, "Fuel Clad Degradation."

Regulatory Analysis:

The NUMARC IC SU4 is acceptable, as it addresses fully the key concerns of NUREG-0654. This IC is considered to be a precursor to a challenge to the fuel cladding barrier and as such the escalation path to higher classification is provided by way of the Fission Product Barrier scheme.

4. "Abnormal coolant temperature and/or pressure or abnormal fuel temperature outside technical specification limits."

Disposition:
The parts of this IC are considered as individual unusual events under the NUMARC ICs, SU2, "Inability to Reach Required Shutdown within Technical Specification Limits" and SU4, "Fuel Clad Degradation".

Regulatory Analysis:
NUMARC addresses fuel status under IC SU4 "Fuel Clad Degradation." Generally, NUMARC does not treat entry into a technical specification action statement as an emergency. However, NUMARC considers indications of fuel cladding degradation exceeding technical specification allowable limits to be a precursor of more serious problems and therefore calls for the licensee to declare an unusual event.

The NUREG-0654 guidance and the NUMARC approach differ fundamentally regarding the abnormal coolant temperature or pressure that is outside the technical specification limits. NUREG-0654 guidance calls for an unusual event to be declared when the technical specifications require the licensee to shutdown the plant. NUMARC proposes that the licensee declare an unusual event only if the plant had not been brought to the required operating mode (usually hot shutdown) within the time limits of the technical specification action statement. The initiation of a plant shutdown required by technical specification requires a one-hour report under 10 CFR 50.72. The NRC agrees that a controlled plant shutdown in compliance with a technical specification action statement is not a potential emergency and, therefore, need not be classified as an unusual event. NUMARC proposes to require the licensee to declare an unusual event when the plant is not brought to the required operating mode within the allowable action statement time in technical specifications. This change will significantly reduce the number of emergencies reported to state and local governments by licensees who implement the new NUMARC EAL guidance.

5. "Exceeding either primary/secondary leak rate technical specification or primary system leak rate technical specification."

Disposition:
NUMARC included this IC as an unusual event in IC SU5, "RCS Leakage," and under the RCS barrier ICs as part of Fission Product Barrier Matrix. NUMARC addressed secondary leakage for pressurized water reactors (PWRs) in IC SU5 and under the RCS barrier and Containment barrier monitoring in the Fission Product Barrier Degradation ICs.

Regulatory Analysis:
Although the NUMARC proposes a numeric threshold in IC SU5 for RCS leakage which is higher than that implied in NUREG-0654, the NRC staff considers the NUMARC ICs to adequately address the primary concerns of NUREG-0654. Leakage exceeding the limit specified in the technical specifications will require a shutdown. IC SU2 covers those conditions in which the required shutdown within the technical specifications was not reached. NUMARC proposes leakage rates, that are readily observable with normal control room indications (i.e. for PWRs, greater than 10 gpm for unidentified or pressure boundary leakage or 25 gpm for identified leakage). The difference between the two leakage rates is justified based on their relative risk significance. The values provided in SU5 will provide early indications of leakage which would be a precursor to the more severe events addressed in the Fission Product Barrier Degradation ICs.

This change is acceptable and is consistent with NUMARC's plan to separate non-emergency reportable events from its EAL scheme.

6. "Failures of a safety relief valve in a safety system to close following reduction of pressure."

Disposition:
NUMARC has integrated this IC into unusual event IC SU5, "RCS Leakage" and into ICs for RCS barrier fission product barrier degradation.

Regulatory Analysis:

The NUMARC IC SU5 applies to this situation. The licensee would raise the event to a higher classification by determining the status of the RCS barrier using IC FA1 in the Fission Product Barrier Matrix. The NUMARC scheme adequately addresses this NUREG-0654 IC.

7. "Loss of offsite power or loss of onsite AC capability."

Disposition:

NUMARC addressed this IC in unusual event IC SU1, "Loss of All Offsite Power to Essential Buses for Greater Than 15 Minutes," and IC SU2, "Inability to Reach Required Shutdown within Technical Specification Limits." NUMARC specified that the licensee would also declare an alert under IC SA5, "AC Power Capability to Essential Buses Reduced to a Single Power Source for Greater than 15 Minutes Such That any Additional Singe Failure Would Result in Station Blackout."

Regulatory Analysis:

NUMARC retained the loss of offsite power event (with emergency generators available) as a precursor to station blackout. A prolonged loss of offsite power reduces power redundancy and could degrade the level of safety of the plant by rendering the plant more vulnerable to a station blackout. This condition would require the licensee to rely solely on the plant equipment powered through emergency buses by the emergency generator in order to control and safely shut down the plant. NUMARC IC SU1 addresses this condition by classifying as an unusual event a loss of offsite power for more than 15 minutes while onsite emergency generators are available. NUMARC included the 15-minute duration to discriminate against transient and momentary power losses.

NUMARC IC SA5 escalates the EAL to an Alert if the power supply becomes degraded further.

While a loss of emergency onsite AC power capability (with offsite power available) reduces redundancy, all normal electrical buses would continue to be powered and all plant equipment would continue to be available. The condition is addressed by the plant's technical specifications and is not considered to be an emergency. The onsite power capability loss IC is addressed in NUMARC IC SU2, "Inability to Reach Required Shutdown within Technical Specification Limits." In the basis section of IC SA5, NUMARC stated that escalation to an alert occurs when, with the loss of onsite emergency generators, further degradation results in only one train of emergency buses being fed from offsite power.

The NUMARC ICs adequately addresses the conditions specified in the NUREG-0654 IC.

8. "Loss of containment integrity requiring shutdown by technical specifications."

Disposition:
NUMARC did not view this IC as an emergency in the proposal. However, recognizing that it may lead to complication, NUMARC listed it as an unusual event in IC SU2, "Inability to Reach Required Shutdown with Technical Specification Limits," and in the containment barrier ICs pertaining to degradation of the fission product barrier.

Regulatory Analysis:
This IC results in entry into a technical specification action statement. A loss of containment integrity as it is defined and interpreted in the technical specifications may not be a precursor to a more serious event. The initiation of a plant shutdown required by the technical specification requires a 1-hour report under 10 CFR 50.72. The licensee must declare an unusual event when the plant is not brought to the required operating mode within the allowable action statement time in the technical specifications.

NUMARC's IC FU1 recognizes that any loss or possible loss of containment function, in and of itself, constitutes an unusual event. NUMARC addressed explicitly the significant containment leak rates associated with plant events in the Fission Product Barrier Degradation EALs.

The NRC concurs with NUMARC's change.

9. "Loss of ESF or Fire protection system function requiring plant shutdown by technical specifications (e.g., because of malfunction, personnel error or procedural inadequacy)."

Disposition:
NUMARC addressed this IC as an unusual event in NUMARC IC SU2, "Inability to Reach Required Shutdown within Technical Specification Limits."

Regulatory Analysis:
This IC results in entry into a technical specification action statement. The loss of these functions as they are defined and interpreted in the technical specifications may not be a precursor to a more serious event. To begin to shut down the plant as required by the technical specification, the licensee must issue a 1-hour report under 10 CFR 50.72. The licensee must declare an unusual event when the plant is not brought to the required operating mode within the allowable action statement time in technical specifications. Loss of certain ESF functions that are associated with plant events are covered by System Malfunction, Hazards, and Fission Product Barrier Degradation ICs.

States will be getting significantly fewer Notifications of Unusual Events in the emergency context as a result of licensees implementing the new NUMARC guidance.

The NUMARC change is acceptable as it meets the intent of NUREG-0654.

10. "Fire within the plant lasting more than 10 minutes"

Disposition:
NUMARC addressed this IC as an unusual event in NUMARC IC HU2, "Fire Within Protected Area Boundary Not Extinguished Within 15 Minutes of Detection," and as an alert in NUMARC IC HA2, "Fire Affecting the Operability of Plant Safety Systems Required for the Current Operating Mode."

Regulatory Analysis:
The revision of the time criteria of this EAL from 10 minutes to 15 minutes was made in order to be consistent with the time criteria used in other EAL examples in the NUMARC methodology. The use of the consistent time criteria of 15 minutes in different EALs is considered advantageous in terms of the actual use of the EALs by operators. NUMARC also clarified that the clock starts when the Control Room is notified or the Control Room alarm has been verified. In IC HA2, NUMARC provides a means for escalating the event to a higher classification.

The NUMARC ICs adequately address the key concerns of NUREG-0654.

11. "Indications or alarms on process or effluent parameters not found functional in the control room to an extent requiring plant shutdown or significant loss of assessment or communication capability (e.g., plant computer, Safety Parameter Display System, all meteorological instrumentation)."

Disposition:
NUMARC addressed this IC as the following two unusual event ICs: IC SU3, "Unplanned Loss of Most or All Safety System Annunciation or Indication in the Control Room for Greater Than 15 Minutes," and NUMARC IC SU6, "Unplanned Loss of All Onsite or Offsite Communications Capabilities."

Regulatory Analysis:

In IC SU3, NUMARC considered the declaration of an unusual event in which the licensee loses most annunciators associated with safety systems for more than 15 minutes, but has available compensatory non-alarming indicators, such as the SPDS and the plant computer. NUMARC did not address the loss of meteorological instrumentation in the ICs due to the shift in emphasis from dose assessment to plant status assessments since the issuance of NUREG-0654. IC SU6 addresses those situations in which a loss of communications capability hampers plant operations or renders routine communications with offsite officials ineffective.

The NUMARC ICs adequately address the intent of this NUREG-0654 IC.

12. "Security threat or attempted entry or attempted sabotage."

Disposition:

NUMARC addressed this IC as an unusual event in IC HU4, "Confirmed Security Event Which Indicates a Potential Degradation of the Level of Safety of the Plant."

Regulatory Analysis:

The NUMARC IC addresses the key concerns of NUREG-0654.

13. "Natural phenomenon being experienced or projected beyond usual levels."

a. Any earthquakes detected at the station with seismic instrumentation
b. A 50-year flood or low water, tsunami, hurricane surge, seiche
c. Any tornado at the site
d. Any hurricane

Disposition:

NUMARC addressed this IC as an unusual event in IC HU1, "Natural and Destructive Phenomena Affecting the Protected Area."

Regulatory Analysis:

The NUMARC IC and example EALs address the key concerns of NUREG-0654.

14. "Other hazards being experienced or projected."

    a. Aircraft crash at the site or unusual aircraft activity over the facility
    b. Train derailment on site
    c. Near or onsite explosion
    d. Near or onsite toxic or flammable gas release
    e. Turbine rotating components failure causing rapid plant shutdown.

Disposition:

NUMARC addressed Items "a" through "e" of the IC as unusual events in IC HU1, "Natural and Destructive Phenomena Affecting the Protected Area," and IC HU3, "Release Of Toxic Or Flammable Gases Deemed Detrimental to Safe Operation of the Plant."

Regulatory Analysis:

The NUMARC IC addresses the key concerns of NUREG-0654.

15. "Other plant conditions exist that warrant increased awareness on the part of plant operating staff or state and/or local offsite authorities or required plant shutdown under technical specification requirements or involve other than normal controlled shutdown (e.g., cooldown rate exceeding technical specification limits, pipe cracking found during operation)."

Disposition:

NUMARC addressed this IC as an unusual event in IC HU5, "Other Conditions Which in the Judgement of the Emergency Director Warrant Declaration of an Unusual Event."

Regulatory Analysis:

Most of the conditions listed in this IC are reportable under 10 CFR 50.72 and State and local agreements. However, the NUMARC IC addresses the key concerns that apply to this emergency classification.

This change meets the intent of NUREG-0654. Licensees should be instructed to include in the guidance for the emergency director a list of the example EALs in this IC.

This will significantly reduce notification of unusual event reporting to State and local government entities by licensees who implement the new NUMARC EAL guidance.

16. "Transportation of contaminated injured individual from site to offsite."

Disposition:
Deleted.

Regulatory Analysis:
This event does not meet the threshold for the emergency class description and is not a precursor to a more serious event. This event is reportable under 10 CFR 50.72 as a non-emergency.

The NRC staff accepts the deletion of this IC.

17. "Rapid depressurization of PWR secondary side."

Disposition:
NUMARC addressed this IC as an example EAL under IC HU5, "Other Conditions Which in the Judgement of the Emergency Director Warrant Declaration of an Unusual Event."

Regulatory Analysis:
Rapid depressurization may cause the RCS inventory to be reduced, reactivity to increase, and the risk of pressurized thermal shock to increase. Each of these conditions requires the licensee to escalate an event to a higher classification. NUMARC addressed each of these

conditions in the Fission Product Barrier Degradation ICs, if the performance of safety systems, such as core injection, becomes degraded.

In NUREG-0654, the staff did not include example ICs to address the following NUMARC ICs in this emergency class:

AU2, "Unexpected Increase in Plant Radiation Levels or Airborne Concentration"

SU6, "Unplanned Loss of All Onsite or Offsite Communications Capabilities"

EMERGENCY CLASSIFICATION: ALERT

Definition in NUREG-0654:
"Events are in process or have occurred which involve actual or potential substantial degradation in the level of safety of the plant. Any releases are expected to be limited to small fractions of the exposure levels provided in the EPA Protective Action Guidelines."

Disposition of NUREG-0654 Example ICs Under This Emergency Class:
NUMARC addressed a number of the NUREG-0654 ICs in the Fission Product Barrier Degradation ICs. If NUMARC found that the matrix did not adequately describe an event or did not anticipate it in a timely manner, NUMARC provided a separate IC for that event. The matrix is better than the individual events identified in NUREG-0654 because it considers the effect of multiple events or conditions in determining the classification. In comparing the individual NUREG-0654 ICs to the NUMARC matrix, it is important to recognize that the individual events often can be detected by more than one monitored parameter and that the individual events may affect more than one barrier. For example, a loss-of-coolant accident in a PWR affecting the RCS barrier could affect both the fuel cladding and containment barriers. The NUMARC Fission Product Barrier Matrix, recognizing these relationships, properly escalates the emergency classification as the additional barriers are challenged or lost.

1. "Severe loss of fuel cladding."

   Disposition:
   NUMARC identified this IC as an alert in Fission Product Barrier Degradation IC FA1, as an indicator of a loss of the fuel cladding barrier.

   Regulatory Analysis:
   As an indicator of a loss of the Fuel Clad barrier, the NUMARC ICs will result in no lower than an Alert declaration, and may result in higher declarations if warranted by the status of other barriers. The activity

threshold level of 300 uCi/gm dose equivalent I-131 used in the NUMARC methodology is identical to that used in NUREG-0654. The NUMARC IC does not explicitly identify BWR offgas or PWR failed fuel monitors (as does NUREG-0654) as these features may vary between plants. The NUMARC methodology requires users to identify additional indicators for specific sites as appropriate.

The NUMARC scheme offers equivalent thresholds for the degradation of fuel cladding and also considers the fuel barrier together with the other barriers. The escalation path is thus provided using the barrier matrix. The NRC staff finds the NUMARC approach for this IC acceptable.

2. "Rapid gross failure of one steam generator tube with loss of offsite power."

Disposition:
NUMARC addressed this IC in the Fission Product Barrier Degradation ICs, as an indicator of a loss of the RCS barrier and, depending on steam generator isolation, a loss of the Containment barrier.

Regulatory Analysis:
NUMARC treated challenges to the RCS barrier in the Fission Product Barrier Matrix. NUMARC treated a loss of offsite power separately under System Malfunction ICs.

The licensee would have difficulty in determining accurately and rapidly the threshold for this NUREG-0654 IC from the control room because it would not know the size of the break. In the ICs, NUMARC indicated that the rupture of a steam generator tube could constitute a loss of the RCS barrier if the rupture requires the licensee to start a second charging pump in the normal charging mode of the RCS barrier. In IC FA1, this condition qualifies as an Alert. NUMARC classified the following as a site area emergency because it constitutes the loss of two of the three

fission product barriers: contaminated steam is released to the atmosphere because of a cooldown or secondary line break, if this release occurs simultaneously with the rapid gross failure of one steam generator tube (loss of both RCS and Containment). The loss of offsite power may necessitate the release of contaminated steam to the atmosphere as part of the cooldown process. Thus, the NUMARC methodology recognizes the containment bypass that this event represents. In any case, the NUMARC IC would require no less than an alert emergency and could require a site area emergency.

The NRC staff believes that this NUREG-0654 IC includes a rare combination of unrelated events that NUMARC addressed adequately and individually. NUMARC also allows the licensee to diagnose the symptoms of events that occur simultaneously.

3. "Rapid failure of steam generator tubes (e.g., several hundred gpm primary to secondary leak rate)."

Disposition:
NUMARC addressed this IC in Fission Product Barrier Degradation alert IC FA1 as a possible loss of the RCS barrier.

Regulatory Analysis:
The licensee would have difficulty determining accurately and rapidly the threshold for this NUREG-0654 IC from the control room. Thus, NUMARC revised this IC to reflect symptoms rather than specific postulated cause or break size and to address the key concerns of NUREG-0654. In FA1, NUMARC treated any breach of the RCS barrier as an alert. See also the disposition for Alert #2.

The NRC staff concurs with this change.

4. "Steam line break with significant (e.g., greater than 10 gpm) primary to secondary leak rate (PWR) or MSIV malfunction causing leakage (BWR)."

Disposition:
NUMARC classified this condition as an unusual event under either IC SU5, "RCS Leakage," or under IC HU5, "Other conditions existing which in the judgment of the Emergency Director warrant the declaration of an Unusual Event" for a PWR. NUMARC classified this event for a BWR as an alert under IC FA1, "Potential Loss of RCS."

Regulatory Analysis: PWR
IC HU5 includes an "Uncontrolled RCS cooldown due to secondary depressurization" as an example EAL. In IC HU5, the licensee would declare an unusual event if a steam line break results in no other condition other than an uncontrolled cooldown of the RCS. The primary-to-secondary leakage of 10 gpm or greater would also qualify at least as an unusual event. The licensee would not consider the two events, when concurrent, under the Fission Barrier Matrix, to meet the conditions to qualify as an alert without other conditions such as if the licensee could not isolate the steam line break of if the primary-to-secondary leak rate exceeded the capacity of one charging pump in the normal charging mode.

Regulatory Analysis: BWR
A BWR steam line break with a MSIV malfunction causing leakage outside the primary containment would require the licensee to declare an alert. This declaration is appropriate because two barriers would be lost in an event of this nature.

The NUMARC scheme provides an escalation path for operators to follow if plant conditions degrade further. The NRC staff concurs with this change.

5. "Primary coolant leak rate greater than 50 gpm."

Disposition:
NUMARC identified this IC as an alert in Fission Product Barrier Degradation IC FA1.

Regulatory Analysis:
The NUMARC Fission Product Barrier Matrix includes an IC for BWRs as specified in NUREG-0654 as an indicator that the RCS barrier could be lost. The loss of this barrier could, by itself, constitute an alert. The corresponding IC for PWRs is a condition that requires the licensee to start a second charging pump in the normal charging alignment. While this IC differs in magnitude from the NUREG-0654 IC, the change is justified in that the IC is based on a readily observable condition directly related to safety function performance, rather than on the 50 gpm value which has been difficult to observe and measure in a timely manner.

The NRC staff believes that NUMARC has adequately addressed the key concerns of this IC.

6. "Radiation levels or airborne contamination which indicate a severe degradation in the control of radioactive materials."

Disposition:
This IC is covered as an alert under NUMARC IC AA3, "Loss of Control of Radioactive Material or Increases in Radiation Levels Within the Facility That Impedes Operation of Systems Required to Maintain Safe Operations or to Establish or Maintain Cold Shutdown."

Regulatory Analysis:
The NUMARC IC defines a severe degradation in the control of radioactive materials to be a condition that impedes access of facility personnel to

plant areas where performance of remote operations or surveillance is necessary for safe operations or shutdown. This impaired ability to operate the plant could degrade substantially the level of safety of the plant. Thus, NUMARC proposed a two-tiered system for the radiation levels within the facility. NUMARC proposed that the exposure rate for the alert classification be greater than 15 mR per hour in areas requiring continuous occupancy (such as the control room), and be determined by site for areas requiring infrequent access. The Fission Product Barrier Matrix contains ICs based on area dose rates that could escalate the event as indication of failed fission product barriers.

The NUMARC IC addresses the key concerns of NUREG-0654.

7. "Loss of offsite power and loss of all onsite AC power."

Disposition:
NUMARC addressed this IC as an alert in IC SA1, "Loss of All Offsite AC Power and Loss of All Onsite Power During Cold Shutdown or Refueling Mode." NUMARC would escalate this IC to a site area emergency under IC SS1, "Loss of All Offsite Power and Loss of All Onsite AC Power to Essential Buses," if the event occurs during power operations, hot standby mode or hot shutdown mode.

Regulatory Analysis:
NUMARC recognized that the mode of operation affects severity of this condition. During the cold shutdown and refueling modes, NUMARC views this IC as meeting the definition of an alert. However, NUMARC has escalated this condition to the level of a site area emergency for hot shutdown through power operation because of the much greater potential of core damage and fission product barrier challenges.

It is noted that there is a likelihood that the results of ongoing risk studies relating to shutdown may necessitate revision of both existing NRC EAL guidance and the new NUMARC guidance as well.

The NRC staff agrees with NUMARC.

8. "Loss of all onsite DC power."

Disposition:
This IC is an alert for cold shutdown and refueling modes under NUMARC IC SA3, "Inability to Maintain Plant In Cold Shutdown." NUMARC escalated this IC for hot shutdown through power operation to a site area emergency under NUMARC IC SS3, "Loss of All Vital DC Power."

Regulatory Analysis:
NUMARC recognized that the mode of operation affects the severity of this condition. A loss of DC power could affect significantly the ability of the licensee to maintain the plant in a safe condition. In IC SA# NUMARC would have the licensee declare an alert during cold shutdown and refueling modes, once the loss of DC power has prevented the licensee from removing decay heat. A loss of DC power is only one of several conditions that could cause the licensee to loose the ability to remove decay heat. The NUMARC EAL addresses the ability to remove decay heat rather than the root cause.

NUMARC proposed to require the licensee to escalate this IC to a site area emergency for hot shutdown mode through power operation mode because of the effects of loss of vital dc power on the control and monitoring functions necessary to maintain the critical safety functions (CSFs). The increased anticipation implied by this escalation is consistent with the increased amount of sensible and decay heat available.

The NRC staff agrees that this IC and the proposed scheme should depend on the mode of operation.

9. "Coolant pump seizure leading to fuel failure."

Disposition:
NUMARC did not develop an equivalent IC. The severity of the symptoms of failed fuel would determine if the licensee chose to declare an unusual event or an alert using NUMARC IC SU4, "Fuel Clad Degradation," and the NUMARC Fission Product Barrier Degradation IC, FA1, respectively.

Regulatory Analysis:
This IC is not necessary because the key concern is the fuel failure and not the seizure of the coolant pump. NUMARC addressed fuel failure in IC SU4, "Fuel Clad Degradation," and the Fission Product Barrier Degradation ICs. Under the NUMARC scheme, any indication of a possible or actual loss of the fuel cladding barrier qualifies as an alert.

The NRC staff accepts this approach.

10. "Complete loss of any function needed for plant cold shutdown."

Disposition:
NUMARC addressed his IC as an alert, but only when the plant is in cold shutdown mode or refueling mode, under IC SA3, "Inability to Maintain Plant In Cold Shutdown."

Regulatory Analysis:
NUMARC differentiates between plant modes and proposes classifications for this IC that depend on the mode of operation. The licensee would escalate the condition to a higher classification by following the ICs for abnormal radiation levels and radiological effluents.

The staff is studying shutdown risk to gain more insight on the risks associated with shutdown and to provide the basis for developing a

comprehensive set of shutdown EALs. The NRC staff concurs with this approach until it can review the findings of the shutdown risk studies.

11. "Failure of the reactor protection system to initiate and complete a scram which brings the reactor subcritical."

Disposition:
NUMARC addressed this as an alert in IC SA2, "Failure of the Reactor Protection System Instrumentation to Complete or Initiate an Automatic Scram Once a Reactor Protection System Setpoint Has Been Exceeded and Manual Scram Was Successful."

Regulatory Analysis:
NUMARC recognized that this condition is a compromise of the plant safety system because the system could not automatically shut down the reactor in response to a valid signal from the reactor protection system (RPS) signal. The NUMARC IC provides credit for manual scrams initiated by the operator. The verification of scram is an initial action in reactor trip emergency operating procedures. If the manual trip fails (i.e. ATWS) NUMARC IC SS2 specifies that the event escalates to a site area emergency, NUMARC IC SS2.

The NUMARC IC addresses the key concerns of NUREG-0654.

12. "Fuel damage accident with release of radioactivity to containment or fuel handling building."

Disposition:
NUMARC addressed this IC as an alert in IC AA2, "Major Damage to Irradiated Fuel or Loss of Water Level that Has or Will Result in Uncovering of Irradiated Fuel Outside the Reactor Vessel."

Regulatory Analysis:
The NUMARC IC addresses the key concerns of NUREG-0654. The licensee would also escalate this condition to a higher classification in the ICs for abnormal radiation levels and radiological effluent.

13. "Fire potentially affecting safety system."

Disposition:
NUMARC addressed this IC as an alert in IC HA2, "Fire or Explosion Affecting the Operability of Plant Safety Systems Required to Establish or Maintain Safe Shutdown."

Regulatory Analysis:
The NUMARC IC Addresses the key concerns of NUREG-0654.

14. "Most or all alarms (annunciators) lost."

Disposition:
NUMARC addressed this IC as an alert IC SA4, "Unplanned Loss of Most or All Safety System Annunciation or Indication in Control Room with Either (1) a Significant Transient in Progress, or (2) Compensatory Non-Alarming Indicators are Unavailable," and as an unusual event under IC SU3, "Unplanned Loss of Most or All Safety System Annunciation or Indication in the Control Room for Greater Than 15 Minutes."

Regulatory Analysis:
NUMARC divided this IC into two ICs: an unusual event and an alert. NUMARC made this decision because of redundant systems such as the safety parameter display system (SPDS) and because of passive, non-annunciating systems, both of which backup the plant annunciators. If compensatory indication is available, this IC does not meet the emergency class description for an alert. However, when this IC is a precursor, it should have the classification of an unusual event. If

compensatory indication is inoperable, or if it occurs during a significant transient, the IC should be an alert.

The NRC staff finds this approach acceptable.

15. "Radiological effluent greater than 10 times technical specification instantaneous limits (an instantaneous rate, which if continued over two hours, would result in about 1 mr at the site boundary under average meteorological conditions)."

Disposition:
NUMARC classified this IC as an alert in IC AA1, "Any Unplanned Release of Gaseous or Liquid Radioactivity that Exceeds 200 Times Radiological Technical Specifications for 15 Minutes or Longer." The NUMARC IC contains a provision for plants that have removed effluent limits from their technical specifications. For these, NUMARC specifies the use of the upper limits in the facility's Offsite Dose Calculation Manual (ODCM).

Regulatory Analysis:
The value in the NUMARC IC compares with the value in NUREG-0654, because the present technical specifications for radiological effluents (or the limits in the facility's ODCM) are calculated by dosage. This NUMARC IC value is also consistent with the definition of an alert. Radioactivity releases of lesser magnitude can not degrade substantially the level of safety of the plant. Instantaneous limits identified in the NUREG-0654 IC have since been replaced with effluent control measures releases based primarily on dose per calendar period (e.g., month, quarter, year). The NUMARC IC reflects this change in control strategy and addresses the key concerns of NUREG-0654.

The NRC staff finds this approach acceptable.

16. "Ongoing security compromise."

Disposition:

NUMARC identified this IC an alert in IC HA4, "Security Event in a Plant Protected Area."

Regulatory Analysis:

The NUMARC IC addresses the key concerns of NUREG-0654.

17. "Severe natural phenomena experienced or projected."

a. Earthquake greater than OBE levels
b. Flood, low water, tsunami, hurricane surge, or seiche near design levels
c. Any tornado striking the facility
d. Hurricane winds near the design basis level

Disposition:

NUMARC identified this IC as an alert under IC HA1, "Natural and Destructive Phenomena Affecting Plant Vital Area."

Regulatory Analysis:

The NUMARC IC addresses the key concerns of NUREG-0654.

18. "Other hazards being experienced or projected."

a. Aircraft crash on facility
b. Missile impacts from whatever source on the facility
c. Known explosion damage to facility affecting plant operation
d. Entry into facility environs of uncontrolled toxic or flammable gases
e. Turbine failure causing casing penetration

Disposition:

NUMARC identified this IC as an alert under the following NUMARC ICs:

HA1, "Natural and Destructive Phenomena Affecting Plant Vital Area"
HA2, "Fire or Explosion Affecting the Operability of Plant Safety Systems Required to Establish or Maintain Safe Shutdown"

HA3, "Release of Toxic or Flammable Gases within a Facility Structure Which Jeopardizes Operation of Systems Required to Maintain Safe Operations or to Establish or Maintain Cold Shutdown"

Regulatory Analysis:

The NUMARC IC addresses the key concerns of NUREG-0654.

19. "Other plant conditions exist that warrant precautionary activation of technical support center and placing near-site Emergency Operations Facility and other key emergency personnel on standby."

Disposition:

NUMARC proposed IC HA6, "Other Conditions Existing Which in the Judgment of the Emergency Director Warrant Declaration of an Alert," to cover this and all other conditions not mentioned specifically in other ICs. NUMARC identified this IC as an alert.

Regulatory Analysis:

NUMARC restated this IC to clarify that the basis for these action is consistent with the emergency class description and is not merely added for other administrative reasons.

NUMARC should add this NUREG-0654 IC as an example EAL under HA6.

20. "Evacuation of control room anticipated or required with control of shutdown system established from local station."

Disposition:

This IC is covered as an alert in NUMARC IC HA5, "Control Room Evacuation Has Been Initiated."

Regulatory Analysis:

The NUMARC IC addresses the key concerns of NUREG-0654. NUMARC need not reference plant control because the licensee, if unable to establish control must escalate the condition to a site area emergency under NUMARC IC HS2, "Control Room Evacuation Has Been Initiated and Plant Control Cannot be Established."

NUMARC added no ICs to this emergency class for events not addressed by the example ICs in NUREG-0654.

EMERGENCY CLASSIFICATION: SITE AREA EMERGENCY

Definition in NUREG-0654:

"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 exposures which exceed EPA Protective Action Guidelines exposure levels except near the site boundary.

Disposition of NUREG-0654 Example ICs Under This Emergency Class:

NUMARC addressed a number of the NUREG-0654 ICs in the Fission Product Barrier Degradation ICs. If NUMARC found that the matrix did not adequately describe an event or did not anticipate it in a timely manner, NUMARC provided a separate IC for that event. The matrix is better than the individual events identified in NUREG-0654 because it considers the effect of multiple events or conditions in determining the classification. In comparing the individual NUREG-0654 ICs to the NUMARC matrix, it is important to recognize that the individual events often can be detected by more than one monitored parameter and that the individual events may affect more than one barrier. For example, a loss-of-coolant accident in a PWR affecting the RCS barrier will, if large enough, affect both the fuel clad and containment barriers. The NUMARC Fission Product Barrier Matrix, recognizing these relationships, properly escalates the emergency classification as the additional barriers are challenged or lost.

1. "Known loss of coolant accident greater than make up pump capacity."

   Disposition:

   NUMARC identified this IC as a site area emergency in Fission Product Barrier Degradation IC FS1.

   Regulatory Analysis: PWR

   The licensee would declare a site area emergency due to the loss or potential loss of the RCS and fuel cladding. The loss or potential loss of the RCS would be based upon an unisolable leak that exceeds the

normal charging pump capacity such that a loss of RCS subcooling has occurred. The loss or potential loss of the fuel cladding would be based upon critical safety function status, core exit thermocouple readings, or other indications which resulted from inadequate core cooling.

The NUMARC IC meets the concerns of the NUREG-0654 IC in a more comprehensive manner, in that it addresses multiple events and sequences according to the barriers they affect and offers an escalation path to higher classifications.

Regulatory Analysis: BWR

The licensee would declare that the RCS barrier could be lost if the RCS leakage exceeds 50 gpm inside the drywell or unisolable primary system leakage occurs outside the drywell. The licensee would declare a loss of the RCS barrier on a Main Steam Line Break and Reactor Vessel Water Level low. Either of these events would prompt the licensee to declare an alert. However, the reduction of Reactor Vessel Water Level also indicates that the integrity of the fuel cladding could be lost. Thus, two barriers would be challenged or lost which, by the NUMARC scheme, warrants the declaration of a site area emergency. Other combinations are possible.

The NUMARC IC meets the concerns of the NUREG-0654 IC in a more comprehensive manner, in that it addresses multiple events and sequences according to the barriers they affect and offers an escalation path to higher classifications.

2. "Degraded core with possible loss of coolable geometry."

Disposition:
NUMARC identified this IC as either a site area emergency or a general emergency depending on other conditions surrounding this event, and listed it among the ICs for Fission Product Barrier Degradation.

Regulatory Analysis:
A degraded core implies a prior event that perhaps should have been classified as a general emergency. The NUMARC Fission Product Barrier Matrix contains ICs regarding core cooling for all three barriers. Thus, such an event may be classified as a site area emergency or a general emergency, depending on the coolant temperature (PWR), the coolant level (BWR), the duration of core uncovery, the containment radiation levels, and RCS activity.

The NUMARC IC addresses the key concerns of NUREG-0654.

3. "Rapid failure of steam generator tubes (several hundred gpm leakage) with loss of offsite power.

Disposition:
NUMARC integrated this IC into the ICs for fission product barrier degradation.

Regulatory Analysis:
The licensee could not rapidly and accurately determine the threshold of this NUREG-0654 IC from the Control room. NUMARC determined to categorize this condition according to symptom rather than according to the specific postulated cause or size of the break. In the Fission Product Barrier Matrix, NUMARC identified this event as a loss of the RCS barrier and a loss of the containment barrier (a site area

emergency) if the licensee can not isolate the ruptured steam generator or if contaminated steam continues to be released to the environment.

NUMARC addressed the loss of offsite/onsite power events separately in the ICs for system malfunction. The effect that the loss of offsite power may have on the rapid failure of steam generator tubes will appear as a challenges to the fission product barriers. NUMARC addressed this effect in the ICs for fission product barrier degradation.

The NRC staff accepts this approach.

4. "BWR steam line break outside containment without isolation."

Disposition:
NUMARC identified this IC as a site area emergency and integrated it into the fission product barrier degradation IC, FS1.

Regulatory Analysis:
In the Fission Product Barrier Matrix, NUMARC identified this event as a loss of the RCS barrier. Unisolable primary system leakage outside the drywell constitutes a loss of the containment barrier. The loss of two barriers would require the licensee to declare a site area emergency.

The NUMARC IC adequately addresses the key concerns of NUREG-0654.

5. "PWR steam line break with greater than 50 gpm primary to secondary leakage and indication of fuel damage."

Disposition:
NUMARC classified this IC as at least as a site area emergency and maybe higher under the ICs for Fission Product Barrier Degradation.

Regulatory Analysis:

NUMARC proposed that the licensee classify this event as a site area emergency only if the steam line break is within the containment. Under the following conditions, NUMARC would classify the event as a general emergency because all three barriers would be challenged or lost: (1) the steam line break is outside of the containment of (2) a prolonged release to the environment will occur (i.e., because of a loss of ac power requiring cooldown of ruptured steam generator by atmospheric steam dump, or a relief valve that is stuck open).

The NUMARC approach adequately addresses the key concerns of NUREG-0654.

6. "Loss of offsite power and loss of onsite AC power for more than 15 minutes."

Disposition:

NUMARC identified this IC as a site area emergency in IC SS1, "Loss of All Offsite Power and Loss of All Onsite AC Power to Essential Buses," and an alert in IC SA1, "Loss of All Offsite AC Power and Loss of All Onsite Power During Cold Shutdown or Refueling Mode."

Regulatory Analysis:

NUMARC recognized that the severity of this condition depends on the mode of operation. NUMARC classified this condition as an alert for the cold shutdown and refueling modes. NUMARC retained this IC as an alert because it meets the emergency class description by virtue of the decreased sensible and decay heat, and substantially increased times for cladding damage and radiological releases. However, NUMARC proposes a site area emergency classification for hot shutdown through power operation because of the much greater potential for core damage and fission product barrier challenges resulting from the increased risk associated with the removal of the sensible and decay heat.

The staff is studying shutdown risk to gain more insight on the risks associated with shutdown and to provide the basis for developing a comprehensive set of shutdown EALs. The NRC staff concurs with this approach until it can review the findings of the shutdown risk studies.

7. "Loss of all onsite DC power."

Disposition:
NUMARC identified this IC as a site area emergency IC SS3, "Loss of All Vital DC Power," and an alert in IC SA3, "Inability to Maintain Plant In Cold Shutdown."

Regulatory Analysis:
NUMARC recognized that the severity of this condition depends on the mode of operation. A loss of DC power is significant because it affects the ability of the licensee to maintain the plant in a safe condition.

In IC SA3, NUMARC proposed that the licensee declare an alert when the loss of dc power results in an inability to remove decay heat during the cold shutdown and refueling modes. However, a loss of dc power is only one of the conditions that can cause the licensee to lose the ability to remove decay heat. The NUMARC EAL addresses the consequences rather than the root cause.

This condition is classified as a site area emergency for the hot shutdown through power operation modes because of the effects the loss of vital dc power has on controlling and monitoring functions necessary to maintain CSFs.

The NRC concurs with this approach.

8. "Complete loss of any plant function needed for hot shutdown."

Disposition:
This IC results in a site area emergency under NUMARC IC SS4, "Complete Loss of Function Required to Achieve or Maintain Hot Shutdown."

Regulatory Analysis:
In the basis of this IC, NUMARC clarified that the complete loss of <u>any</u> function required to achieve or maintain hot shutdown qualifies as this IC.

The NRC staff agrees that this IC adequately covers the key concerns of NUREG-0654.

9. "Transient requiring operation of shutdown systems with failure to scram (continued power generation but no core damage immediately evident)."

Disposition:
This IC would require the licensee to declare a site area emergency under NUMARC IC SS2, "Failure of Reactor Protection System Instrumentation to Complete or Initiate an Automatic Scram Once a Reactor Protection System Setpoint Has Been Exceeded and Manual Scram Was NOT Successful."

Regulatory Analysis:
NUMARC SS2 is the logical escalation path of SA2 if the plant's automatic scram system does not respond to a valid scram signal and the manual scram fails to bring the reactor to a subcritical state (ATWS condition).

The NRC staff accepts the NUMARC approach.

10. "Major damage to spent fuel in containment or fuel handling building (e.g., large object damages fuel or water loss below fuel level)."

Disposition:
This IC would require the licensee to declare a site area emergency under NUMARC IC SS5, "Loss of Water Level in the Reactor Vessel That Has or Will Uncover Fuel in the Reactor Vessel." If this IC involves fuel outside the reactor vessel in PWRs and BWRs, the licensee would declare an alert under NUMARC IC AA2, "Major Damage to Irradiated Fuel or Loss of Water Level that Has or Will Result in Uncovering of Irradiated Fuel Outside the Reactor Vessel."

Regulatory Analysis:
The manner in which NUMARC treats this condition depends on the location of the fuel at the time of this event.

NUMARC chose to decrease the severity of the fuel incident outside of the reactor vessel to follow the guidance in NUREG/CR-4982, "Severe Accident in Spent Fuel Pools in Support of Generic Safety Issue 82." In NUREG/CR-4982, the NRC concluded that the probability of injury would be low and that no fatalities would result even if corrective actions were not taken. These conclusions and the amount of time that would lapse after these events before the fuel would be damaged significantly indicate that the threshold for a site area emergency is not exceeded for events outside of the reactor vessel. The quantity of decay heat could increase if the event occurred inside the reactor vessel, which would warrant declaring a site area emergency as an anticipatory response. Further escalation would be by radiation monitor ICs.

The NRC staff concurs with this change.

11. "Fire compromising the functions of safety systems."

Disposition:
NUMARC identified fire in vital areas of the plant as an alert in IC HA2, "Fire Affecting the Operability of Plant Safety Required for the Current Operating Mode," unless other ICs stipulate that the consequences of the fire warrant classifying the condition as a site area emergency.

Regulatory Analysis:
By declaring the alert, the licensee would ensure that it receives support from the Technical Support Center and that it increases the plant monitoring capability. To address the large number of fire-initiated damage scenarios that could result from fire, all with varying levels of consequences, the NUMARC methodology provides that the licensee would escalate the condition according to the consequential damages and their effect on the performance of critical safety functions, as stated in other NUMARC event ICs and in the Fission Product Barrier Matrix.

The NRC staff concurs with this change.

12. "Most or all alarms (annunciators) lost and plant transient in progress."

Disposition:
NUMARC identified this IC as a site area emergency in IC SS6, "Inability to Monitor a Significant Transient in Progress" and as an alert in IC SA4, "Unplanned Loss of Most or All Safety System Annunciation or Indication in Control Room with Either (1) a Significant Transient in Progress, or (2) Compensatory Non-Alarming Indicators are Unavailable."

Regulatory Analysis:

In IC SS6, NUMARC proposed that the licensee declare a site area emergency when a transient is in progress and the operating crew can not monitor the plant response.

NUMARC recognizes that redundant systems such as SPDS and the passive, non-annunciating systems as backup to plant annunciators should ensure that the operator has the ability to monitor a transient. Under these circumstances, the licensee should declare an alert to ensure that it receives support from the Technical Support Center and has increased plant monitoring capability.

The discriminating factor between an alert and a site area emergency is the ability of the operator to monitor the transient in progress.

This is an acceptable change.

13. "a. Effluent monitors detect levels corresponding to greater than 50 mr/hr for 1/2 hour or greater than 500 mr/hr W.B. for two minutes (or five times these levels to the thyroid) at the site boundary for adverse meteorology

b. These dose rates are projected based on other plant parameters (e.g., radiation level in containment with leak rate appropriate for existing containment pressure) or are measured in the environs

c. EPA Protective Action Guidelines are projected to be exceeded outside the site boundary."

Disposition:

NUMARC classified Part "c" of this NUREG-0654 as a general emergency under IC AG1. NUMARC modified the remaining conditions and classified them as a site area emergency under IC AS1, "Site Boundary Dose Resulting from an Actual or Imminent Release of Gaseous

Radioactivity Exceeds 100 mR Whole Body or 500 mR Child Thyroid for the Actual or Projected Duration of the Release."

Regulatory Analysis:
Exceeding Environmental Protection Agency (EPA) Protective Action Guidelines (PAGs) outside the site boundary has become, by exercise practice, the threshold for a general emergency. Therefore, NUMARC addressed part "c" under AG1, which results in a higher emergency class.

The dose rates identified in part "a," which indicate failures of equipment necessary to protect the public, lacked clarity. Instead of using the specified dose rates for specified duration, NUMARC chose criteria based on dose. The 100 mR whole body and 500 mR child thyroid values are 10 percent of the EPA Protection Action Guides. These values are appropriate thresholds for a site area emergency because 100 mR whole body is the non-occupational annual radiation exposure limit in the revised 10 CFR 20.

The NRC staff agrees with this approach.

14. "Imminent loss of physical control of the facility."

Disposition:
This IC would require the licensee to declare one of the following:

a. A general emergency under NUMARC IC HG1, "Security Threat Resulting in Loss of Ability to Reach and Maintain Cold Shutdown," NUMARC IC HG2, "Other Conditions Which in the Judgment of the Emergency Director Warrant Declaration of a General Emergency"

b. A site area emergency under NUMARC IC HS1, "Security Event in a Vital Area," NUMARC IC HS2, "Control Room Evacuation Has Been Initiated and Plant Control Cannot Be Established," and NUMARC IC

HS3, "Other Conditions which in the Judgment of the Emergency Director Warrant Declaration of a Site Area Emergency."

Regulatory Analysis:

NUMARC recognized the severity of this condition in classifying it as either a general emergency or a site area emergency. If the plant staff will not be able to control the facility and thus lose the ability to maintain fission product barriers, the licensee should declare a general emergency. Those conditions not immediately threatening a loss of physical control of the entire facility meet the definition of site area emergency.

The NRC staff agrees.

15. "Severe natural phenomena being experienced or projected with the plant not in cold shutdown."

a. Earthquake greater than SSE levels
b. Flood, low water, tsunami, hurricane surge, seiche greater than design levels of failure of protection of vital equipment at lower levels
c. Sustained winds or tornadoes in excess of design levels

Disposition:

NUMARC proposed that the licensee declare a site area emergency for these events only if they adversely affect the Fission Product barriers under the Fission Product Barrier Degradation ICs, the System Malfunction ICs, and HS3, "Other conditions existing which in the judgment of the Emergency Director warrant the Declaration of a Site Area Emergency." Otherwise, these events, which would cause no consequential damage, would warrant that the licensee declare an alert under the NUMARC IC HA1, "Natural and Destructive Phenomena Affecting Plant Vital Area."

Regulatory Analysis:

Consequential damage to safety system from these hazards would prompt the licensee to declare a site area emergency under other NUMARC ICs, depending on specific circumstances. The ICs for the fission product barrier would most likely be the NUMARC ICs to address the effects of such events and provide for the appropriate classification. The NUMARC approach anticipates these events sufficiently to address the results of multiple failures, whether they have a common cause or not.

NUMARC proposed that, if the licensee does not find an indication of consequential damage, these events would warrant an alert, thus ensuring that the licensee receives support from the Technical Support Center for an increased plant monitoring capability.

The NRC staff agrees.

16. "Other hazards being experienced or projected with the plant not in cold shutdown."

    a. Aircraft crash affecting vital structures by impact or fire.
    b. Severe damage to safe shutdown equipment from missiles or explosion.
    c. Entry of uncontrolled flammable gases in vital areas. Entry of uncontrolled toxic gases into vital areas where lack of access to the area constitutes a safety problem.

Disposition:

NUMARC classified these events as warranting a site area emergency only if consequential damage could cause the loss of two fission product barriers under the fission product barrier matrix, the System Malfunction ICs, or HS3, "Other conditions existing which in the judgment of the Emergency Director warrant the Declaration of a Site Area Emergency." Without such consequences, such events are classified as alerts under the NUMARC IC HA1, "Natural and Destructive Phenomena Affecting Vital Areas," and NUMARC IC HA3, "Release of Toxic or Flammable Gases within a Facility Structure Which Jeopardizes Operation of Systems Required to Establish and Maintain Cold Shutdown."

Regulatory Analysis:
Consequential damage to safety system from these hazards could prompt the licensee to declare a site area emergency under other NUMARC ICs, depending on specific circumstances. The results of this IC only qualify as an alert unless two Fission Product barriers could be lost, the System Malfunction ICs are met, or the Emergency Director determines otherwise. This classification ensures that the licensee would receive support from the Technical Support Center and increased plant monitoring capability. As stated on page 5-2, NUMARC ICs anticipate these events sufficiently to address the results of multiple failures, regardless of whether or not they have a common cause.

The NRC staff agrees.

17. "Other plant conditions exist that warrant activation of emergency centers and monitoring teams or a precautionary notification to the public near the site."

Disposition:
NUMARC provided that, if conditions warrant the declaration of a site area emergency, the emergency director can use discretion in IC HS3, "Other Conditions Which in the Judgment of the Emergency Director Warrant Declaration of a Site Area Emergency."

Regulatory Analysis:
The NUMARC IC addresses the key concerns of NUREG-0654.

The NRC staff agrees.

18. "Evacuation of control room and control of shutdown systems not established from local stations in 15 minutes."

Disposition:
This IC would prompt the licensee to declare a site area emergency in IC HS2, "Control Room Evacuation Has Been Initiated and Plant Control Cannot be Established."

Regulatory Analysis:
The NUMARC IC addresses the key concerns of NUREG-0654.

The NRC staff agrees.

Other NUMARC ICs in this emergency class for events not addressed by the example ICs listed in NUREG-0654 include the following:

The NUMARC Fission Product Barrier Matrix allow for more combinations of events than are specifically identified in NUREG-0654.

EMERGENCY CLASSIFICATION: GENERAL EMERGENCY

Definition in NUREG-0654:

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

Disposition of NUREG-0654 Example ICs Under This Emergency Class:

NUMARC addressed a number of the NUREG-0654 ICs in the NUMARC Fission Product Barrier Degradation ICs. If NUMARC found that the matrix did not adequately describe an event or did not anticipate it in a timely manner, NUMARC provided a separate IC for that event. The matrix is better than the individual events identified in NUREG-0654 because the matrix considers the effect of multiple events or conditions in determining the classification. In comparing the individual NUREG-0654 ICs to the NUMARC matrix, it is important to recognize that the individual events often can be detected by more than one monitored parameter and that the individual events may affect more than one barrier. For example, a loss of coolant accident in a PWR affecting the RCS barrier could affect both the fuel cladding and containment barriers. The NUMARC Fission Product Barrier Matrix, recognizing these relationships, properly escalates the emergency classification as the additional barriers are challenged or lost.

1. "Example radiation monitoring and dose assessment initiating conditions:
   a. Effluent monitors detect levels corresponding to 1 rem/hr W.B. or 5 rem/hr thyroid at the site boundary under actual meteorological conditions.
   b. These dose rates are projected based on other plant parameters (e.g., radiation levels in containment with leak rate appropriate for existing containment pressure with some confirmation from effluent monitors) or are measured in the environs."

Disposition:
This IC would prompt the licensee to declare a general emergency. NUMARC addressed this IC in IC AG1, "Site Boundary Dose Resulting from an Actual or Imminent Release of Gaseous Radioactivity that Exceeds 1000 mR Whole Body or 5000 mR Child Thyroid for the Actual or Projected Duration of the Release Using Actual Meteorology."

Regulatory Analysis:
The NUMARC IC fully addresses the NUREG-0654 IC.

The NRC staff agrees.

2. "Loss of 2 of 3 fission product barriers with a potential loss of 3rd barrier, (e.g., loss of primary coolant boundary, clad failure, and high potential for loss of containment."

Disposition:
NUMARC fully addressed this IC in the Fission Product Barrier Matrix as the fundamental definition of a general emergency.

Regulatory Analysis:
The FG1 IC fully addresses all the permutations for the loss of two of the three fission product barriers with the potential loss for the third barriers. NUMARC offered a whole range of ICs based on the status of the three major Fission Product barriers. Thus, NUMARC is providing the operator with an escalation path to higher classifications according to the effect of the event(s) on particular barriers. NUREG-0654 does not provide the operator with this ability.

The NRC staff finds the barrier approach in NUMARC to be a significant improvement.

3. "Loss of Physical Control of the Facility."

Disposition:
This IC would prompt the licensee to declare a general emergency. NUMARC addressed this IC in IC HG1, "Security Event Resulting in Loss of Ability to Reach and Maintain Cold Shutdown," and IC HG2, "Other Conditions Which in the Judgment of the Emergency Director Warrant Declaration of a General Emergency."

Regulatory Analysis:
The NUMARC ICs address the NUREG-0654 IC.

The NRC staff agrees.

4. "Other plant conditions exist, from whatever source, that make release of large amounts of radioactivity in a short time possible, e.g., any core melt situation."

and

5. "Example PWR Sequences"

and

6. "Example BWR Sequences"

Disposition:
This IC would prompt the licensee to declare a general emergency in the Fission Product Barrier Matrix, NUMARC IC SG1, "Prolonged Loss of All Offsite Power and Prolonged Loss of All Onsite AC Power," and NUMARC IC SG2, "Failure of the Reactor Protection System to Complete an Automatic Scram and Manual Scram was NOT Successful and There is Indication of an Extreme Challenge to the Ability to Cool the Core."

Regulatory Analysis:

NUMARC developed the fission product barrier matrix, which allows for many more permutations than could be included in a list of specific sequences. This matrix reflects the belief of the industry that no list could be all inclusive. In developing the matrix, NUMARC used fundamental indications of core melt sequences as the basis for declaring a general emergency. The matrix encompasses in the general emergency classification those sequences that could result in offsite radiological releases. Indicators of potential and actual losses of the Containment barrier do not indicate directly the status of the containment barrier. Instead, they indicate core melt sequences that could result in significant offsite radiological consequences.

NUMARC determined that the containment barrier in a PWR could be lost if, for any reason, the core exit thermocouple readings exceeded 1200°F (or exceeded 700°F with the level below top of active fuel) and the restoration procedures were not effective within 15 minutes. Core exit thermocouple readings of greater than 1200°F regardless of duration, mean that the Fuel cladding barrier is lost. The saturation pressure corresponding to 1200°F would cause subcooling to be lost. A loss of subcooling is a loss of the RCS barrier. This results in a loss of two barriers and could cause the third to be lost. The improbable pressurized vessel sequence analyzed in severe accident studies is possible only with a station blackout, which under these conditions would be declared as a general emergency under NUMARC IC SG1.

NUMARC determined that the containment barrier for a BWR could be lost if the water level in the reactor vessel is less than a (site specific) value and if the core remains uncovered for longer than the maximum core uncovery time. If the water level in the reactor vessel covers less than the top of active fuel or less than 2/3 of the core depending on the plant, for even a brief period, the fuel cladding barrier and the RCS barrier would both be lost. Thus, two barriers would be lost and the third could be lost.

NUMARC provided IC SG1, "Prolonged Loss of All Offsite Power and Prolonged Loss of All Onsite AC Power," recognizing the importance of ac power in restoring challenged or lost critical safety functions. NUMARC developed IC SG2, "Failure of the Reactor Protection System to Complete an Automatic Scram and Manual Scram was NOT Successful and There is Indication of an Extreme Challenge to the Ability to Cool the Core," recognizing that emergency core cooling systems can not remove greater than decay heat.

The NUMARC IC addresses the key concerns of NUREG-0654.

The NRC staff accepts this NUMARC approach.

7. "Any major internal or external events (e.g., fires, earthquakes, substantially beyond design basis) which could cause massive common damage to plant systems resulting in any of the above."

Disposition:
NUMARC deleted this IC because this type of event would better be addressed under symptom-based and barrier-based ICs.

Regulatory Analysis:
NUMARC did not provide an IC for this event in particular. However, to respond to the consequences for such events when challenging the integrity of the fission product barriers, the licensee would likely declare a general emergency under NUMARC IC FG1, "Loss of ANY Two Barriers and Potential Loss of Third Barrier." Other NUMARC ICs which could consequences of such events and would prompt the licensee to declare a general emergency are IC HG1, "Security Event Resulting in Loss of Ability to Reach and Maintain Cold Shutdown," IC HG2, "Other Conditions Which in the Judgment of the Emergency Director Warrant Declaration of a General Emergency," and IC SG1, "Prolonged Loss of All Offsite Power and Prolonged Loss of All Onsite AC Power."

Other NUMARC ICs under this emergency class addressing events not addressed by the example ICs listed in NUREG-0654 include the following:

SG1, "Prolonged Loss of All Offsite Power and Prolonged Loss of All Onsite AC Power"

The NUMARC Fission Product Barrier Matrix allows for more combinations of events than are specifically identified in NUREG-0654.