Nuclear Energy Institute
International Event Scale Meeting
June 25, 2003

On January 14, 2002, the Nuclear Regulatory Commission (NRC) issued Regulatory Issue Summary (RIS) 2002-01, "Changes to NRC Participation in the International Nuclear Event Scale (INES)". On July 26, 2002, the Nuclear Energy Institute (NEI) met with the NRC staff in a public meeting in Rockville, Maryland to discuss the INES program changes and provide recommendations for changes in the implementation of the program based on potential unintended consequences.

Overview

The purpose of the INES is to facilitate communication and understanding on the safety significance of events occurring at nuclear installations. The world wide audience includes the nuclear community, the media, and the public. In general, the nuclear community is knowledgeable, able to understand the safety significance of an event, and trained to apply the operating experience (OE) communicated by the INES classification to improve their plant operational safety based on the shared information. The media and public may be less knowledgeable and less likely to fully comprehend the safety significance of an event classification.

The 2001 edition of the INES User's Manual states that the scale does not replace the criteria already adopted nationally and inter-nationally for the technical analysis and reporting of events to safety authorities nor does it form a part of the formal emergency arrangements that exist to deal with radiological accidents. In no way is usage of the INES intended to change the way event notifications are made in accordance with 10 CFR 50.72 or 10 CFR 50.73 or is usage of the INES intended to change the way events are classified in accordance with a utilities NUREG-0654 or NUMARC EAL based set of Emergency Plan emergency action levels (EALs). NEI appreciates the time and effort which the NRC has devoted to discussing and reviewing the industry's concerns. The specific concerns are communicated below.

I. Provisional Ratings and Prompt Publication of Ratings

NEI believes that provisional ratings reported to the IAEA by the NRC from preliminary information has the potential to be inaccurate, have unwarranted adverse impact on the utility, and needlessly decrease public confidence. Communications on event classification need to be based on as accurate an assessment of the significance as possible. To minimize the potential for falsely alerting the public, NEI requests that the licensees have an opportunity to review and provide comments on the INES report before it is submitted to the IAEA to ensure accuracy. Additionally, such a review, would further help the licensees to prepare their own public relations response. This is especially important with events rated at INES Level of 3 or less that may not have corresponding NRC emergency action levels and therefore would not result in an emergency classification. The recently reported events at Davis Besse (INES level 3) and Point Beach (INES Level 2) did not have a corresponding emergency action level.

Incorrect characterization could result in damaging, unintended consequences such as a loss of public confidence and misinterpretation of a non-risk significant event. An INES rating of 2 or above indirectly addresses licensee's performance. Publicizing such a rating in two days, which is the policy described in SECY-01-0071, after notification of an event is not consistent with any other agency rating system significance assessment processes including Reactor Oversight Program, Significance Determination Process, Enforcement, or Accident Sequence Precursor.

II. Fuel Damage Classification Concerns

The INES User's Manual additionally states that although broadly comparable, nuclear and radiological safety criteria and the terminology used to describe the criteria vary from country to country. The INES User's manual encourages user countries to clarify the scale within their national context. NEI suggests that the INES User's Manual be clarified to include measurable quantitative criteria for fuel damage rather than the current INES qualitative (subjective) criteria. Incorporation of qualitative criteria as detailed below could enhance the consistency of reporting and the understanding of the ratings by industry since they provide measurable criteria.

The INES On-Site criteria classification path for radiological barrier damage (fuel damage) appears to be unclear or overly conservative. Examples include interpretation of the meaning of statements such as "a few percent of the core inventory has been released from the fuel assemblies". Is this only the activity in the gap or does it include the total curie content of the core? Is this the result of mechanical damage to the fuel or is an actual safety significant overheat required?

The following example demonstrates how the risk informed Defense-in-Depth criteria may be overshadowed by the subjectively written On-Site criteria:

In most US industry events involving fuel clad damage over the last 20 years, RCS activity has remained within the Technical Specification LCO range with I-131 coolant activity remaining in the acceptable operating range of the Technical Specification activity limit curve (an example typical PWR curve is attached). Using a literal interpretation of the INES criteria these events could have been misinterpreted, especially for BWR events, and end up being over-classified using On-Site impact criteria instead of Defense-in-Depth impact criteria. The following supporting details assume that "barrier damage" or "core damage" is synonymous with "clad damage" (i.e.. this is not an overheat/melt condition):

- INES On-Site criteria defines Level 5 "severe core damage" as more than a few % core inventory released from the fuel assemblies
  - If assume that PWR (BWR) coolant activity would be 2e4 (1e3) uc/gm for a 100% gap activity release (source: RTM-96)
  - Then PWR 3% core release ~ 600 uc/gm I-131 coolant activity
  - Then BWR 3% core release ~ 30 uc/gm I-131 coolant activity
- INES On-Site criteria defines Level 4 "significant core damage" as more than 0.1 % core inventory released from the fuel assemblies
  - Then PWR 0.1% core release ~ 20 uc/gm I-131 coolant activity
  - Then BWR 0.1% core release ~ 1 uc/gm I-131 coolant activity

Without clarification this could result in an overly conservative INES classification of a relatively minor fuel event while a unit is still operating within licensed Technical Specification limits.

Since perception may be an individual's reality, incorrect characterization could result in the damaging unintended consequence of loss of public confidence through misinterpretation of a non-risk significant event. Unintended consequences can be avoided by proactively clarifying the On-site impact criteria and adding examples to the Defense-in-Depth impact criteria.

Fuel Damage Qualitative Criteria Recommendations

1) On-Site Impact Level 5 Clarification

Definition and Sheet 3 Note 1: Severe Damage to the reactor core or radiological barriers

More than a few per cent of the fuel in a power reactor is molten or more than a few per cent of the core inventory has been released from the fuel assemblies. Incidents at other installations involving a major release of radioactivity on the site (comparable with the release from a core melt) with a serious off-site radiological safety threat. Examples of non-reactor accidents would be a major criticality accident, or a major fire or explosion releasing large quantities of activity within the installation.

Recommended Change:

More than 20 per cent of the fuel gap in a power reactor has been released into the reactor coolant and subsequently into the containment from the fuel assemblies. Incidents at other installations involving a major release of radioactivity on the site (comparable with a major release from the fuel clad gap) with a serious off-site radiological safety threat.

Change Justification:

A major release of radioactivity requiring offsite protective actions is not possible unless the containment barrier fails subsequent to a major failure of fuel cladding allowing radioactive material to be released from the core into the reactor coolant. 20 per cent fuel gap release is a value which indicates severe fuel damage. Regardless of whether containment is challenged, this amount of activity in containment, if released, could have such severe consequences that it is prudent to treat this as a potential loss of containment. NUREG-1228, "Source Estimations During Incident Response to Severe Nuclear Power Plant Accidents," indicates that such conditions do not exist when the amount of clad damage is less than 20%. This definition is consistent with the Emergency Action Level (EAL) classification methodology of NEI 99-01, Revision 4, for a General Emergency. Short-term, the evaluation of whether the activity release is a result of damaged clad due to fuel melting is irrelevant and would require either non-ALARA sampling/analysis and/or possible visual fuel inspection to determine. This change is believed to risk inform the definition based on US established classification criteria. The detailed determination of core melt percentage (especially localized occurrences) is not seen as important – it is simply information and does not change actions that will be performed to minimize exposure and contamination spread. This conclusion is also supported by PASS elimination documentation which clearly indicates that non-ALARA detailed sampling and analysis is not needed to adequately develop protective actions to protect the public.

2) On-Site Impact Level 4 Clarification

Definition and Sheet 3 Note 2: Significant damage to the reactor core or radiological barriers

Any fuel melting has occurred or more than about 0.1% of the core inventory of a power reactor has been released from the fuel assemblies. Events at non-reactor installations

involving the release of a few thousand terabecquerels of activity from their primary containment which cannot be returned to a satisfactory storage area.

Recommended Change:
More than a few per cent of the fuel gap (reactor coolant activity >300 μc/cc DEI) in a power reactor has been released into the reactor coolant and subsequently into the containment from the fuel assemblies. Events at non-reactor installations involving the release of a few thousand terabecquerels (8.1e4 Ci) of activity from their primary containment which cannot be returned to a satisfactory storage area.

Change Justification:
A release of radioactivity requiring on-site protective actions from core damage is not possible unless the containment barrier fails subsequent to a partial failure of fuel cladding allowing radioactive material to be released from the core into the reactor coolant. 5 per cent fuel gap release (reactor coolant activity >300 μc/cc DEI) is a concentration indicative of fuel damage several times larger than the maximum fuel leakage (including iodine spiking) allowed within technical specifications and is therefore indicative of significant fuel damage. This definition is consistent with the Emergency Action Level (EAL) classification methodology of NEI 99-01, Revision 4, for a Site Area Emergency. Escalation to level 5 would occur should activity levels rise to a 20% value. Short-term, the evaluation of whether the activity release is a result of damaged clad due to fuel melting is irrelevant and would require either non-ALARA sampling/analysis and/or possible visual fuel inspection to determine.

3) On-Site Impact Level 3 Clarification

Definition and Sheet 3 Note 3: Significant release from barriers which can be returned to a satisfactory storage area
Events resulting in the release of a few thousand terabecquerels of activity into a secondary containment where the material can be returned to a satisfactory storage area.

Recommended Change:
More than a few per cent of the fuel gap (reactor coolant activity >300 μc/cc DEI) in a power reactor has been released into the reactor coolant from the fuel assemblies. Events resulting in a release of a few thousand terabecquerels (8.1e4 Ci) of activity into a secondary containment where the material can be returned to a satisfactory storage area.

Change Justification:
A release of radioactivity requiring on-site protective actions from core damage is not possible unless a partial failure of fuel cladding allows radioactive material to be released from the core into the reactor coolant. 5 per cent fuel gap release (reactor coolant activity >300 μc/cc DEI) is a concentration indicative of fuel damage several times larger than the maximum fuel leakage (including iodine spiking) allowed within technical specifications and is therefore indicative of fuel damage. With the fuel activity contained within the reactor coolant system, contamination spread may be controlled and activity levels may be reduced through installed isolation and cleanup systems. This definition is consistent with the Emergency Action Level (EAL) classification

methodology of NEI 99-01, Revision 4, for an Alert Emergency. Escalation to level 4 would occur should significant reactor coolant leakage into containment subsequently occur.

4) Defense in Depth Level 2 Clarification

Recommended Example Addition:

DEI elevated into the Unacceptable Operation region of the Technical Specification transient limit requiring shutdown.

Change Justification:

Example is consistent with current Defense-In Depth approach. If Level 2 criteria is met then the event is most likely not due to just an Iodine spike therefore indicating potential clad failure. Level 2 classification is therefore appropriate. This definition is consistent with the Emergency Action Level (EAL) classification methodology of NEI 99-01, Revision 4, for a Notification of Unusual Event based on a Technical Specification required shutdown. Escalation to level 3 would occur should reactor coolant activity exceed 300 μc/cc DEI.

5) Defense in Depth Level 1 Clarification

Recommended Example Addition:

DEI elevated into the Allowable Operation region of the Technical Specification transient limit for greater than the specified action statement time limit requiring shutdown.

Change Justification:

Example is consistent with current Defense-In Depth approach. If Level 1 criteria is met then the event is most likely due to an Iodine spike and not an indication of potential clad failure. Level 1 classification is therefore appropriate. This example would probably not result in the Emergency Action Level (EAL) classification methodology of NEI 99-01, Revision 4, being exceeded since the plant would most likely be shutdown proactively prior to exceeding the action statement time limit. Technical Specifications would require notifications and documentation of the event per the LER process. Escalation to level 2 would occur should reactor coolant activity exceed the Allowable Operation region of the transient limit curve.

6) Defense in Depth Level 0 Clarification

Recommended Example Addition:

DEI elevated out of normal Technical Specification operating limit but returned to within normal operating limit within specified action statement time limit with no shutdown required

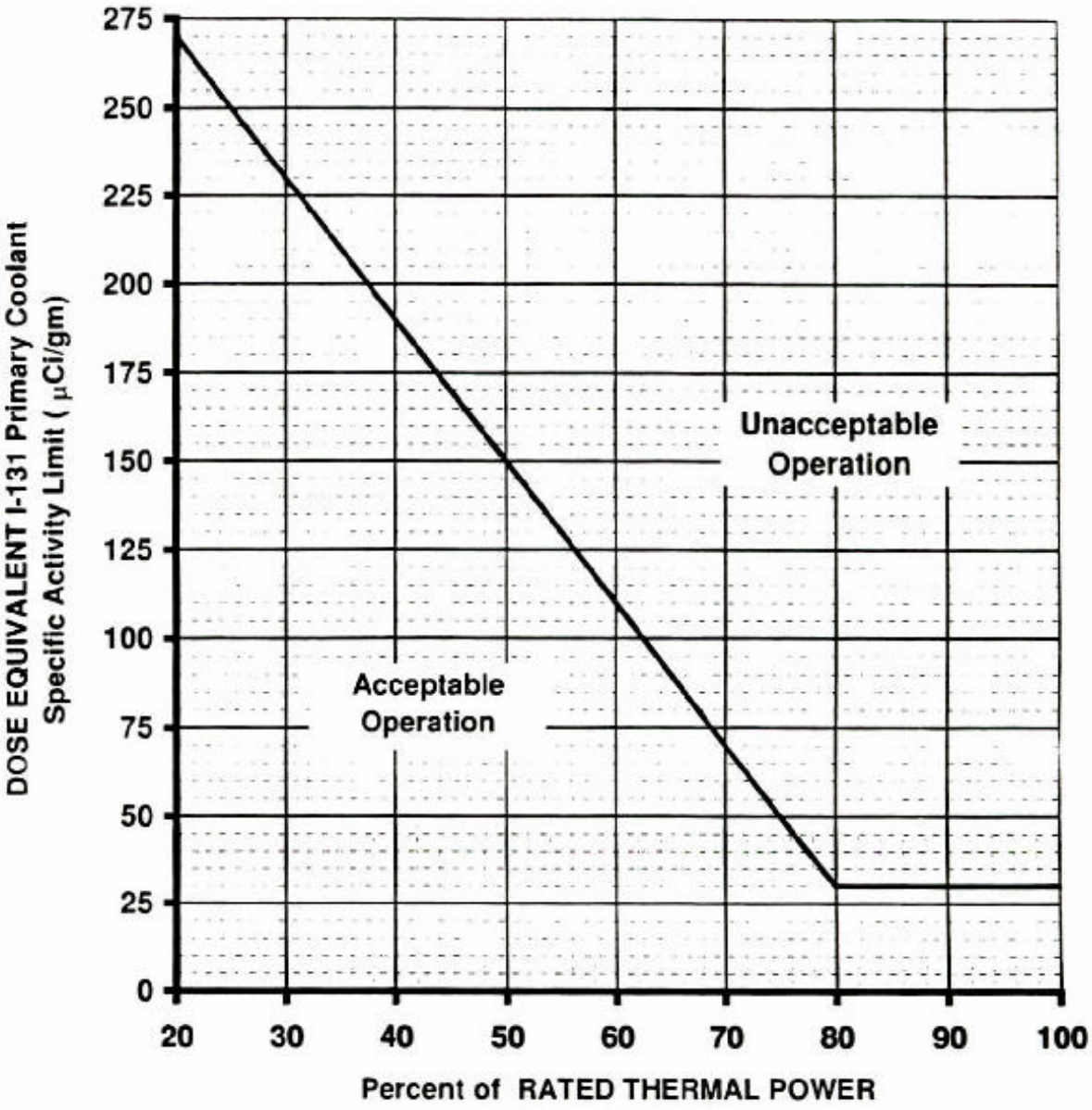
Change Justification:

Example is consistent with current Defense-In Depth approach. If Level 0 criteria is met then the plant is operating within normal licensed parameters and no safety risk exists. Level 0 classification is therefore appropriate. This example would not result in the Emergency Action Level (EAL) classification methodology of NEI 99-01, Revision 4, being exceeded and would therefore not result in an emergency classification. Escalation to level 1 would occur should reactor coolant activity increase above normal operating limits and not return within the allowable transient time limit.

This meeting introduced minor revisions to the Defense in Depth examples previously provided to NRC from NEI via letter dated May 29, 2003. The revised examples better categorize risk to

the public based on current INES definitions and therefore facilitate better communication of event safety significance.

As industry prepares for the increased participation in the INES program, NEI desires to keep an ongoing dialogue with the NRC concerning the implementation of the INES program changes.



PWR Typical Technical Specification Activity Example Curve