International Nuclear Event Scale (INES) Meeting

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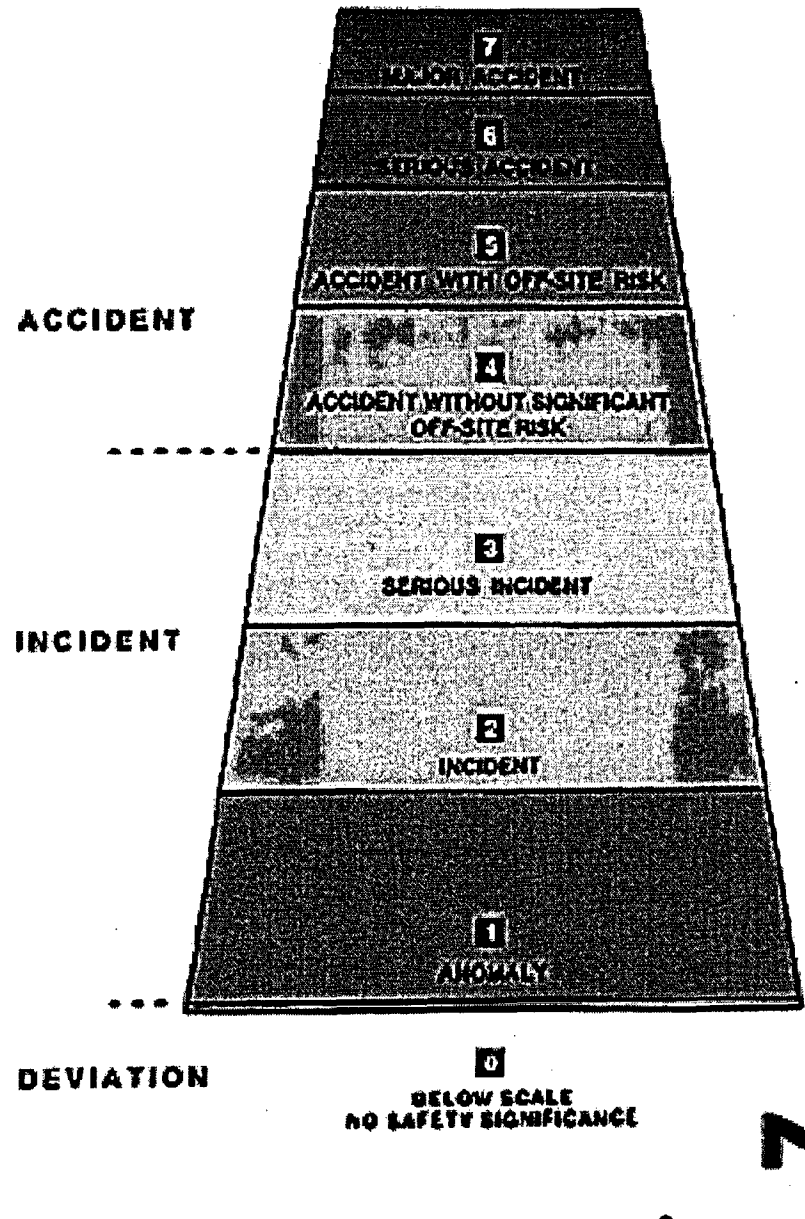
Purpose

INES facilitates communication and understanding of event safety significance



INES Limitations

- "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"

INES Recommendation

- "Although broadly comparable, nuclear and radiological safety criteria and the terminology used to describe them vary from country to country"
- "The international scale has been designed to take account of this fact, but it is possible that user countries may wish to clarify the scale within their national context"

INES Usage

- Events are considered in terms of three different areas of impact:
  - Off-site impact
  - On-site impact
  - Defense-in-depth impact
- An event which has an impact on more than one area is always rated at the highest of the seven possible levels identified

	AREA OF IMPACT		
	OFF-SITE IMPACT	ON-SITE IMPACT	IMPACT ON DEFENCE IN DEPTH
7 MAJOR ACCIDENT	MAJOR RELEASE: WIDESPREAD HEALTH AND ENVIRONMENTAL EFFECTS		
6 SERIOUS ACCIDENT	SIGNIFICANT RELEASE: LIKELY TO REQUIRE FULL IMPLEMENTATION OF PLANNED COUNTERMEASURES		
5 ACCIDENT WITH OFF-SITE RISK	LIMITED RELEASE: LIKELY TO REQUIRE PARTIAL IMPLEMENTATION OF PLANNED COUNTERMEASURES	SEVERE DAMAGE TO REACTOR CORE/RADIOLOGICAL BARRIERS	
4 ACCIDENT WITHOUT SIGNIFICANT OFF-SITE RISK	MINOR RELEASE: PUBLIC EXPOSURE OF THE ORDER OF PRESCRIBED LIMITS	SIGNIFICANT DAMAGE TO REACTOR CORE/RADIOLOGICAL BARRIERS/FATAL EXPOSURE OF A WORKER	
3 SERIOUS INCIDENT	VERY SMALL RELEASE: PUBLIC EXPOSURE AT A FRACTION OF PRESCRIBED LIMITS	SEVERE SPREAD OF CONTAMINATION/ACUTE HEALTH EFFECTS TO A WORKER	NEAR ACCIDENT NO SAFETY LAYERS REMAINING
2 INCIDENT		SIGNIFICANT SPREAD OF CONTAMINATION/ OVEREXPOSURE OF A WORKER	INCIDENTS WITH SIGNIFICANT FAILURES IN SAFETY PROVISIONS
1 ANOMALY			ANOMALY BEYOND THE AUTHORIZED OPERATING REGIME
0 DEVIATION	NO SAFETY SIGNIFICANCE		

Industry Concern

- Current fuel damage/melt definitions could result in an overly conservative INES classification of a relatively minor event
  - Could still be operating within Tech Spec limits
  - Risk informed Defense-in-Depth criteria overshadowed by On-site criteria
- Perception is reality
  - Incorrect initial characterization could result in damaging unintended consequences
    - Misinterpretation of a non-risk significant event

NEI

On-Site Criteria

- On-Site criteria for radiological barrier damage (fuel damage) appears to be unclear or overly conservative
- INES classifies "severe core damage" at Level 5
  - Defined 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 classifies "significant core damage at Level 4
  - Defined 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

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.

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.

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.

Defense in Depth Criteria

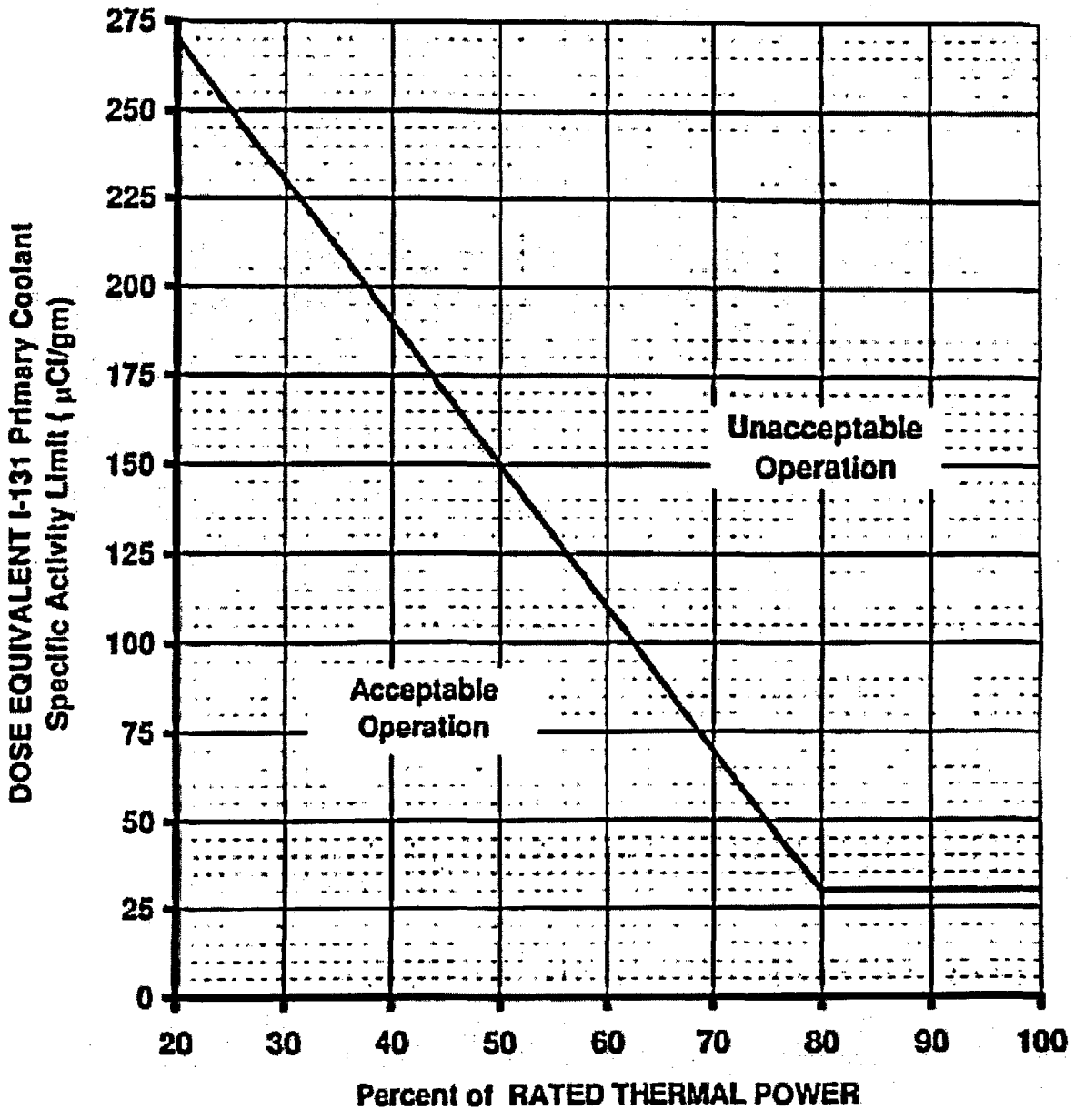
- Has multiple examples provided for the user but excludes examples dealing with RCS activity and clad damage

- Recommend RCS activity examples be added for clarification

Defense in Depth -Examples

- Level 2
  - DEI elevated into the Unacceptable Operation region of the Technical Specification transient limit requiring shutdown
- Level 1
  - DEI elevated into the Allowable Operation region of the Technical Specification transient limit for greater than the specified action statement time limit requiring shutdown
- Level 0
  - 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

PWR Technical Specification Example



Questions???