

CRITICALITY INCIDENT DETECTION

GEOFF DRUCE

CRITICALITY INCIDENT DETECTION

Aims & Objectives

- to provide the IRMF community with an overview of criticality incident detection & alarm systems
- to discuss the requirement to assign the system with a 'safety status' (Nuclear Site Licence Condition)
- to describe the importance of criticality incident detection & alarm system testing to demonstrate that the demands of the safety status can be achieved
- to gain IRMF community acceptance of the UK CIDS Service Providers produced Good Practice Guide into the NPL suite of documents

CRITICALITY INCIDENT DETECTION

What is criticality?

- An unintentional or accidental occurrence of nuclear fission
- When and where can it occur?
 - When all engineering controls and procedures fail
 - In an Aqueous process
 - In a Metal process

What measures do we take should failure occur?

- Rapid detection of the fission [criticality]
- Personnel evacuation to a safe haven [primary function]
- Warn of re-entry to the incident area
- Option to make a process 'safe'
- Remote assessment of radiological conditions
- Emergency Planning

CRITICALITY INCIDENT DETECTION

Rapid detection of the criticality incident

- From Delafield & Clifton (SRD R 309 1984)
 - Minimum credible event $1 \text{ E}14$ fissions
 - Tissue dose in free air @ 1 metre from an unshielded event/assembly
 - Hydrogen Moderated Event
 - $2 \text{ E-}16$ Gy/fission for Gamma
 - $1 \text{ E-}16$ Gy/fission for Neutron
 - Unmoderated Metal Event
 - $0.5 \text{ E-}16$ Gy/fission for Gamma
 - $3 \text{ E-}16$ Gy/fission for Neutron

CRITICALITY INCIDENT DETECTION

Detectors

- Geiger Counters
- Ion Chambers
- Scintillation
- Junction Diodes

Trigger Methods

- Dose Rate
- Integrated Dose
- Rate of Change

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Criticality Incident Detection & Alarm System

- Detection System
- Audible Alarm - Primary Alarm
 - Instantly recognised tone
 - Time to alarm criteria of 200 E-3 S
 - Human Factors
 - Visual warning in high ambient noise areas >80 dB
- Visual Warnings - Secondary System
- Remote outputs
 - Facility Control Room
 - Emergency Site Control Centre
 - Process Interface
 - Process Shutdown Systems

CRITICALITY INCIDENT DETECTION

Safety Status

- Safety Assessment Principles for Nuclear Plant
 - Specific requirements for criticality
 - Availability & Reliability requirements
 - Failure to Alarm on Demand
 - Safety Integrity Levels
 - Consideration of post incident information
- Assigning the Safety Status*
 - Detection & Alarm System
 - Detection & Alarm System with positive process action

* The detection & alarm system will not prevent criticality

CRITICALITY INCIDENT DETECTION

Reliability & Testing

- Dual Redundancy
 - Single point of failure criteria
- Type Testing
 - To demonstrate fitness for purpose
- Periodic Testing
 - To demonstrate the degree of certainty to function correctly

Good Practice Guide for the UK

- Why?
 - Agree common approach
- Who was involved?
- Part of the NPL portfolio