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SRNS Credible Accident Scenarios - Revisited

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Overview

- **Savannah River Site**
  - Over 300 sq. mi.
  - Major construction in the 1950's
  - Multiple facilities, many miles apart
  - Reactors, Separations Canyons, Labs, Liquid and Solid Waste
  - Multiple mission changes over the decades
- **Facilities discussed**
  - Mobile Plutonium Facility
  - H-Canyon
  - K-Area (storage facility)

Credible Scenario Development – Mobile Plutonium Facility

- **Containers are assumed to be subcritical upon receipt**
  - Acceptable risk for operation of the facility
  - Allows for minimally invasive handling on receipt to determine processing path
  - Any other initial condition that would violate this assumption is not a credible scenario
- **Containers identified upon receipt to not conform to the facility criticality safety are isolated and handled case-by-case**
- **Credible scenarios then derive from these assumptions**
  - No credible scenario involving a single container
  - All credible abnormal conditions that have the potential for criticality are derived from handling upsets
    - *Most involve multiple containers*
- **Ultimately the facility is divided into mass control zones and containers are given a fissile mass limit**

Credible Scenario Development – H-Canyon

- **H-Canyon runs a radiochemical separations process**
- **Credible scenarios need to derive from credible process upsets**
  - as limited by both facility design and physics/chemistry
- **Does chemistry preclude criticality?**
  - Acid dilution or over concentration in separations process – not credible
  - Over concentration or over mass of HFIR dissolution – not credible
- **Does facility design preclude criticality?**
  - Tributyl phosphate dilution or over concentration in separations process – not credible
- **Do site conditions preclude criticality?**
  - Weather conditions prevent freezing of large exterior volume tanks

Credible Scenario Development – H-Canyon

- **Compare the preceding to credible scenarios:**
  - Process equipment containing more than a single parameter mass of fissile material is heated to induce a chemical reaction
    - *Overconcentration occurs due to inaccurate or failed temperature instrumentation*
    - *Overconcentration occurs due to continued evaporation (steam not removed from heating coil) after the reaction*
    - *Active engineered interlock on level to shut off steam*
    - *Active engineered interlock on temperature to shut off steam*
    - *Administrative action to manually close secondary steam valves upon any interlock actuation*
  - Evaporators are used to concentrate more than a single parameter mass of fissile material
    - *Overconcentration due to incorrect level endpoint or level instrumentation error*
    - *Overconcentration due to error in batch fissile mass*
    - *Active engineered control on tank level to shut off steam*
    - *Calculation of batch size from sending tank based on sample analysis*
    - *Second, Independent calculation of batch size from sending tank based on sample analysis*
    - *Engineered alarms on sump level to detect leaks*

Credible Scenario Development – K-Area

- Original criticality evaluations were written 15 – 20 years ago
- Subsequent revisions looked at impact of process changes to the scenarios but did not re-evaluate the credibility of the scenario itself
- Recent efforts have been made to revisit the entire criticality evaluation, including credible scenarios and control development
- Challenge is understanding basis for current controls without previous criticality personnel still available.

Credible Scenario Development – K-Area - Examples

- **NCSE requires criticality drains to limit water depth to ≤ 5 cm**
- **Previous Scenario Development**
  - All Pu oxide in a can-bag-can configuration, from a standard (located in a safe in a different room), and glovebox holdup, spills into a common pile on the floor
  - Process area has gaseous fire suppression system, so it is assumed guillotine breaks of water supplies in other areas occur and leak through the door, mixes with Pu oxide creating critical configuration.
  - Assumes introduction of additional water from firefighting hoses, but ignores water leaving through the open doors required to bring hoses into building
  - Assumes full top reflection even though no mechanism to "float" reflector on top of water slab
- **Current Scenario Development**
  - Credits container configuration
  - Does not combine all Process Area oxide into a single location
  - Still assumes some water can leak through door

Credible Scenario Development – K-Area - Examples

- **NCSE required misload review of shipping packages prior to authorizing storage**
  - Detailed frequency analysis "Perform a review of the controls implemented on the packaging of 239Pu/235U material into the shipping package"
    - *The shipper's procedures could not change those credited procedural steps without a new frequency calculation*
  - Keep track of total number of shipping packages entering/exiting facility in a year
- **Previous Scenario Development**
  - Assumed every shipping package in the array contains metal with a 1 kg overbatch and is demonstrated to be subcritical
  - Assumed a subset of the array is both damaged and overbatched and is demonstrated to be subcritical
  - Assumed "a fissile material container overloaded to any amount over the analyzed payload will cause a criticality event if received or stored"
- **Current Scenario Development**
  - Considers credible overbatch and demonstrates the configuration is subcritical
  - Does not require the detailed misload review of shipper's procedures

Credible Scenario Development – K-Area - Examples

- TRU waste drum limit is 195 FGE Pu-239
- Glovebox Holdup limit is 450 FGE Pu-239
- NCSE requires a mass balance prior to removing waste to ensure the mass of waste is less than 195 FGE Pu-239
- NCSE also requires assigning 35 FGE Pu-239 to waste cuts coming out of glovebox until assayed
  - NCSE does not give a basis for the 35 FGE Pu-239 or define a credible scenario that appeared to require the limit
  - Investigation revealed that a previous NCSE had 35 FGE Pu-239 limit for holdup and all of holdup was assigned to the waste cut
  - When the holdup limit changed, the legacy 35 FGE Pu-239 for waste cuts was kept even though the new NCSE added a control to protect the 195 FGE Pu-239
- Revisiting scenarios resulted in determining the 35 FGE Pu-239 value was not a required NCSE control