Workshop on Risk Related to Spent Fuel Pool Accidents at Decommissioning Plants

Heavy Loads Discussion Session

George Hubbard, Section Chief, SPLB
Edward Throm, DSSA/SPSB

July 16, 1999

Frequency of Load Drops

- Technical Working Group considered only cask handling.

- NUREG-0612: "Control of Heavy Loads at Nuclear Power Plants"

  - Based on Navy crane data (1974 -1977):
    - 1.5×10^{-4} to 1.0×10^{-5} drops per lift (non-single-failure proof system)
    - 1.5×10^{-3} to 1.0×10^{-4} drops per lift (with common mode failures)
    - 1.0×10^{-4} to 4.0×10^{-7} /R-yr (failure of handling system, single-failure proof system)

- NUREG-1353: Regulatory Analysis for the Resolution of Generic Issue 82, "Beyond Design Basis Accidents in Spent Fuel Pools"
  - ◊ 1.0×10^{-3} to 1.0×10^{-4} drops per lift
- "Savannah River Site Human Error Data Base Development for Nonreactor Nuclear Facilities," Westinghouse Savannah River Co., WSRC-TR-93-581, February 28, 1994.
  - ◊ 1.5×10^{-3} to 1.5×10^{-5} drops per operation
- Mechanical/Electrical crane failure rates
  - ◊ 3×10^{-6} per operating hour

Human Errors Are The Major Concern

- **NUREG-0612**
  - **OSHA data:** Rigging- 34%
    Operator errors- 42%
  - **Navy data(74-77):** Rigging- 7%;
    Operator errors -70%

Human Errors Are The Major Concern

- Technical Study
  - Department of Interior (DI): Major contributor "employee negligence," 44% poor maintenance, overloading
  - Crane Accident Workgroup (DI): 35% human error
  - DOE Study*: Human error (68%)- major cause of incidents; Work planning (18%)- significant factor; Training-related deficiencies- not a significant problem (9% inadequate procedures)

* http://tis-hq.eh.doe.gov/oversight/reviews/hoist_rig.html)

Technical Study Summary

Since the human error contribution appears to have remained constant and human errors are the major concern, the technical study used the NUREG-0612 evaluation to estimate the frequency of damage to the spent fuel pool at a decommissioned plant.

System	Drop over or near spent fuel pool (per R-yr)	Result in pool wall damage (per R-yr)	Result in pool floor damage (per R-yr)
Non-single failure proof system	1.5×10^{-4} - 2.0×10^{-7}	1.5×10^{-6} - $<10^{-8}$	1.5×10^{-5} - 2.0×10^{-8}
Single failure proof system	2.5×10^{-5} - 2.0×10^{-8}	2.5×10^{-7} - $<10^{-8}$	2.5×10^{-6} - $<10^{-8}$

Other Factors Which Influence Risk

- Risk of loss of inventory is reduced with:
  - segregated cask loading area (limit draindown)
  - cask crush pad (prevent pool floor failure)
  - specific cask drop analyses (adequate structural design)

Other Factors Which Influence Risk

- Potential areas to refine risk estimates:
  - data specific to nuclear power plant cranes (75 to 125 ton)
  - cask handling plans
    - frequency (estimates based on ~200 lifts per year)
    - time after last fuel removed from reactor
  - human factor considerations
  - other heavy loads handled near or over spent fuel pool

Definitions

- **Single failure proof system:**

  A lifting system (hoisting system and braking system for the trolley and bridge) designed so that a single failure will not result in the loss of capability of the system to safely retain a critical load or setting the load down while repairs or adjustments are made.

Definitions

- **Common mode failure (as used in NUREG-0612):**

  Prescribed load path not followed and electrical interlocks have failed. For example, poorly trained or unqualified operator fails to follow load path, fails to check operability of interlocks and proceeds to operate load handling system, leading to a load drop.