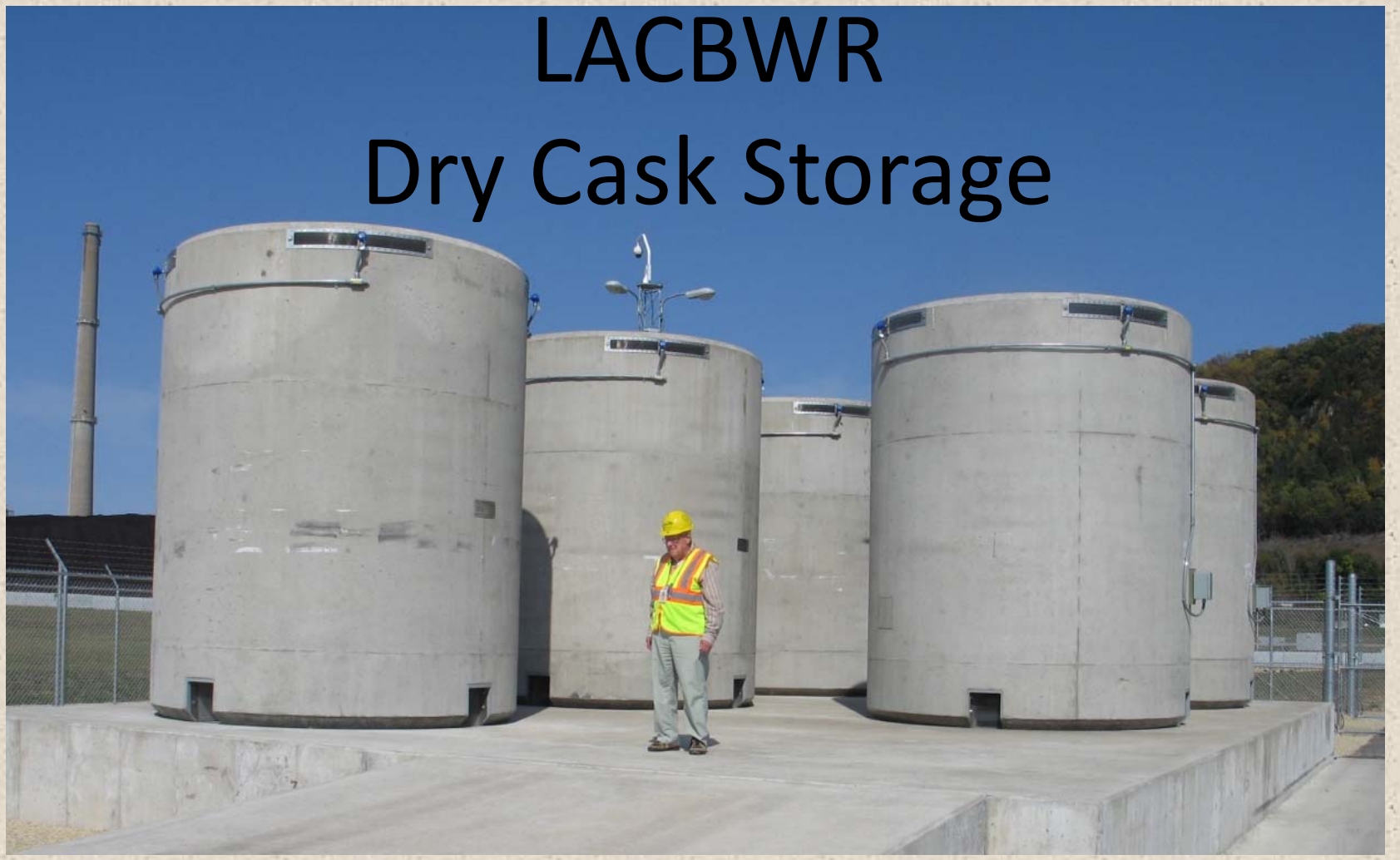
LACBWR
Dry Cask Storage



NEI - Used Fuel Management Conference

May 7 - 9, 2013

LACBWR History

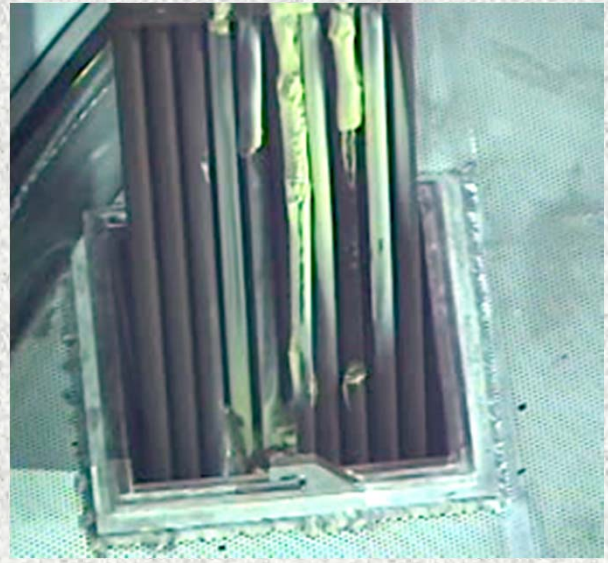
- 1961 - AEC approves application
  - Wisconsin's 1st commercial nuclear plant - 50 MWe
  - 1st owned by an REA co-op
- 1963 - Allis-Chalmers starts construction
  - 3rd commercial A-C plant
- 1967 - Initial criticality
- 1973 - AEC turns over LACBWR to DPC
- 1987 - End of power operations - SAFSTOR
- 2007 - RPV removal

The Project

- Move 333 spent fuel assemblies from wet storage to dry storage
- Load 5 NAC canisters
- Place them on ISFSI pad on the LACBWR Site

Spent Fuel Inventory

- 333 spent fuel assemblies
  - 155 Allis-Chalmers assemblies - all designated damaged
  - 178 Exxon assemblies - 2 damaged
- 5 canisters to load
  - 160 damaged fuel cans
    - Loading 155 A-C + 2 Exxon + 1 debris
    - 2 spares/empty in TSC #5
  - 180 positions - intact assemblies
    - 4 spares/empty in TSC #5

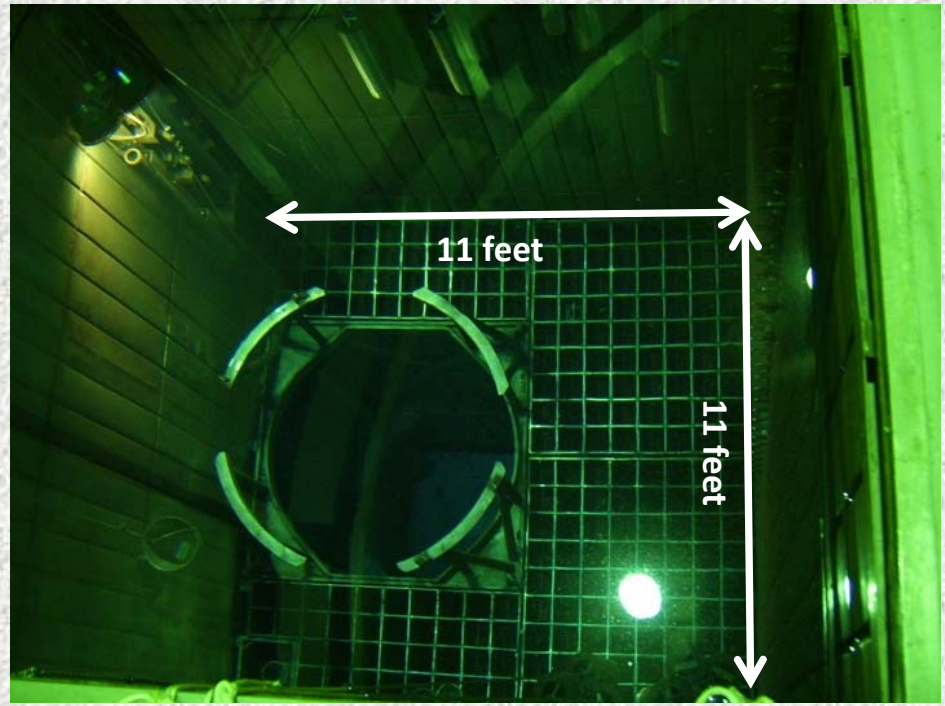


The Challenges

- Fuel pool was not sized to accept an ISFSI storage style of transfer cask/canister
- Reactor building crane
  - Undersized to handle transfer cask
  - Not a single failure proof design
  - No cask laydown area on grade level
- Addressing seismic analysis issues
- Torturous haul path complicated hazards analysis

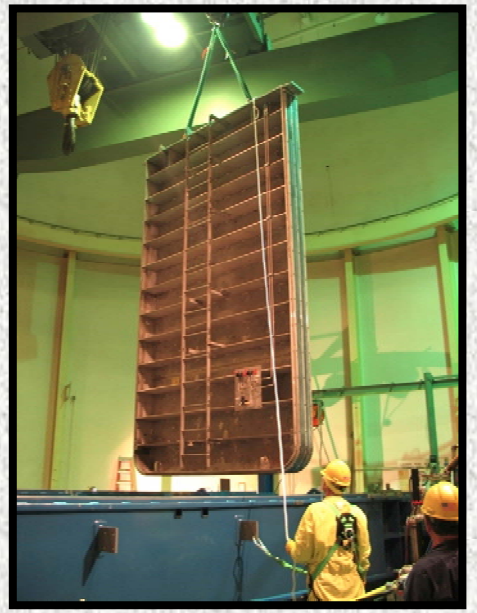
Fuel Element Storage Well

- LACBWR Pool was designed for small spent fuel casks
  - Casks that fit into the pool & thru the airlocks
- Small casks not practical or efficient for ISFSI storage
- LACBWR needed storage casks that fit the standard design

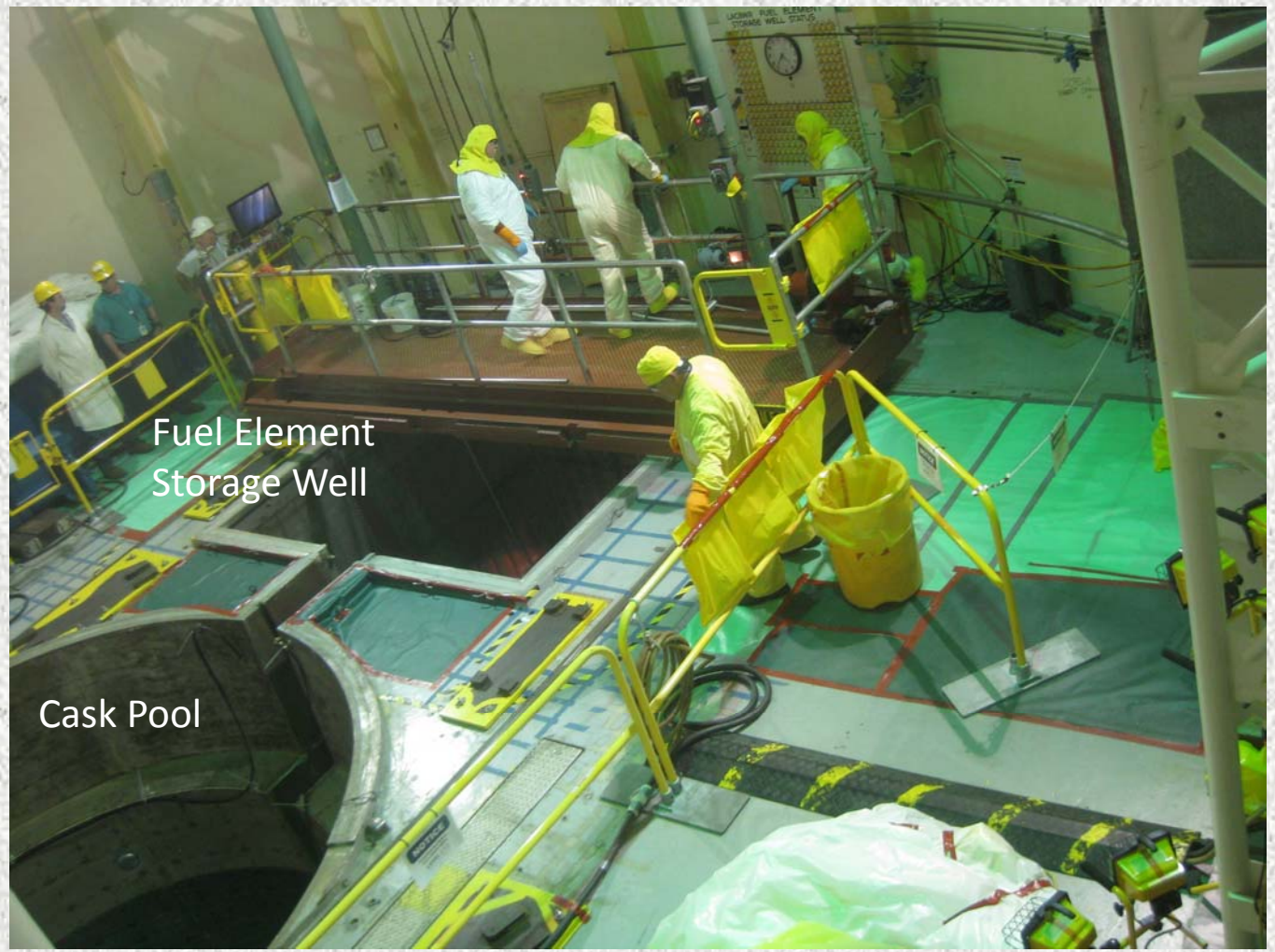


Cask Pool w/Gate

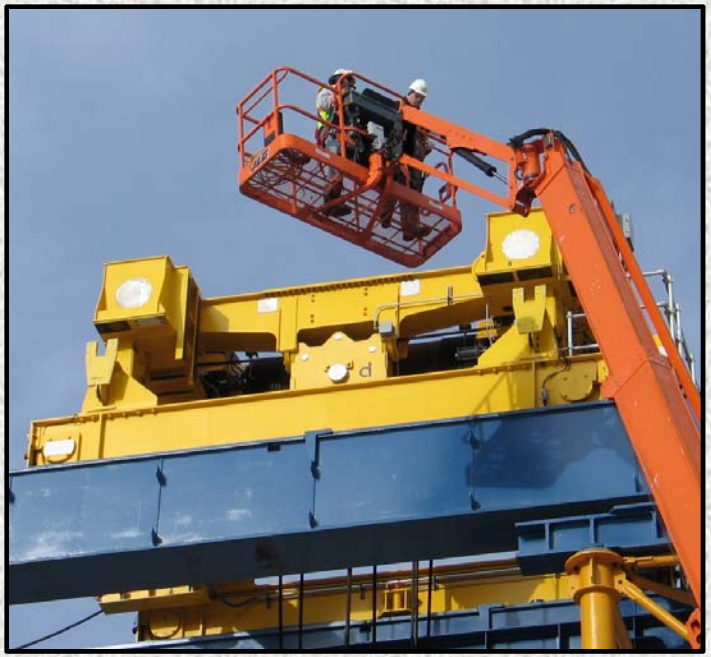
- Cask pool installed in ex-reactor cavity
- Utilize transfer canal to load fuel assemblies
- Gate required for transfer cask clearance



The Fuel Handling Floor



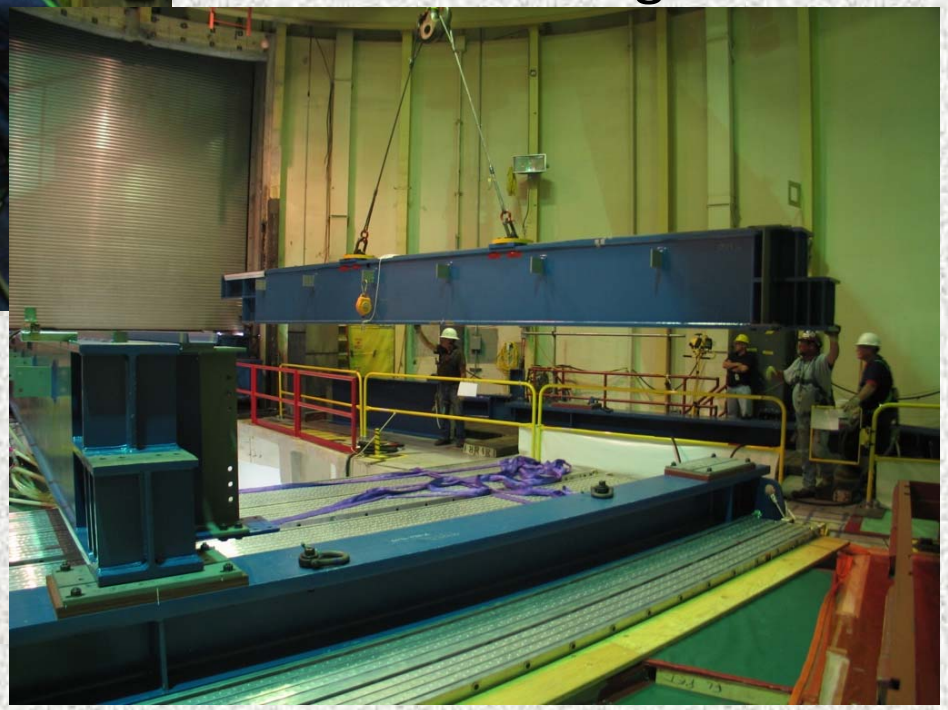
Cask Handling Crane



- American Crane/Rigging Int'l
- Single failure proof hoist (Maine Yankee)
- Rated at 85 tons
- Multiple counterweights/bracing

Cask Handling Crane

- Removable rails required to allow access for fuel handling
- Connect to outer rails at reactor building wall



- Seven inner beams/rails cycled each time a cask is moved
- ~8 hour duration to install or remove rails

Seismic Considerations

- Design Basis Confirmation
  - Met with NRC to confirm seismic design basis
    - LACBWR was in SAFSTOR for 20 years
    - Ensure that LACBWR design basis was acceptable
    - Design basis established back to SER topics
- Unclear regulator position on cask tipping analysis
  - Conservative decision made to use restraint systems
    - Geometric and space constraints inside Reactor Building
    - Difficult functional design for stack-up & canister transfer

Seismic Restraints

- Installed sling/turnbuckle restraints at the cask prep area
- Restraint structure/cable & clamps at stack-up/transfer

Haul Path Issues

External Hazards

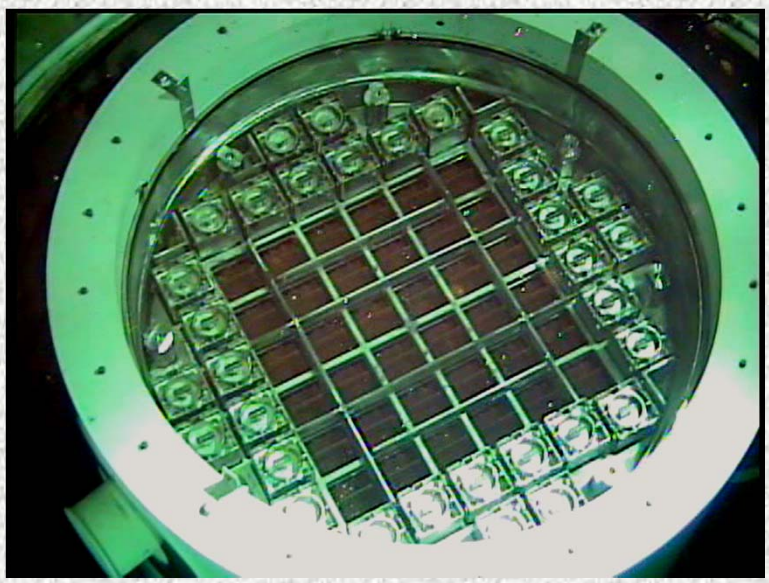
- Fires and explosions
  - On-site buildings and chemical tanks
  - Site equipment with fuel tanks, personal vehicles
  - Railcars, river barges, trucks on the highway
- Tornados, high winds
  - Building collapse, crane failure during transfer
- Heavy haul transport break downs
  - Extending transport time beyond 8 hour window

Hazards Analysis

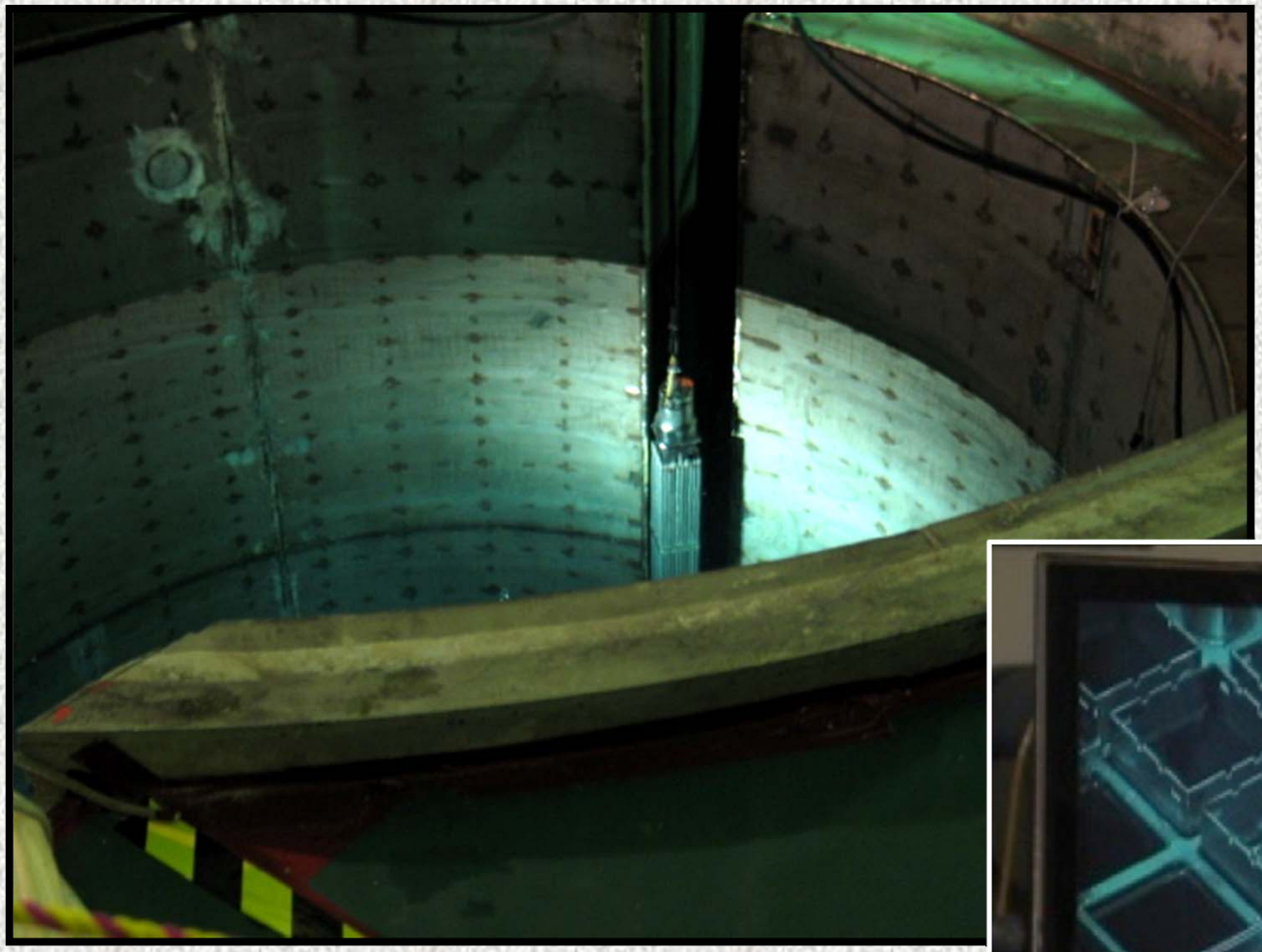
- Regulatory guidance
  - Reg. Guide 1.91: Stationary Explosions, simple PRA
  - Standard Review Plan: PRA acceptance criteria – <10-6 events per year
- Probabilistic Risk Assessment
  - How long will the hazardous condition exist?
    - The cask is transferred past a site building
    - A railcar or a truck is hazardous as it is passing the site
  - What is the probability of a hazard?
    - Building fire frequency
    - Railcar accident / spill frequency

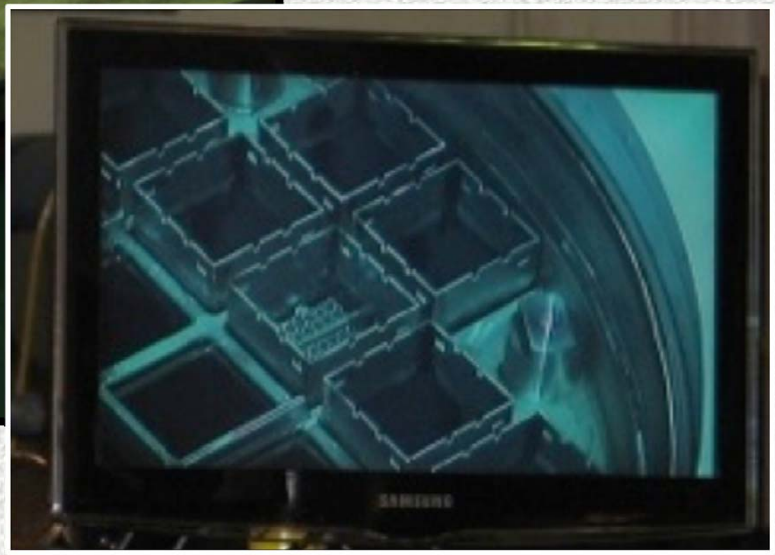
I - Loading a Canister

- Empty canister is placed in transfer cask
- Transfer cask is moved to pool
- Cask pool gate is installed, pool flooded, transfer canal gate is removed
- Crane beams are removed
- 68 fuel assemblies are loaded
- Damaged fuel can lids are installed
- Final FME inspections
- Canister closure/shield lid is installed

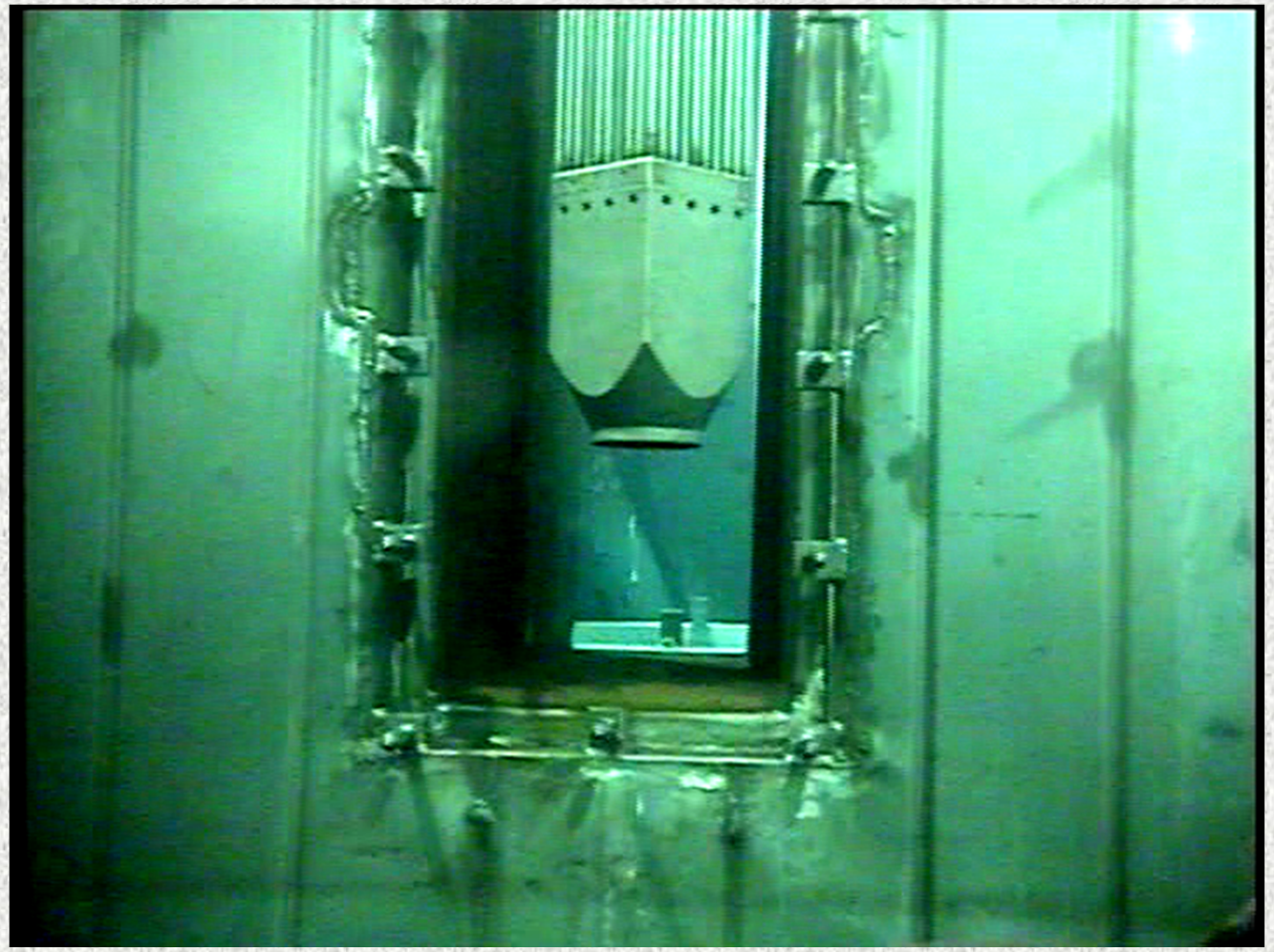


Fuel Assembly Loading





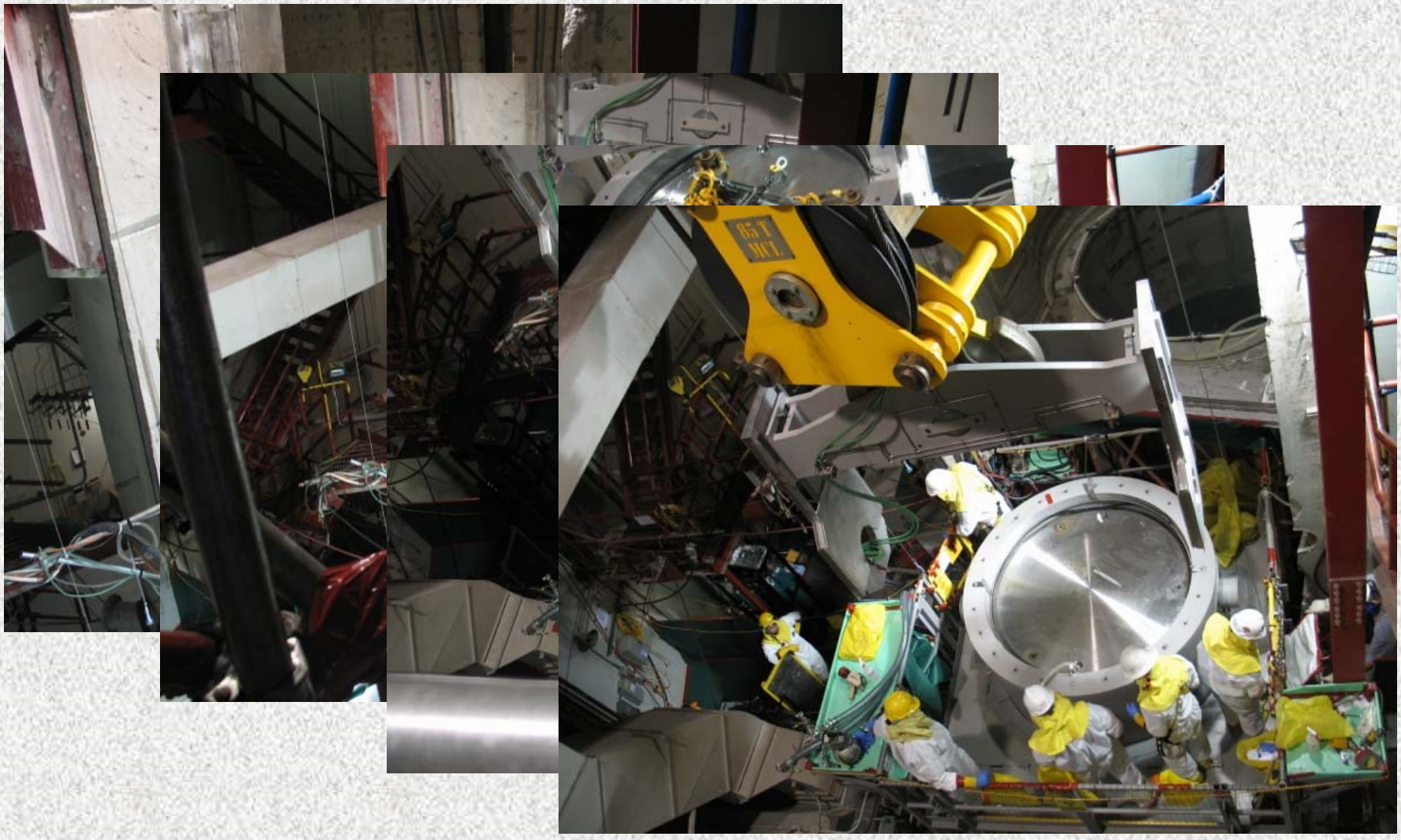
Fuel Assembly
Moving Through Transfer Canal



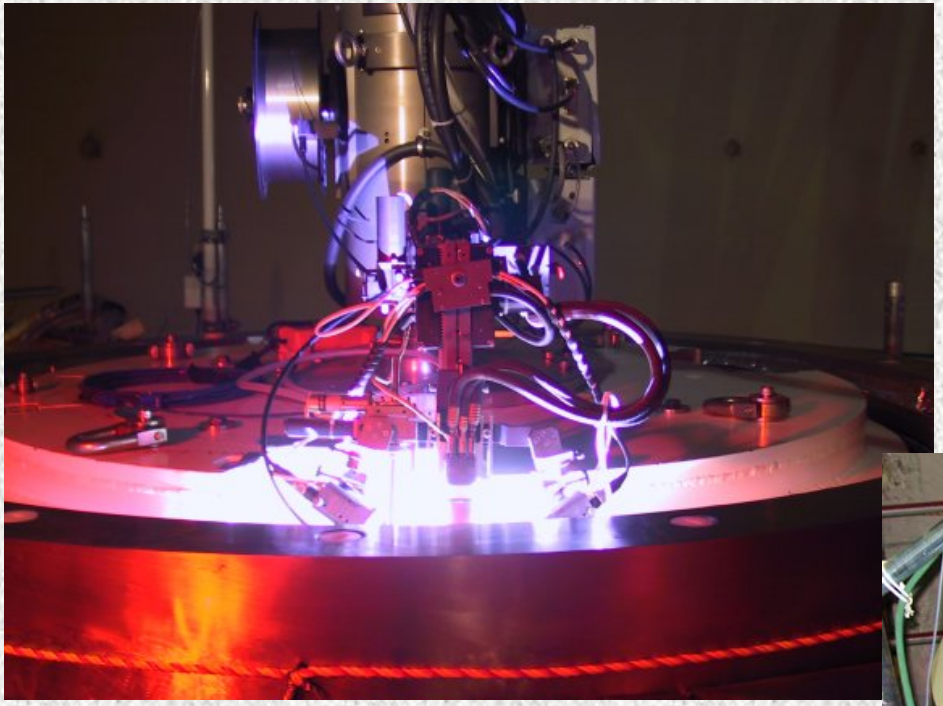
II - Processing

- Install the transfer canal gate
- Lower the cask pool level
- Remove the cask pool gate
- Install the crane rails
- Move the transfer cask to the CPA
- Install inside seismic restraints
- Weld closure lid primary weld, Hydrostatic testing, weld closure ring
- Vacuum dry the canister, inert canister, weld port covers
- Decon & survey

Cask Pool to Cask Prep Area



Canister Sealing Operations

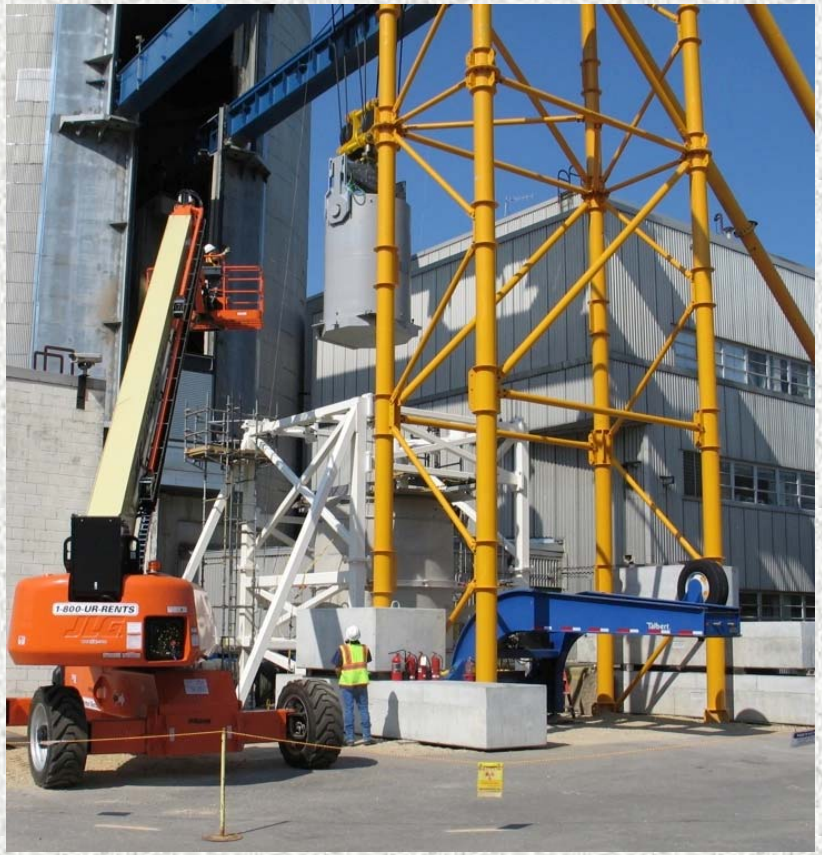


- Vacuum drying cycle - 1 to 3 days

- Welding takes 24 hours & 70 pounds of welding wire

III - Stack-up & Download

- Heavy haul trailer/concrete cask is placed under the cask handling crane
- Cask cover is removed, transfer adapter, cross-beam & lower restraints installed
- Crane brings the transfer cask/canister out of reactor building (weather, security & hazards assessment)
- Transfer cask stacked on cask, upper restraints installed
- Crane is attached to canister, lifted 1 inch, cask bottom doors opened
- Canister is downloaded
- Upper restraints opened, transfer cask back into reactor building



Canister Transfer to VCC

IV - Move to the ISFSI

- Cross-beam, transfer adapter removed
- Rigging removed, cask lid installed
- Lower restraints removed
- Security & hazards walk-downs complete
- Railroad & Sheriff controlling traffic
- Cask & canister travel to ISFSI
- Cask is placed on the ISFSI pad

Cask Transfer to ISFSI Pad

Outside Influences

- BNSF Railroad
  - Required to stop rail traffic during transport
  - BNSF requested two days notice to process Form B
  - BNSF flagman dispatched to site on day of move
    - Sets up control zone, radio contact with dispatcher and trains
  - High priority trains could not be delayed - “Precious”, “Z-Train”
  - Staged a wrecker in case of breakdowns

Outside Influences

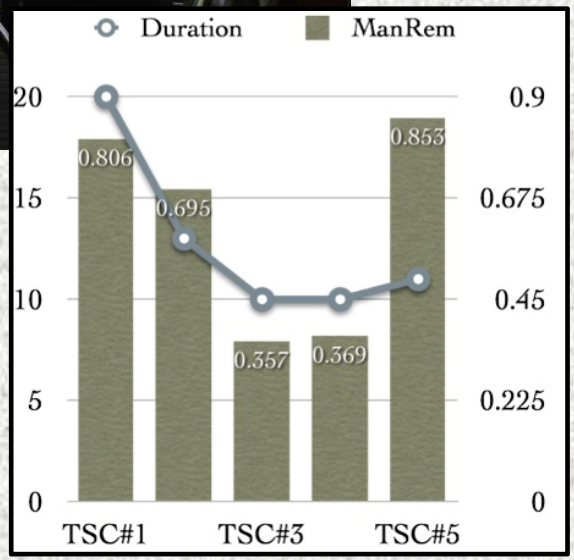
- Severe weather restrictions
  - Required to reduce probability of external events
    - Structure collapse, fire & explosions
  - Monitor NWS convective outlook & terminal aerodrome forecasts
    - 50 mph wind observed or severe thunderstorm/tornado warning - suspend fuel handling operations
    - >20 mph wind predicted and >10% chance of severe thunderstorm abort cask handling operations
  - Caused delays as follows:
    - Held up fuel handling due to severe thunderstorm one time
    - Two cask handling delays - a one day delay and a two day delay

Outside Influences

- Required to stop highway traffic during transport
  - Vernon County Sheriff
    - Manned the road blocks - ~30 minute shutdown
  - Area schools
    - Avoid school bus schedules
  - Keep public happy
    - Boat launch
    - Friday night fish fry

Loading Campaign Numbers

- 333 fuel elements
- Five canisters
- 8 to 20 days/canister
- 8 fuel racks + miscellaneous
- 2 shifts per day
- 60 people
- 85 days, 9 1/2 hours, start to finish



Project Wrap-up

- Demobilized the cask handling crane
- Decontaminated and drained the FESW
- Prepared the transfer cask for long-term storage
- Modified on-site security requirements

Decommissioning

- Transition into Decommissioning
  - Downsize programs
  - Shrink systems
  - Temporary systems
- Groundwater monitoring
- Expand waste contract
- System dismantlement
  - DPC staff
  - Contract personnel

Simple PRA

The simple PRA as defined in Reg Guide 1.91 is:

$r = n * f * s$

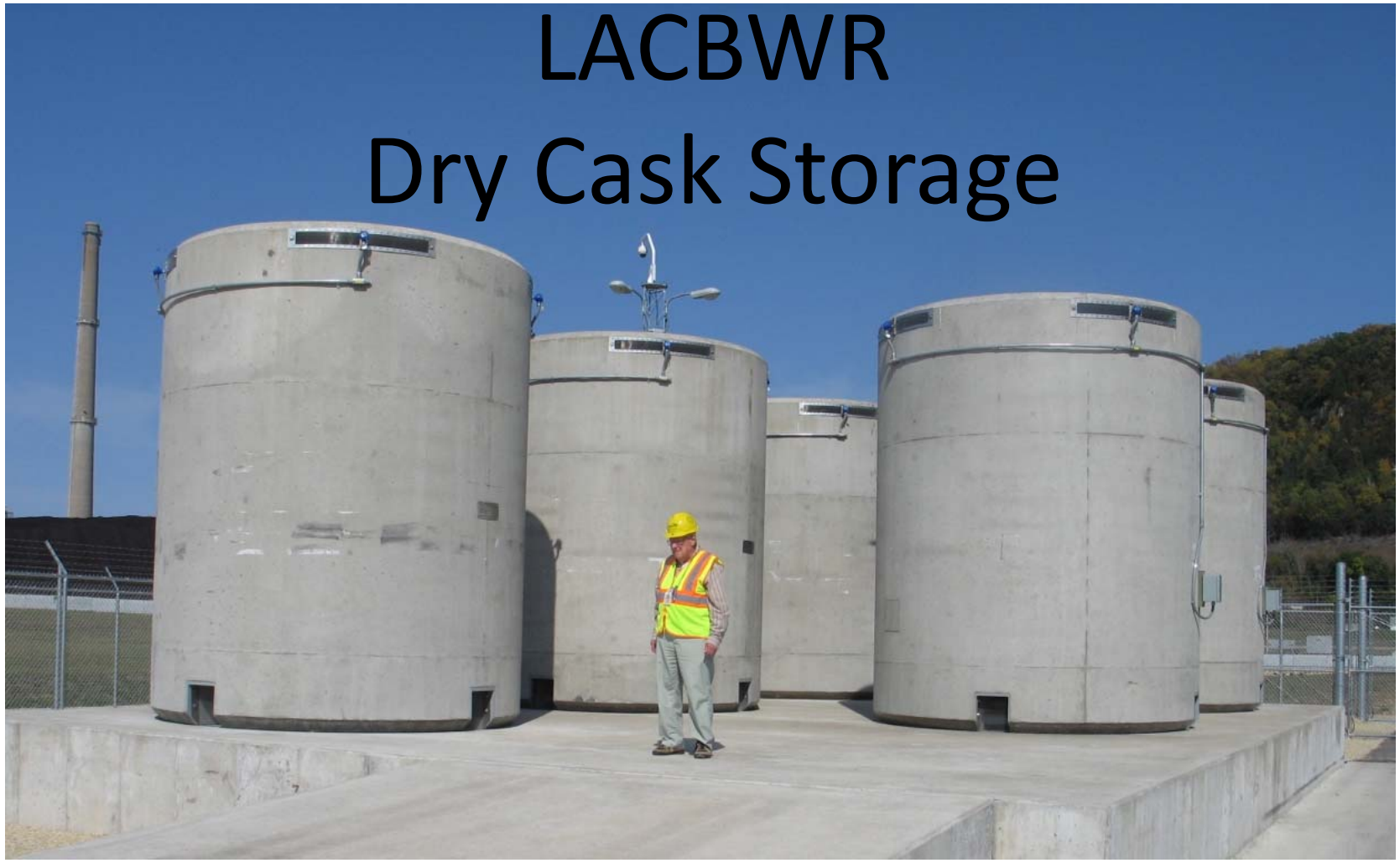
where r is the exposure frequency (hazardous conditions / year), n is the explosion rate for the chemical and transportation method (hazardous conditions / transported mile), f is the frequency of shipments (transported trips / year), and s is the exposure distance (transported miles / transported trip).

A deterministic analysis is used to determine the minimum standoff distance where an explosion would not cause a hazardous condition. The exposure distance, s, is measured by counting the miles of rail or road within that standoff distance.

Conservatisms used in this analysis:
1. No credit taken for administrative controls in reducing accident frequency (n). This includes building fires and tank fires
2. 10% of leaks from stationary tanks assumed to result in large enveloping fire
3. All fuel tanks that have a fire are assumed to explode
4. 5% of a chance of a tornado on a day when weather forecasts state there is 0% chance of a tornado or thunderstorms
5. Crane and other structures assumed to fail as soon as the documented wind capacity is reached. Most capacities are listed as the highest tested, not highest capable.

BACK

LACBWR
Dry Cask Storage



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