Load Drop Analysis for Spent Fuel Cask Handling Operations Kewaunee Power Station

June 28, 2016
License Amendment Request Pre-Application NRC Presentation
Dominion Energy Kewaunee

Agenda

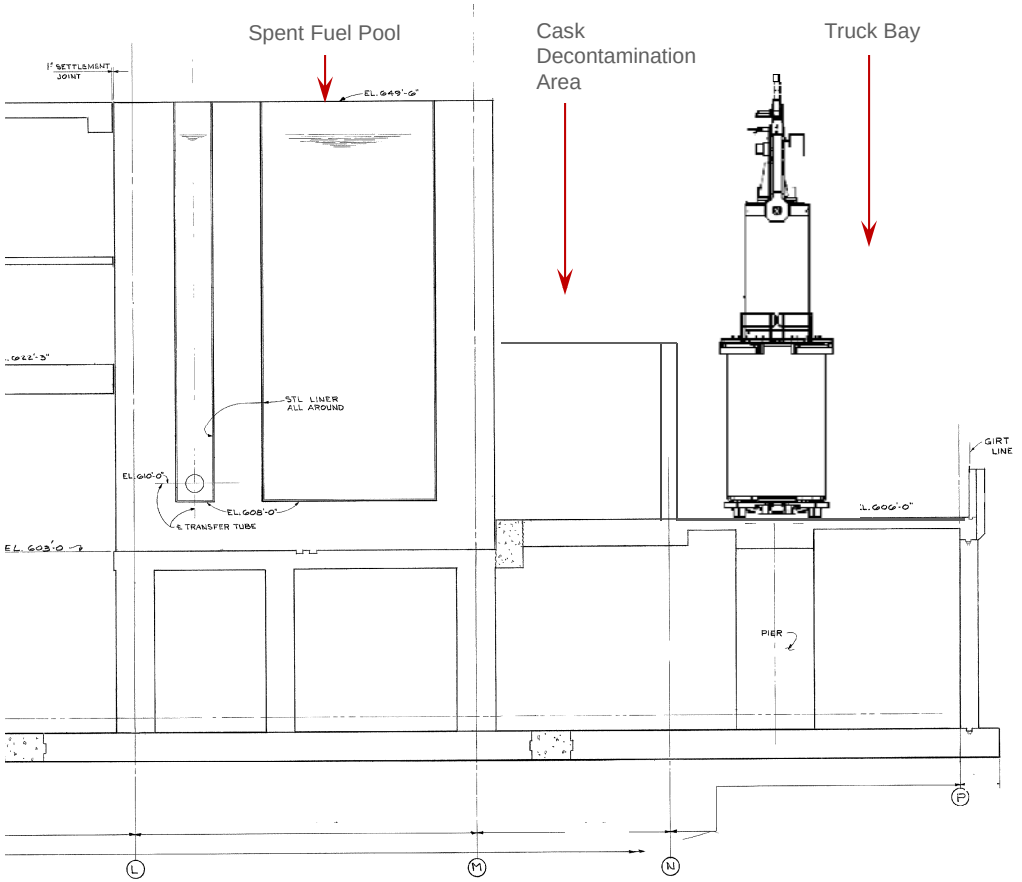
- Meeting Objectives
- Cask Handling Operations Current Licensing Basis (CLB)
- NAC International Secure Lift System
- Basis for Requesting Prior NRC Approval
- Load Drop Analysis
- License Amendment Request (LAR)
- Questions

Meeting Objectives

- Discuss basis and need for LAR submittal
- Discuss proposed cask handling methods
- Discuss LAR submittal and supporting information required for NRC review
- Develop a clear understanding of any NRC concerns
- Respond to NRC Questions

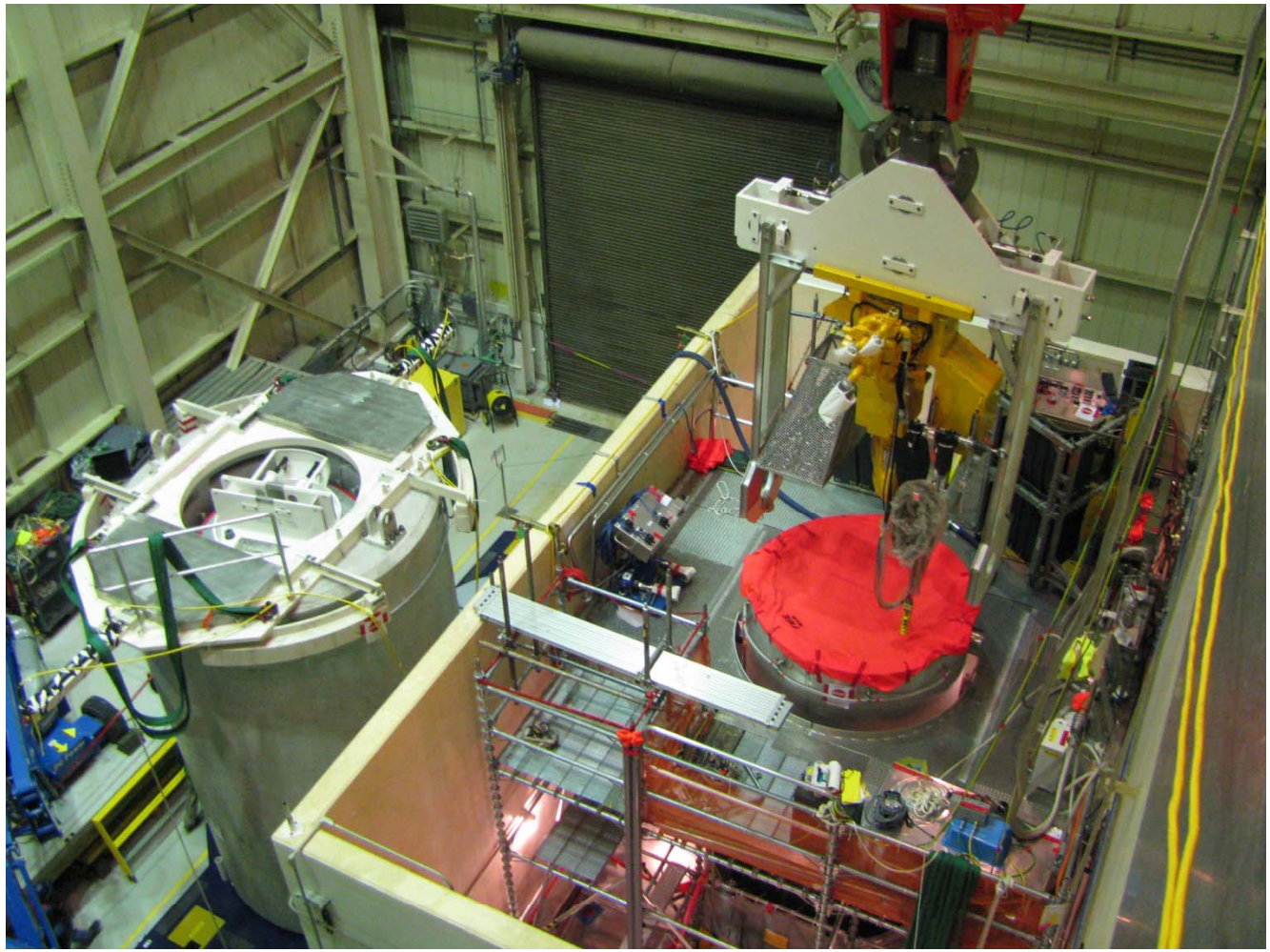
Cask Handling Operations

Auxiliary Building Cross Sectional View (looking South)

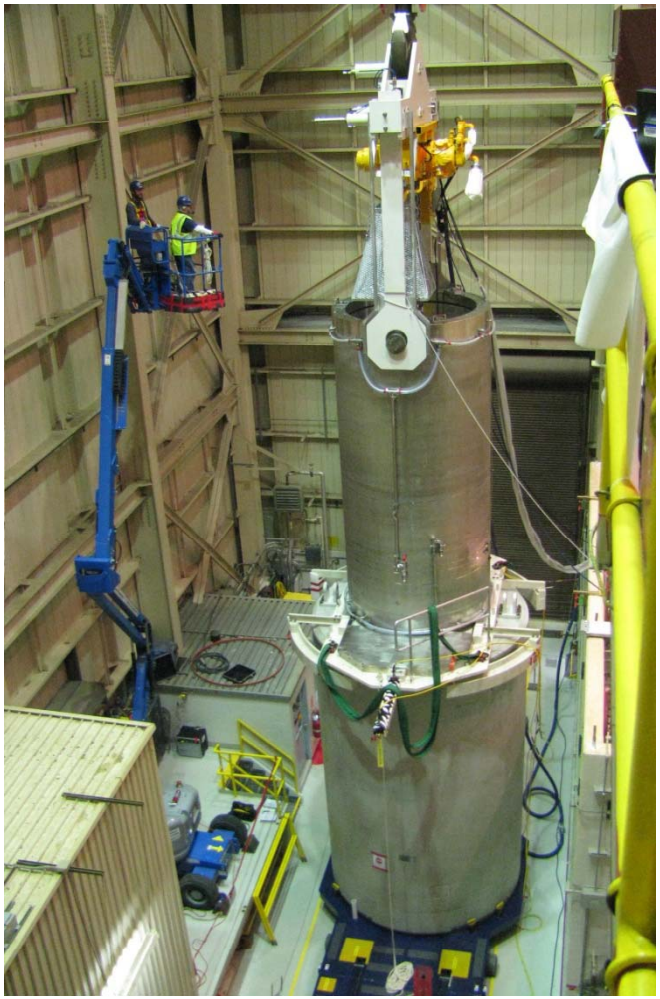


Cask Handling Operations

View from Spent Fuel Pool Elevation (looking North)



Cask Handling Operations



Views from Spent Fuel Pool Elevation (looking North)

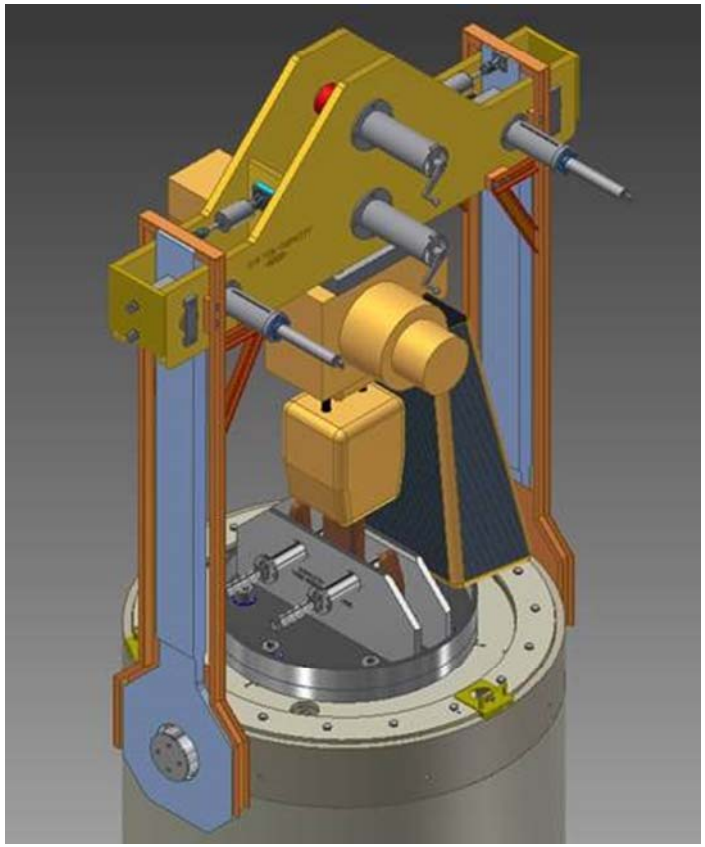
Cask Handling Operations CLB (cont.)

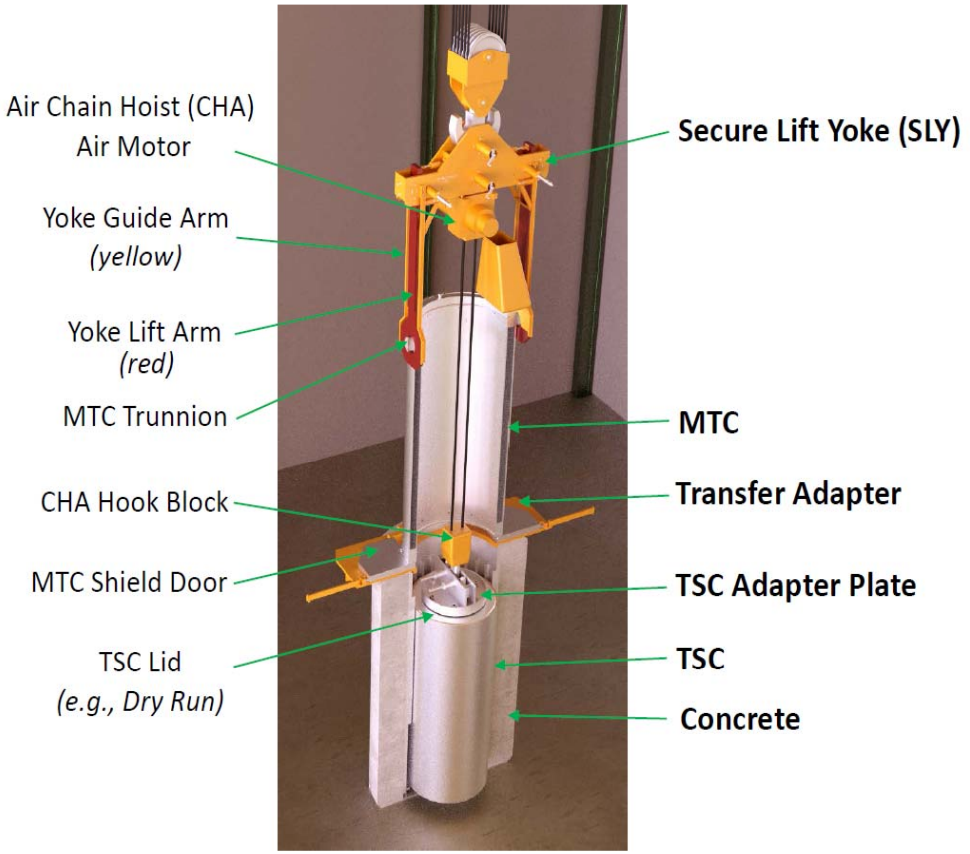
- **10 CFR 50 Fuel Handling Facility (Auxiliary Building)**
  - Storage Canister Loading (Spent Fuel Pool)
  - Storage Canister Processing (Cask Decontamination Area)
  - Storage Canister Transport (Truck Bay)
- **Auxiliary Building (AB) Crane**
  - Single-failure-proof upgrade (LA 205)
  - NUREG-0612 / NUREG-0554 guidance
  - USAR includes additional detail and clarifications

Cask Handling Operations CLB (cont.)

- Heavy Loads Program
  - Cask handling in/around the SFP (TRM) (LA 200)
  - Cask handling requires a single-failure-proof handling system when using AB Crane (USAR)
    - Special lifting devices (NUREG-0612 / ANSI 14.6-1993)
    - Slings (NUREG-0612 / ASME B30.9-2003)
    - Interfacing lift points (NUREG-0612)
    - USAR includes additional details and clarifications
  - Cask load drop not considered credible and accident removed from licensing basis (LA 200)
  - Relied on for spent fuel protection

NAC Secure Lift System





NAC Secure Lift System (cont.)

- Special Lifting Devices
  - Secure Lift Yoke
  - Chain Hoist Assembly Top Bracket
  - TSC Adapter Plate
  - Single-failure-proof handling system devices (NUREG-0612 / ANSI 14.6-1993)
- Chain Hoist Assembly is not a Special Lifting Device

NAC Secure Lift System (cont.)

- Chain Hoist Assembly (CHA) (ASME B30.16-2007)
  - Critical Load Handling Equipment (ASME NUM-1-2009)
    - Type IB (Enhanced Safety Features)
      - » Design factors 10:1
      - » Redundant braking and two-block protection
      - » Important to Safety Category B component (QA Program)
      - » Rigorous testing , including 300% (MCL) load test
    - Not Type IA (Single-Failure-Proof Features)
  - Equipment not acceptable within a nuclear single-failure-proof handling system (NUREG-0612 or NUREG-0554)

Basis for Prior NRC Approval

- **Heavy Loads Current Licensing Basis Resolution**
  - **NUREG-0612 alternatives:**
    - **Single-failure-proof equipment; or**
    - **Load drop analysis demonstrating satisfactory outcomes (non-single-failure-proof equipment)**

Single-Failure-Proof Alternative	Disadvantages (to CHA)
Free Standing Stability Analysis / Slings	ALARA, Complexity, Schedule
Seismic Restraint / Slings	Industrial Safety, ALARA, Building Capacity, Space Limitations, Schedule
Dual Reeve Electric Hoist	Complexity, Space Limitations, Crane Capacity Margin, Schedule

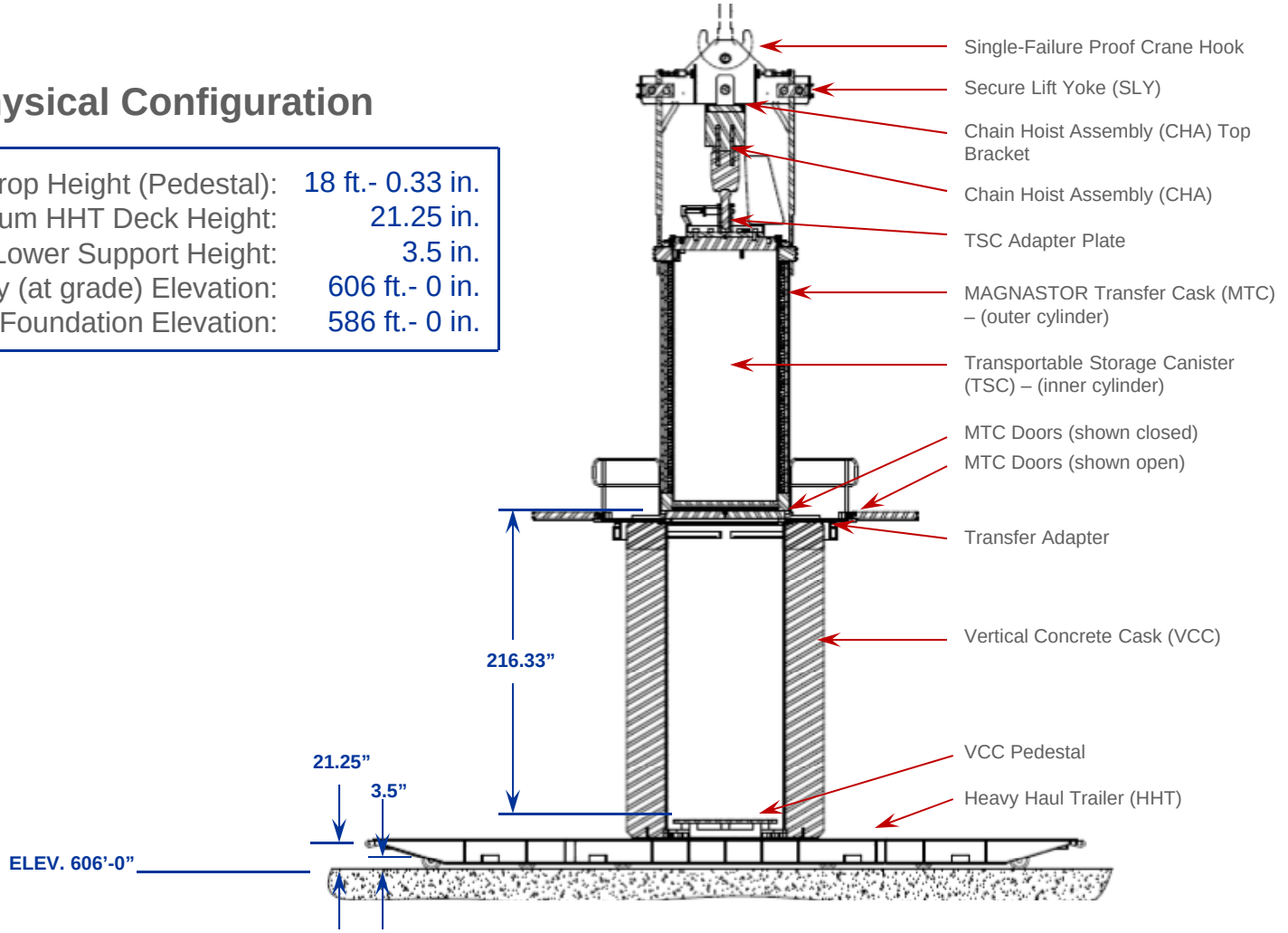
Basis for Prior NRC Approval (cont.)

- Add Cask (TSC) Load Drop Accident into CLB
  - Use of non-single-failure-proof NAC chain hoist assembly
  - 10 CFR 50.59(c)(2) requires prior NRC approval
    - Accident of a different type (TSC load drop) than previously evaluated
    - Malfunction of equipment important to safety (CHA) with a different result (impact loading to the truck bay structure) than previously evaluated
  - 10 CFR 72.48 does not require revision to MAGNASTOR current licensing basis

Load Drop Analysis

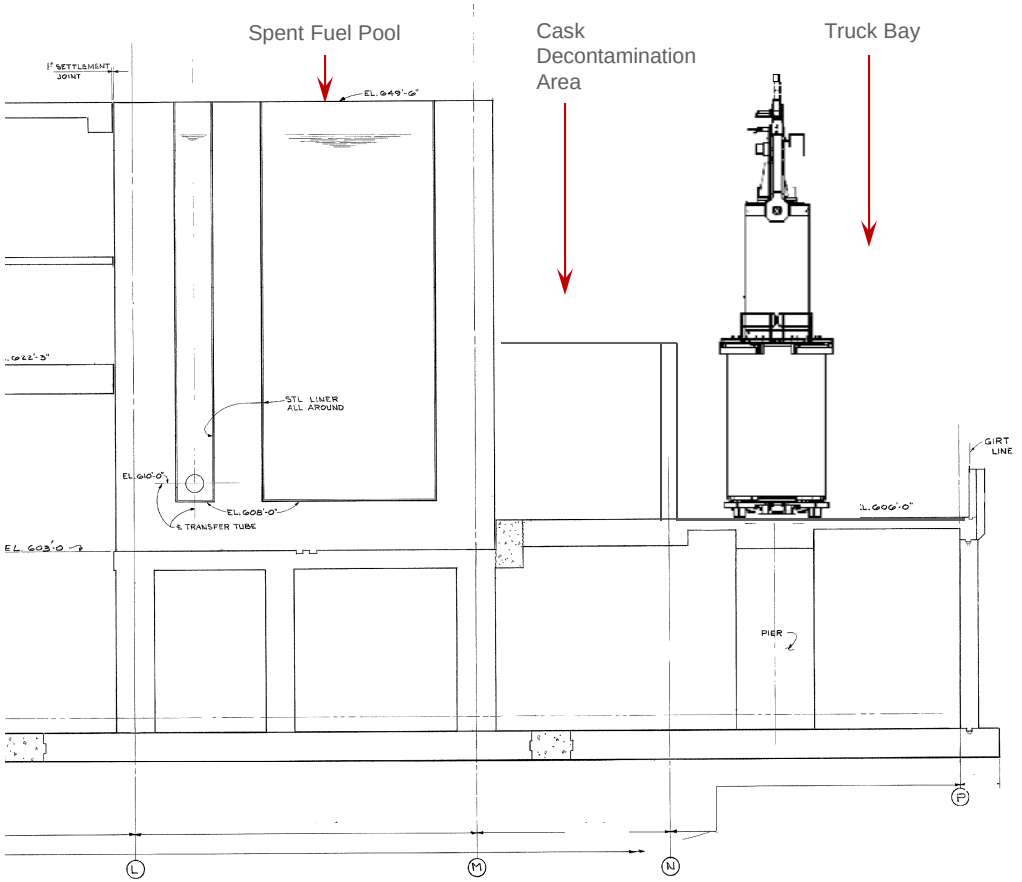
Stack Up Physical Configuration

Maximum TSC Drop Height (Pedestal):	18 ft.- 0.33 in.
Minimum HHT Deck Height:	21.25 in.
Minimum HHT Lower Support Height:	3.5 in.
Truck Bay (at grade) Elevation:	606 ft.- 0 in.
Foundation Elevation:	586 ft.- 0 in.



Load Drop Analysis (cont.)

Auxiliary Building Cross Sectional View



Load Drop Analysis (cont.)

- Configuration Analyzed
  - Loaded TSC/MTC and empty VCC in stack up position on HHT
  - HHT positioned and leveled for transfer operation on Auxiliary Building Truck Bay concrete floor
- Analysis Methodology
  - 3-D Solid Finite Element Model
    (LS-DYNA Nonlinear Time-History Analysis)
  - ANSYS Simulation software
  - ASME Code Section III Appendix F criteria
  - NUREG-0612 Appendix A guidance

Load Drop Analysis (cont.)

- Analysis Methodology (cont.)
  - Conservative TSC Drop heights
    - 18.25 ft (base case) through 27.5 ft (150% base case)
  - HHT gap heights at 3 and 4 inches
  - Maximum TSC payload and associated dropped component weights included
  - Secondary impacts conservatively modeled with HHT, fuel, fuel basket and TSC bottom plate
  - Flexural energy in HHT and impact damping conservatively ignored

Load Drop Analysis (cont.)

- Additional Evaluations
  - Storage canister spent fuel sub-criticality
  - Storage canister passive cooling
  - Auxiliary building truck bay floor stability
    - Structural capacity margin
  - Spent Fuel Pool (SFP) integrity
    - Simplified limit states analysis methodology
  - Affect on SSCs supporting SFP functions

Load Drop Analysis (cont.)

- Results (preliminary)
  - Storage canister confinement integrity maintained
  - Concrete cask passive cooling adequate
  - Storage canister and concrete cask remain upright on transport trailer (floor stability)
  - Auxiliary Building Crane maintains control of MTC (no secondary drop accident)
  - Spent fuel pool (SFP) integrity maintained
  - SFP support equipment unaffected

License Amendment Request

- **Add Cask (TSC) Load Drop Analysis into CLB**
  - **Narrow applicability and scope**
    - **Applies ONLY when away from Spent Fuel Pool (SFP)**
    - **Applies ONLY for MAGNASTOR TSC transfer operations between MTC and VCC**

Chain Hoist Assembly Lifts (110 Ton Capacity / 55 Tons MCL)		
Component Lifted	Weight (Tons)	Area
Transportable Storage Canister (TSC)	49	Truck Bay (stack up only)

    - **All other cask handling requirements unchanged**

License Amendment Request (cont.)

- Supporting load drop analyses
  - Proprietary finite element model
  - Auxiliary Building Structural Evaluation
  - No Radiological Consequences
- Proposed Kewaunee USAR revision
  - Intermediate lift device design requirements and safety features
  - Testing, inspection and maintenance standards for use
  - Drop analyses descriptions and references

License Amendment Request (cont.)

- Proposed TRM revision
  - New section to ensure analysis parameters are satisfied
  - Compensatory measures for nonconforming conditions
  - Technical verification prior to lifting a loaded TSC
- Schedule
  - Target submittal in late July
- Request expedited review
  - Provide details required for efficient NRC review
  - Planned decommissioning (PSDAR) activities affected

Questions?

List of Acronyms

ALARA	As Low As Reasonably Achievable
CoC	Certificate of Compliance
CLB	Current Licensing Basis
DEK	Dominion Energy Kewaunee (Dominion)
FSAR	Final Safety Analysis Report
HHT	Heavy Haul Trailer
ISFSI	Independent Spent Fuel Storage Installation
KPS	Kewaunee Power Station
LA	License Amendment
LAR	License Amendment Request
MAGNASTOR®	Modular Advanced Generation Nuclear All-purpose STORage
MCL	Maximum Critical Lift
MTC	MAGNASTOR Transfer Cask
NAC	Nuclear Assurance Corporation (NAC International, Inc.)
NRC	Nuclear Regulatory Commission
QA	Quality Assurance
SFP	Spent Fuel Pool
SLY/CHA	Secure-Lift Yoke and Chain Hoist Assembly
SSC	System, Structure, Component
TRM	Technical Requirements Manual
TSC	Transportable Storage Canister
USAR	Updated Safety Analysis Report
VCC	Vertical Concrete Cask