

# **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

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- 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



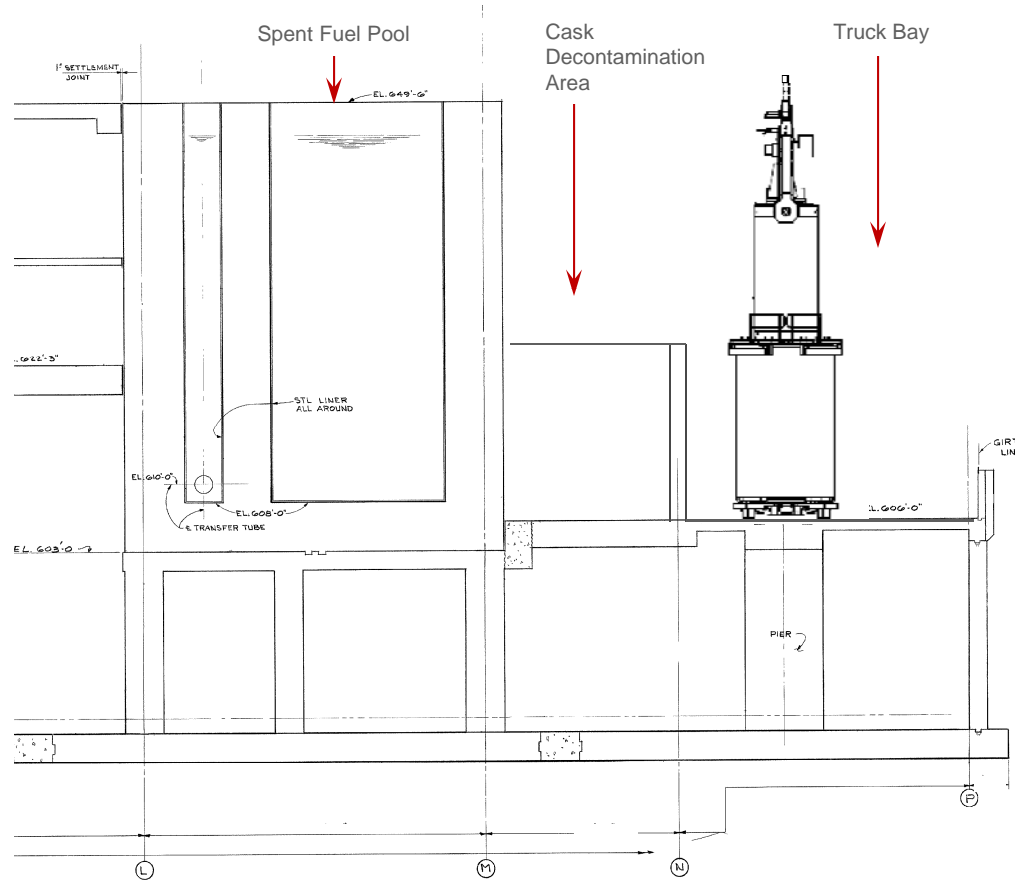
# Meeting Objectives

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- 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

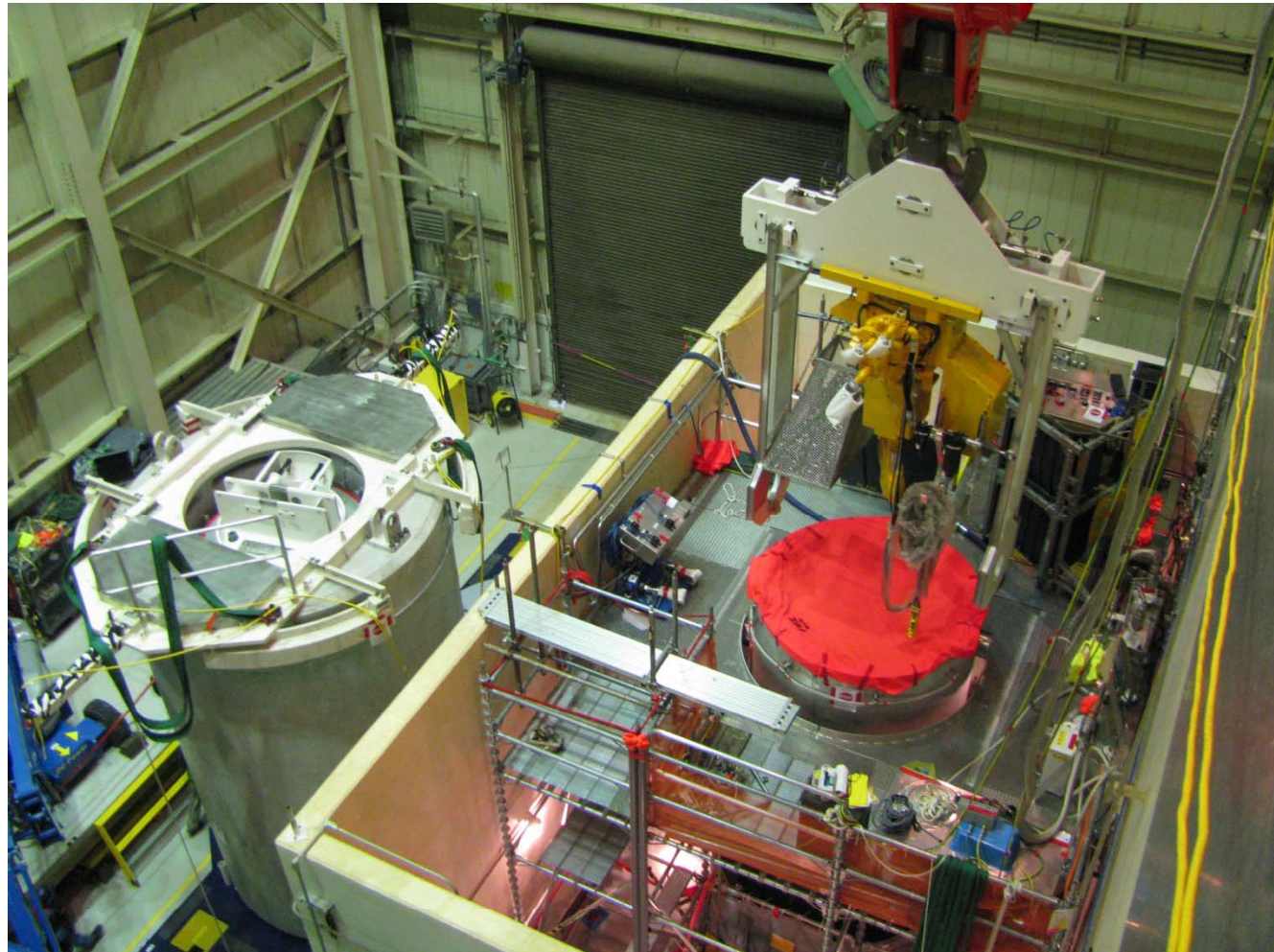
# Cask Handling Operations

**Auxiliary Building  
Cross Sectional View  
(looking South)**



# Cask Handling Operations

View from  
Spent Fuel  
Pool Elevation  
(looking North)



# Cask Handling Operations



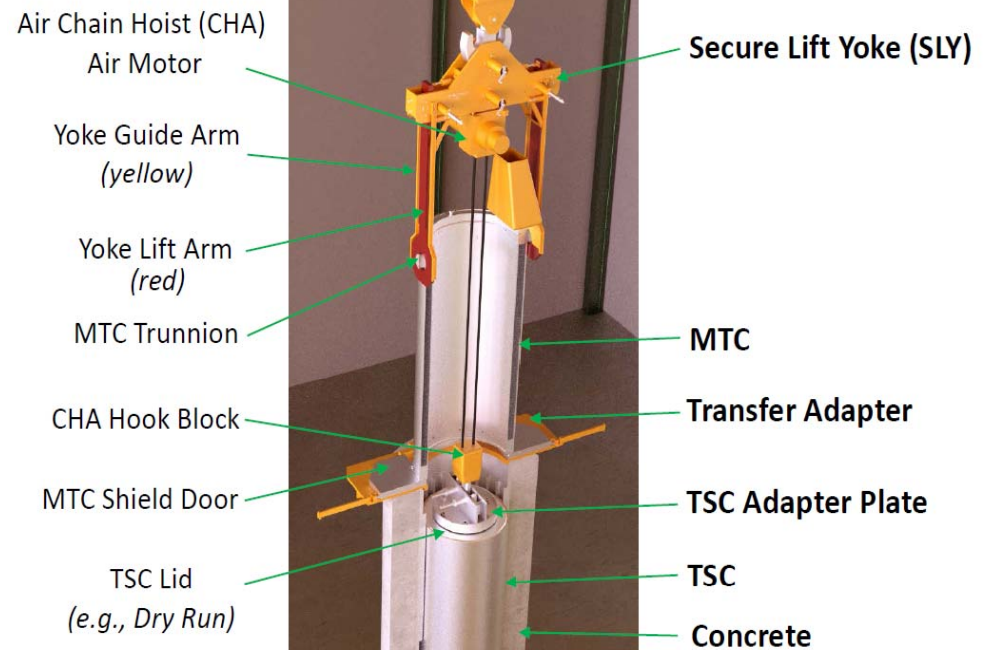
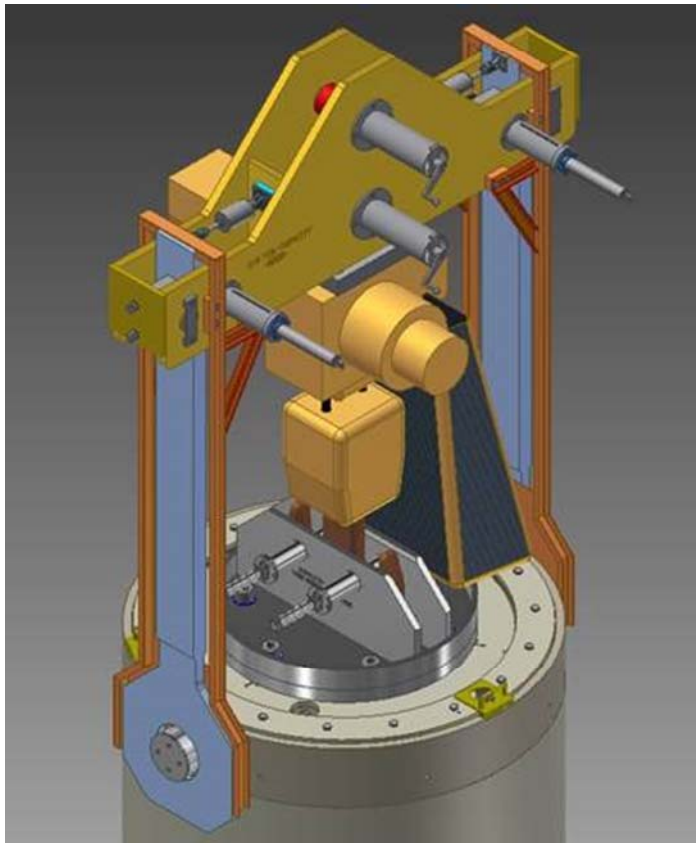
**Views from Spent Fuel Pool Elevation (looking North)**

- **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

- **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.)

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- **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.)

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- **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)

<b>Single-Failure-Proof Alternative</b>	<b>Disadvantages (to CHA)</b>
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.)

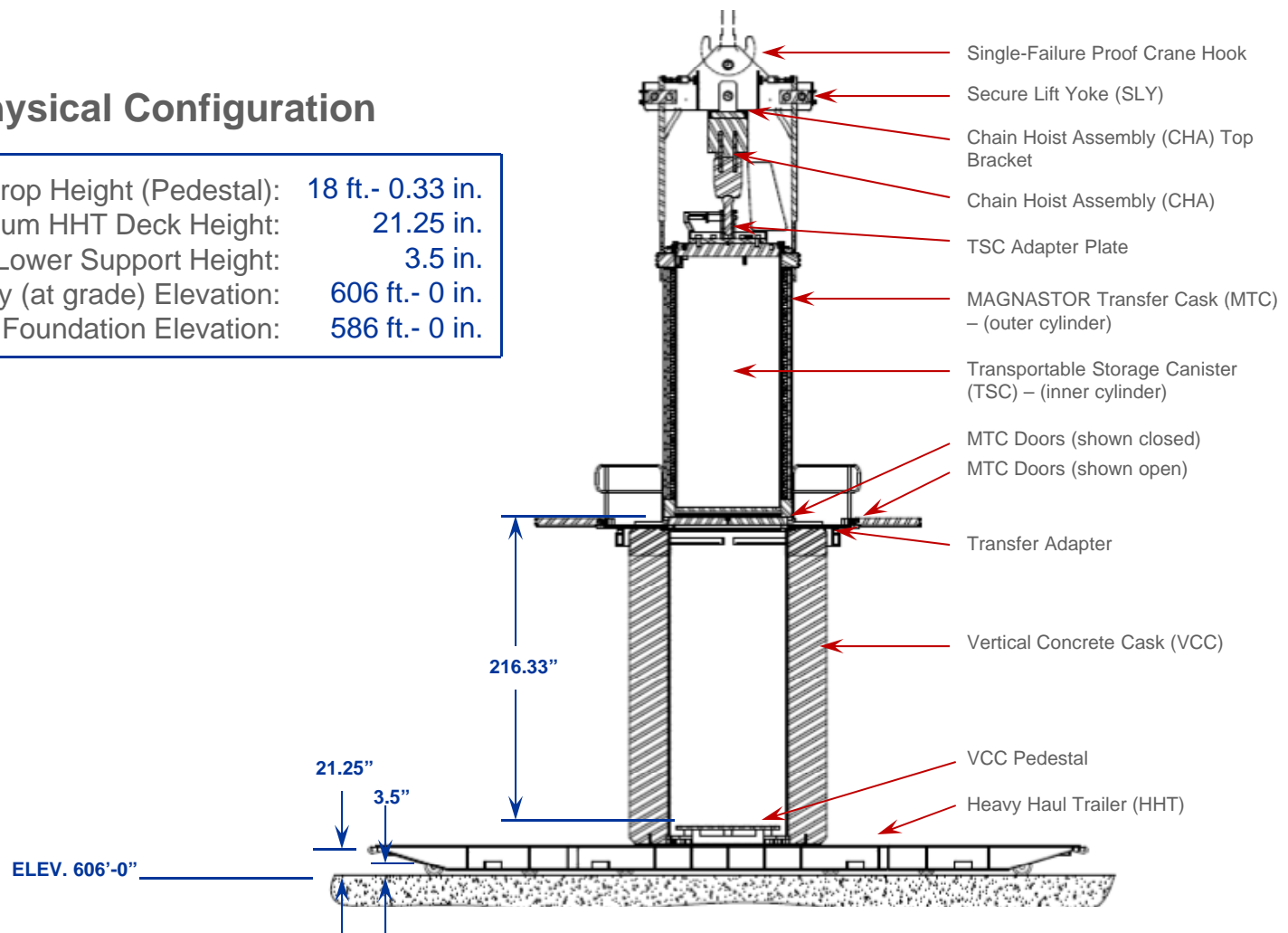
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- **Add Cask (TSC) Load Drop Accident into CLB**
  - **Use of non-single-failure-proof NAC chain hoist assembly**
  - **10 CFR 50.59(c)(2) requires prior NRC approval**
    - **Accident of a different type (TSC load drop) than previously evaluated**
    - **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

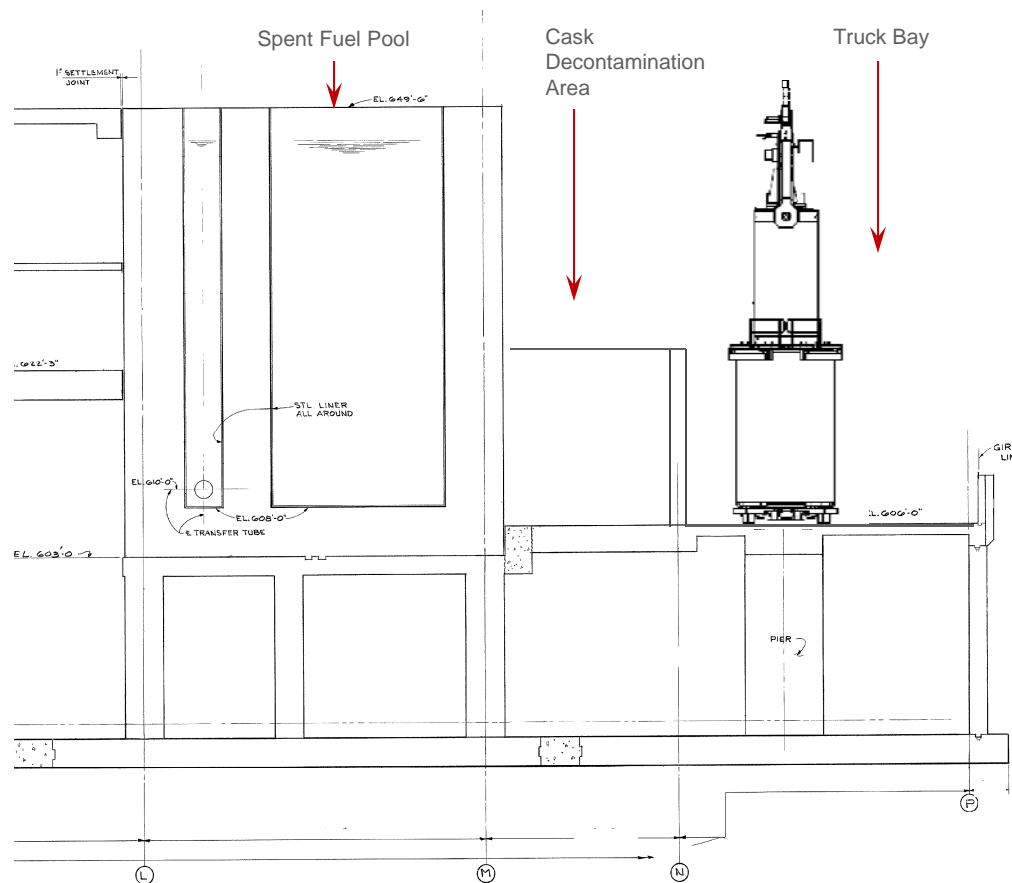
## Stack Up Physical Configuration

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.)

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- **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.)

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- **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.)

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- **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.)

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- **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**

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

- **All other cask handling requirements unchanged**



## License Amendment Request (cont.)

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- **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.)

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### – 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

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ALARA	<u>A</u> s <u>L</u> ow <u>A</u> s <u>R</u> easonably <u>A</u> chievable	MTC	<u>M</u> AGNASTOR <u>T</u> ransfer <u>C</u> ask
CoC	<u>C</u> ertificate of <u>C</u> ompliance	NAC	<u>N</u> uclear <u>A</u> ssurance <u>C</u> orporation (NAC International, Inc.)
CLB	<u>C</u> urrent <u>L</u> icensing <u>B</u> asis	NRC	<u>N</u> uclear <u>R</u> egulatory <u>C</u> ommission
DEK	<u>D</u> ominion <u>E</u> nergy <u>K</u> ewaunee (Dominion)	QA	<u>Q</u> uality <u>A</u> ssurance
FSAR	<u>F</u> inal <u>S</u> afety <u>A</u> nalysis <u>R</u> eport	SFP	<u>S</u> pent <u>F</u> uel <u>P</u> ool
HHT	<u>H</u> eavy <u>H</u> aul <u>T</u> railer	SLY/CHA	<u>S</u> ecure- <u>L</u> ift <u>Y</u> oke and <u>C</u> hain <u>H</u> oist <u>A</u> ssembly
ISFSI	<u>I</u> ndependent <u>S</u> pent <u>F</u> uel <u>S</u> torage <u>I</u> nstallation	SSC	<u>S</u> ystem, <u>S</u> tructure, <u>C</u> omponent
KPS	<u>K</u> ewaunee <u>P</u> ower <u>S</u> tation	TRM	<u>T</u> echnical <u>R</u> equirements <u>M</u> anual
LA	<u>L</u> icense <u>A</u> mendment	TSC	<u>T</u> ransportable <u>S</u> torage <u>C</u> anister
LAR	<u>L</u> icense <u>A</u> mendment <u>R</u> equest	USAR	<u>U</u> pside <u>S</u> afety <u>A</u> nalysis <u>R</u> eport
MAGNASTOR®	<u>M</u> odular <u>A</u> dvanced <u>G</u> eneration <u>N</u> uclear <u>A</u> ll-purpose <u>S</u> TORAGE	VCC	<u>V</u> ertical <u>C</u> oncrete <u>C</u> ask
MCL	<u>M</u> aximum <u>C</u> ritical <u>L</u> ift		