U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

NRC Crane Inspections

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Outline

- ISFSI Crane Inspections
- Crane & Heavy Load Background
- Utility Crane Upgrades
- Recent Crane Inspections & Findings
- Summary

ISFSI Crane Inspection Process

- Fuel handling crane inspected as part of ISFSI pre-operational inspections
  - Includes site specific requirements
  - Site performs demonstration using weighted load to simulate cask load
- Heavy Load Database developed which includes requirements from:
  - NUREG 0612 – Control of Heavy Loads
  - NUREG 0554 – Single-Failure-Proof Cranes
  - ANSI N14.6 – Special Lifting Devices
  - ASME B30.2 – Overhead Cranes
  - ASME B30.9 – Slings

Crane & Heavy Load Background

- Crane requirements at nuclear facilities in US have evolved over the past 40 years based on industry experience:
  - Branch Technical Position APCSB 9-1 reviewed utility cranes for meeting single failure proof criteria used in mid-1970's (precursor of NUREG 0554)
  - NUREG 0554 "Single Failure Proof Cranes for Nuclear Power Plants" issued in May 1979
  - NUREG 0612 "Control of Heavy Loads at Nuclear Power Plants" issued January 1980

Crane & Heavy Load Background

- Crane requirements (continued)
  - ANSI / ASME B30.2 “Overhead and Gantry Cranes” originally issued in 1967
  - ASME NOG-1 “Construction of Overhead and Gantry Cranes” issued in 1983
- Supplemental requirements are derived from:
  - ANSI N14.6 – Special Lifting Devices
  - ASME B30.9 – Slings

Branch Technical Position APCSB 9-1

- Position developed to control design, operation and testing of single-failure-proof cranes since no industry codes existed at the time
- Provided consistent basis for review of equipment and components for crane systems
- Required dual components, auxiliary systems or ancillary systems to retain and hold the load in a safe position
- Evolved into NUREG 0554

NUREG 0554
Single-Failure-Proof Crane

- NUREG 0554 issued in 1979
- Provided specific criteria for single-failure-proof cranes that is still in use today
- Included criteria for:
  - Material properties
  - Seismic design
  - Welding requirements
  - Hoisting machinery
  - Bridge and trolley
  - Wire rope
  - Testing and preventative maintenance

NUREG 0612
Control of Heavy Loads

- Integrated approach to dealing with crane requirements and heavy loads
- Included requirements from other industry codes- overhead cranes (ANSI/ASME B30.2); Special Lifting Devices (ANSI N14.6); Slings (ANSI/ASME B30.9); Single-failure-proof cranes (NUREG 0554)
- Allowed use of non-single-failure-proof cranes for handling loads as long as:
  - Radiological dose to public below Part 100 limits and expectation that dose should be less than 25 % of Part 100 limits(25 Rem whole body / 300 Rem thyroid)
  - Reactivity of fuel remained below 95% (Keff) during accidental drop.
  - No damage to equipment in dual safe shutdown paths.

NUREG 0612
Control of Heavy Loads

- Stipulated use of Safe Load Paths to limit damage to plant
- Provided allowances for operating nuclear plant upgrades to existing cranes to meet the requirements of NUREG 0554

ANSI / ASME B30.2 Overhead Cranes

- Utilized at all nuclear plants
- Provides requirements for overhead cranes:
  - Construction
  - Installation
  - Inspection
  - Testing
  - Maintenance
  - Operator qualifications & training

ASME NOG-1
Nuclear Facility Cranes

- Provides requirements for overhead cranes at Nuclear facilities
- Code will be used for construction and installation of new cranes
  - Structural components
  - Mechanical components
  - Electrical components
  - Inspection and testing
  - Packaging, shipping, receiving, storage and handling

Crane Supplemental Requirements

- ANSI N14.6 – Provides requirements for special lifting devices:
  - Defines critical load that could affect safety related system or result in offsite radiological releases
  - Requires design stress factors of 3 for yield stress and 5 for ultimate stress
  - Requires dual load paths or increased stress factors of 6/10 for lifts of critical loads
  - Load test conducted for 150% of rated load or 300% for critical loads
- ANSI / ASME B30.9 – Provides requirements for slings:
  - Wire rope and synthetic material
  - Inspection and testing requirements

Utility Crane Upgrade

- Many plants elect upgrade to non-single-failure-proof crane
- Upgrades consist of:
  - Trolley and hoist replacement
  - Seismic analysis of crane (trolley, bridge, end trucks) down to crane rail
  - Seismic analysis of building structure (foundation to crane rail)
  - Typically involve modifications to building connections and support structure

Utility Crane Upgrade Trolley

- The existing trolley is replaced with a new trolley complete with single-failure-proof main hoist
- New trolley weight must be considered in seismic analysis
- Perform 125% load test of new main hoist and auxiliary hoist

Utility Crane Upgrade Building Capacity

- Many of the original building seismic calculations were performed by hand
- New computer analysis may indicate overstressed joints and members requiring modifications
- Must include weight of new trolley in calculations
- Errors discovered in old calculations dealing with assumed building conditions (degrees of freedom)

Utility Crane Upgrades Licensing Requirements

- Decision to use 10 CFR 50.59 process or use License Amendment:
  - What is original license basis?
  - Changes needed to Plant License or Technical Specifications?
  - Specific conditions embedded in FSAR?
  - Increase in maximum crane capacity can be made using 50.59 process
  - Most crane upgrades use 50.59 process

Utility Crane Upgrades Inspection Requirements

- Regulatory inspection of crane upgrades:
  - What is the licensing basis?
  - Has the single-failure-proof crane been reviewed by the NRC before in a Topical Report?
  - Matrix of how the crane meets the licensing requirements
  - Review records of the crane design, installation and testing

Recent Crane Inspections & Issues

- Region II Plant (2004)
  - Crane was single-failure-proof with 125 ton capacity
  - The NRC demonstration occurred with no problems
  - During the initial cask loading the crane experienced 2 trips when carrying the fully loaded canister
  - Crane inspected after trips with broken rail bolts identified
  - During the repair of the broken rail bolts, weld cracks were found on all 4 bridge trucks located near the concrete walls
  - Over 20 weld and base metal cracks were repaired
  - Licensee had not inspected bridge truck welds because they were not considered to be critical welds by the crane vendor

Recent Crane Inspections & Issues

- Region IV Plant (March – May 2006)
  - Crane capacity limited to 75 tons
  - First use of TN light weight transfer cask (OS197L)
  - Crane operational considerations were high priority due to potential dose rates
  - Licensee unable to find documented inspection of crane bridge structural welds after initial load test
  - Engineering firm performed seismic analysis for the Auxiliary Building which indicated overstress conditions existed in building columns during seismic event. NRR staff enlisted to review licensee calculations.
  - No analysis had been performed for the supporting crane rails and girders during seismic event

Recent Crane Inspections & Issues

- Region IV Plant (October – November 2006)
  - Initial 125% load test preformed in 1980, without recording ambient temperature. Cold-proof testing repeated prior to cask loading.
  - Inoperable bridge & trolley travel limit switches (only the hard stops existed)
  - Incorrect viscosity lubricating oil found in bridge drive unit and hoist motor gearbox showing high levels of particulate, materials and moisture
  - Hoist primary bull gear & pinion found dry and galled.
  - Licensee could not confirm operability of load drop protection

Recent Crane Inspections & Issues

- Region IV Plant (October – November 2006)

  Licensee initiated a testing program resulting in the following additional findings:

  – Inoperable wire rope equalization system
  – Load cell was found disabled
  – Hoist motor over current relay found off-scale high. Relay would not have engaged until the hoist motor was loaded with 250-tons
  – One of the two sets of mechanical load brakes was found inoperable
  – Crane had never been turned over for operational use

Recent Crane Inspections & Issues

- Region II Plant (February – March 2007)
  - Non-Single-Failure proof 125-ton Whiting Crane
  - Part 21 issue identified in 2006
  - No safety related systems near or under the floor of the transport path
  - Licensee hired the dry cask vendor to perform cask drop analysis for canister. Analysis indicated that canister would not breach and therefore the Part 21 dose limits would not be exceeded.
  - Licensee had not addressed that the fuel would remain subcritical (NUREG 0612 , Section 5.1.II – Keff <.95)

Recent Crane Inspections & Issues

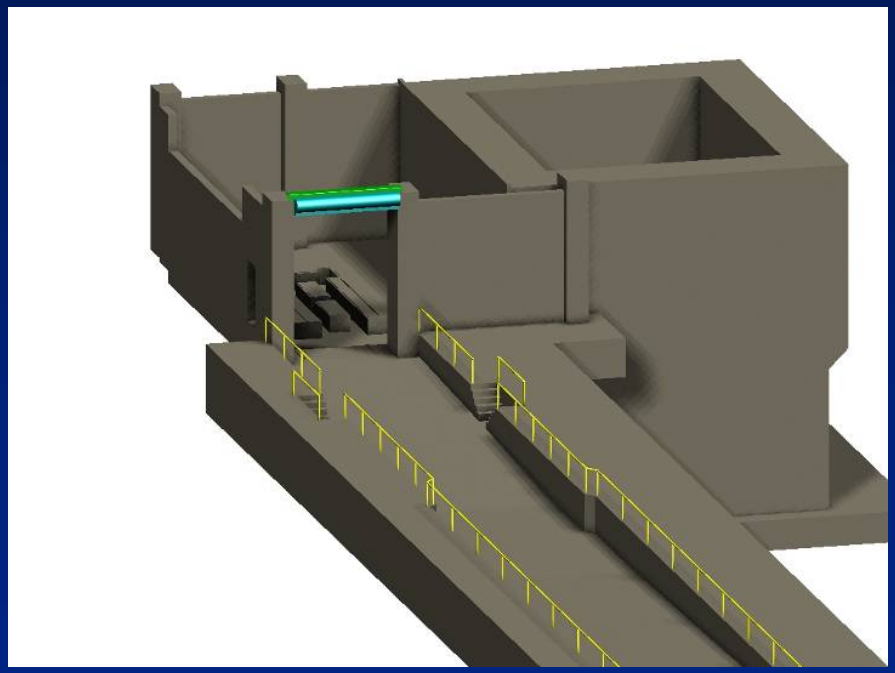
- Region I Plant (July - August 2007)
  - Licensee performed major modification to building for new expandable gantry crane
  - Expandable gantry crane fabricated and fully load tested at fabricator due to extension over spent fuel
  - Agency initially believed licensee had to perform 125% load test after crane had been erected at licensee facility
  - Licensee had committed to older version of ASME B 30.2, which did not require 125% load test after erection
  - Licensee will be permitted to use crane taking credit for load test performed at fabricator

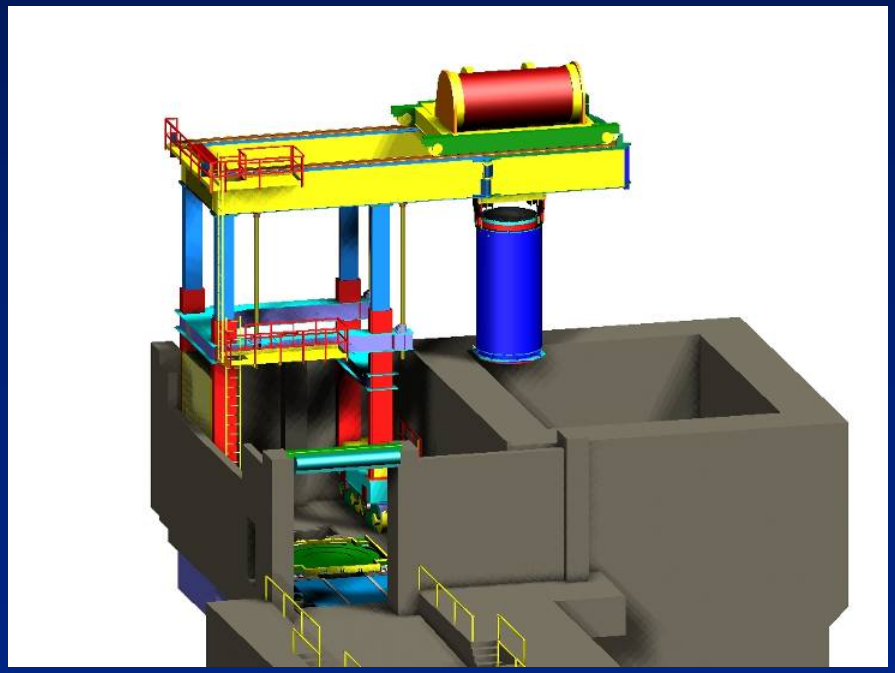
Recent Crane Inspections & Issues

- Region I Plant (July - August 2007) Slides

Recent Crane Inspections & Issues

- Region I Plant (July - August 2007) Slides





Summary

- Heavy loads are the highest risk activity associated with dry fuel storage
- The crane issues have been different at each site.
- All of the issues could have been avoided by the licensee by performing a thorough inspection of the crane and the associated documentation prior to the inspection
- Many of the new licensees are replacing or upgrading their cranes to single-failure-proof instead of using the existing equipment

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