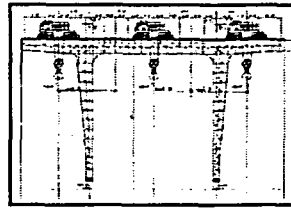


SONGS 1 Cask Handling System Upgrade



INTRODUCTIONS

◆ SCE team:

- Jim Reilly Director of Unit 1 Decommissioning
- Dave Pilmer Manager, Unit 1 Licensing
- Riyadh Qashu Supervisor Analysis Group
- Torrey Yee Consulting Engineer
- Paul Gyswyt Senior Civil Engineer

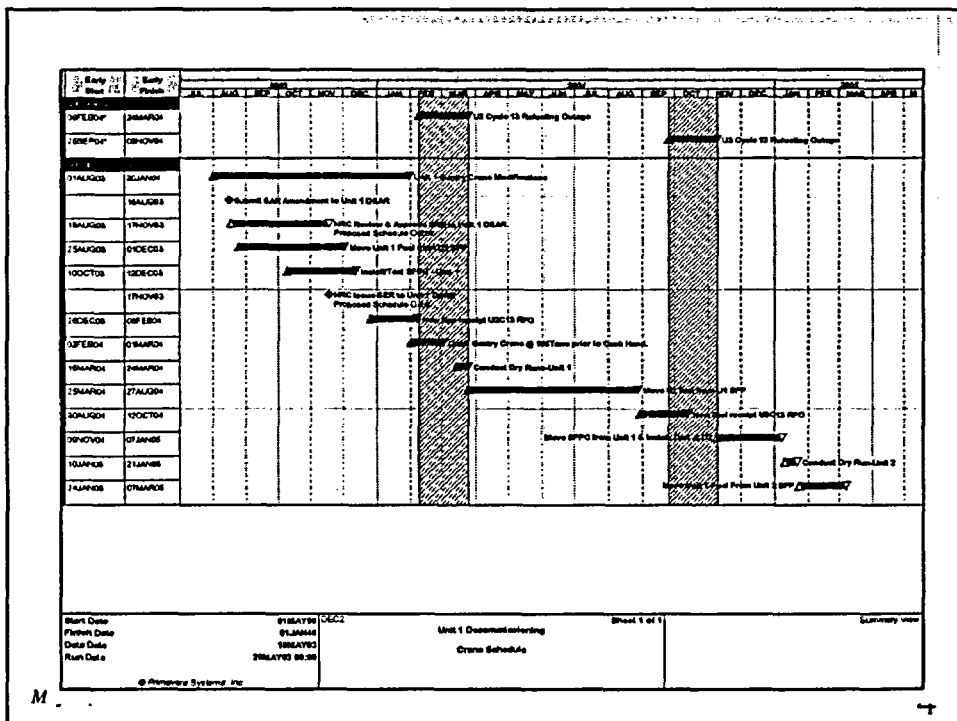
BACKGROUND

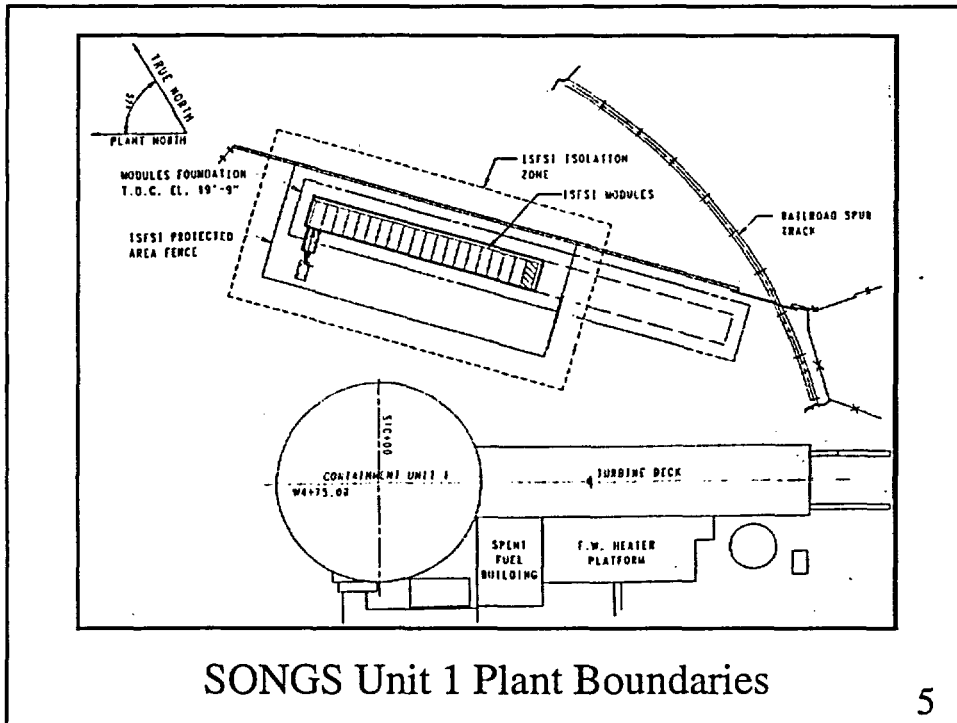
- ◆ SONGS 1 undergoing active decommissioning
- ◆ ISFSI required to support SONGS 2&3 operation
- ◆ ISFSI located at Unit 1 portion of site
- ◆ Recent NRC questions at other sites on cask handling issues
- ◆ Need to address cask handling issues before schedule is impacted

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SONGS Unit 1 Cask Handling System

- ◆ Project Scope for the SONGS Unit 1 Cask Handling System to Comply with NUREG-0612/0554 Requirements:
 - "Single Failure Proof" Turbine Gantry Crane
 - ◆ Retrofit and Seismically Qualify
 - Ederer eXtra-Safety And Monitoring (X-SAM) Trolley
 - ◆ Replace Existing Trolley
 - North Extension Building Structure
 - ◆ Upgrade for "Single Failure Proof" Gantry Crane

NUREG-0612 Evaluation

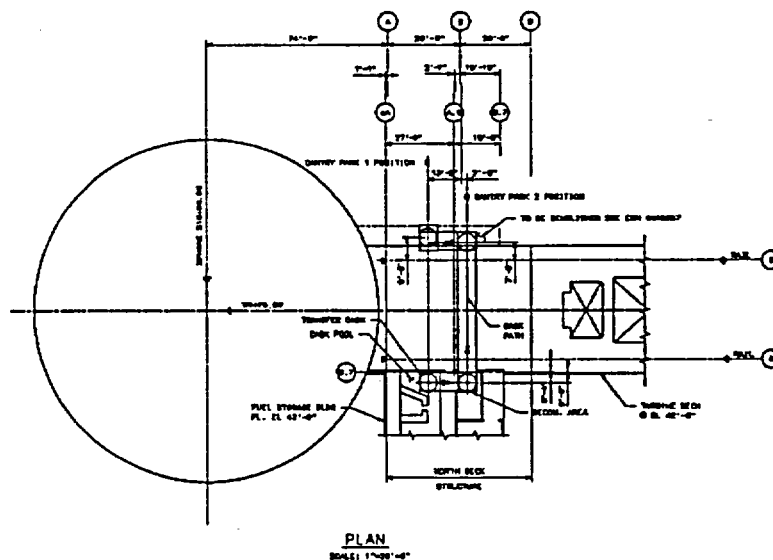
◆ Guideline # 1: Gantry Crane Safe Load Paths

- Drawings define transfer cask path
 - ◆ No safe-shutdown SSCs or spent fuel below path
- Plant procedures define the transfer cask load path
- Operator training reinforces the transfer cask load path
- Markings clearly show transfer cask load path on Turbine Building and Fuel Storage Building
 - ◆ Second person is assigned to “walkdown” the path and guide the crane operator in the gantry cab

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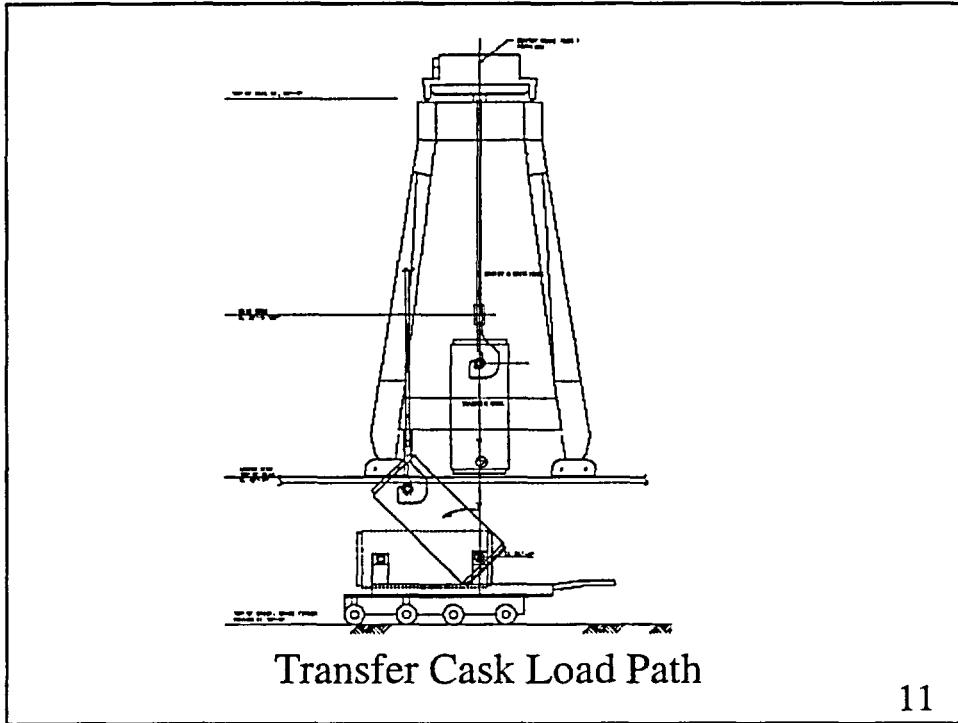
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Transfer Cask Load Path

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NUREG-0612 Evaluation

- ◆ Guideline # 2: Load Handling Procedures
 - Procedures assure required actions and precautions related to cask handling are well understood by operator
 - ◆ Gantry Crane Operation Procedure
 - Radio remote for trolley/hoist control
 - Back-up pendant precautions
 - eXtra-Safety And Monitoring trolley safety features
 - ◆ Transfer Cask Control Procedure

NUREG-0612 Evaluation

- ◆ Guideline # 3: Gantry Crane Operator Training
 - 12 hours of training ensures journeyman operator familiarity with equipment and plant procedures
 - ◆ Reduce occurrence of crane operator errors
 - ◆ Crane operator qualification process

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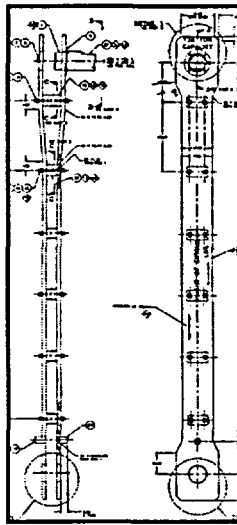
NUREG-0612 Evaluation

- ◆ Guideline # 4: Special Lifting Devices
 - Adequate safety margins and proper installation and use.
 - ◆ Two special devices: Yoke and Yoke Extension
 - Design Criteria per ANSI N14.6
 - 10:1 ultimate factor of safety
 - ◆ Prior to use visual, dimensional, nondestructive exams
 - ◆ Procedures for storage and handling of devices
- ◆ Guideline # 5: Lifting Devices (Standard Rigging)
 - Use 10:1 ultimate factor of safety margin
 - Proper installation and use.

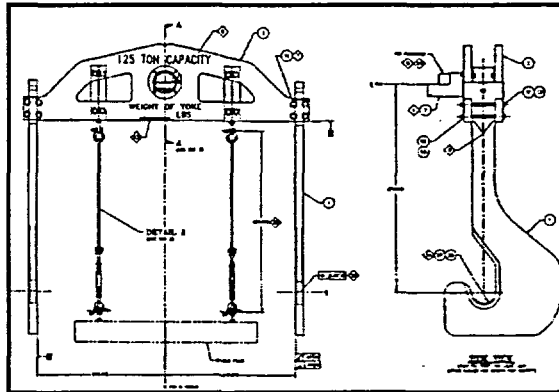
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Extension



Yoke

Hook Special Lifting Devices

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NUREG-0612 Evaluation

- ◆ Guideline # 6: Cranes (Inspection, Testing, and Maintenance)
 - Gantry Crane Inspection
 - ◆ Welding and Dimensional Checks
 - Gantry Crane Load Testing prior to use
 - ◆ 125% of 105 Tons = 262,500 pound test weight
 - Gantry Maintenance Current prior to first lift
 - ◆ Load bearing components are in proper working order
 - ◆ Worn or damaged parts are identified and replaced
 - SONGS Inspection & Testing Procedures:
 - ◆ Maintenance and Inspection of Cranes
 - ◆ Rigging Standards, Prior to Use Inspections
 - ◆ Inspection and Testing of Special Lifting Devices

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NUREG-0612 Evaluation

- ◆ Guideline # 7: Crane Design
 - Conformance to design guidelines ensures industry standards are met.
 - ◆ CMAA – 70
 - Structural, Mechanical, & Electrical Requirements
 - Crane specific considerations, i.e. bumpers
 - NUREG-0612 Appendix 'C'
 - ◆ Modification of Existing Crane
 - ◆ NUREG-0554, "Single Failure Proof Cranes for Nuclear Power Plants"

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NUREG-0554 Evaluation (NUREG-612 Appendix 'C')

- ◆ Allowable Stress Limits
 - Stresses are maintained below yield, anywhere in the individual members, when they are exposed to maximum load lifts during SSE.

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NUREG-0554 Evaluation (NUREG-612 Appendix 'C')

- ◆ Control & Hold the Load During SSE
 - Handling System Seismically Qualified
 - ◆ Gantry Crane/Building Coupled Structural Analysis
 - ◆ Trolley Mechanical/Structural Analysis
 - X-SAM
 - EDR-1, Topical Licensing Report

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NUREG-0554 Evaluation (NUREG-612 Appendix 'C')

- ◆ Automatic Controls and Limiting Devices
 - X-SAM Components Design
 - Malfunction can not prevent the crane from stopping or holding the load
- ◆ Dual Reeving
 - X-SAM concept includes a dual reeving system
 - ◆ Two independent sets of reeving
 - ◆ Hydraulic load equalization system
 - Cushions sudden motion from one wire rope failure

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NUREG-0554 Evaluation (NUREG-612 Appendix 'C')

- ◆ Sensing Devices for Overspeed, Overload, Overtravel
 - X-SAM Failure Detection System
 - ◆ Detects the loss of mechanical continuity in the hoist
 - Improper rope spooling
 - Drum overspeed
 - ◆ Detects actuation of Energy Absorbing Torque Limiter
 - Limits load imposed on the reeving system from:
 - Load hang-up
 - Two-blocking
 - ◆ Load Cell senses overloads during hoisting

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NUREG-0554 Evaluation (NUREG-612 Appendix 'C')

- ◆ Design for "Two-Blocking"
 - The X-SAM utilizes a Hoist Integrated Protective System
 - ◆ Prevents overload of hoist components, i.e. wire rope.
 - ◆ Independent, emergency path for stopping and holding the load in the event of any single, credible failure in the hoist drive system.

- ◆ Hoisting Drum Design for Shaft or Bearing Failure
 - Drum Safety Structure
 - ◆ Separate hub and stub assembly
 - ◆ Restraint structure to prevent drum gear and emergency brake from disengaging

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NUREG-0554 Evaluation (NUREG-612 Appendix 'C')

- ◆ Safety Devices, i.e. Limit Switches
 - Safety devices such as trolley and gantry travel mechanical stops
 - ◆ Dual and separate upper limit hoist switches
 - ◆ One vertical lower limit hoist switch
 - ◆ Trolley end of travel limit switches

- ◆ Static and Dynamic Load Tests
 - 125% load testing
 - 100% full performance load testing

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STRUCTURAL ANALYSIS

- ◆ CRANE DESCRIPTION
 - The gantry is 47' tall, 40' center span, box girder construction
 - Originally designed for 115 tons and currently rated for 100 ton capacity lifts
 - The deck is pre-stressed reinforced concrete slab
 - The gantry crane runway/deck is supported by a steel frame structure
 - The Gantry Crane movement is restricted to the Turbine Building North Extension

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STRUCTURAL ANALYSIS

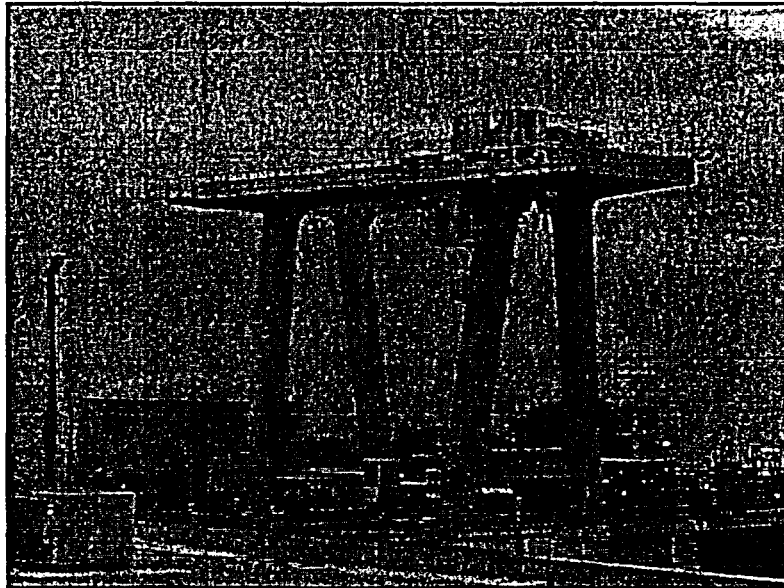
◆ SEISMIC CLASSIFICATION

- The North Extension is Seismic 'A'
- The Gantry Crane is Seismic 'B', upgraded to Seismic 'A'
- The Trolley is a "Single Failure Proof" Seismic 'A'

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Turbine Gantry Crane

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STRUCTURAL ANALYSIS

◆ DESIGN CRITERIA

- SONGS 1 Seismic Design Basis
- The allowable stress limits are maintained below yield, to prevent permanent deformation of the individual structural members when exposed to maximum load lifts during SSE. SONGS 1 Design Criteria provided allowable stresses below yield:
 - ◆ Tensile 0.96 Sy
 - ◆ Compression 0.96 Sy
 - ◆ Shear 0.57 Sy
- Column buckling per AISC
- Plate buckling per AISC and CMAA
- Maximum lifting load 105 tons

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STRUCTURAL ANALYSIS

◆ STRUCTURAL ANALYSIS METHODOLOGY

- Modal response spectra analysis @ 5% damping
- Geometry was based on as built dimensions
- Standard three dimensional FEA using a combination of beam, plate, and mass elements
 - ◆ Trolley and lifted load were modeled as rigid mass
 - ◆ Gantry and building were modeled with beam elements
 - ◆ Deck was modeled with plate elements
 - ◆ Gantry (local stress) was modeled with plate elements
- Coupled model of gantry and building

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STRUCTURAL ANALYSIS

- Boundary conditions
 - ◆ Trolley wheels were modeled as pin connections
 - ◆ The gantry wheels were modeled as pin-connections to rails in the E-W, and up-down. To prevent the up/down motion L-shaped hold down restraint were added
 - ◆ Sliding of the gantry is allowed N-S, and is bounded by a spring load equals 0.3(normal load)
- Computer programs used:
 - ◆ SAP 2000
 - ◆ GT-STRU DL
 - ◆ ANSYS

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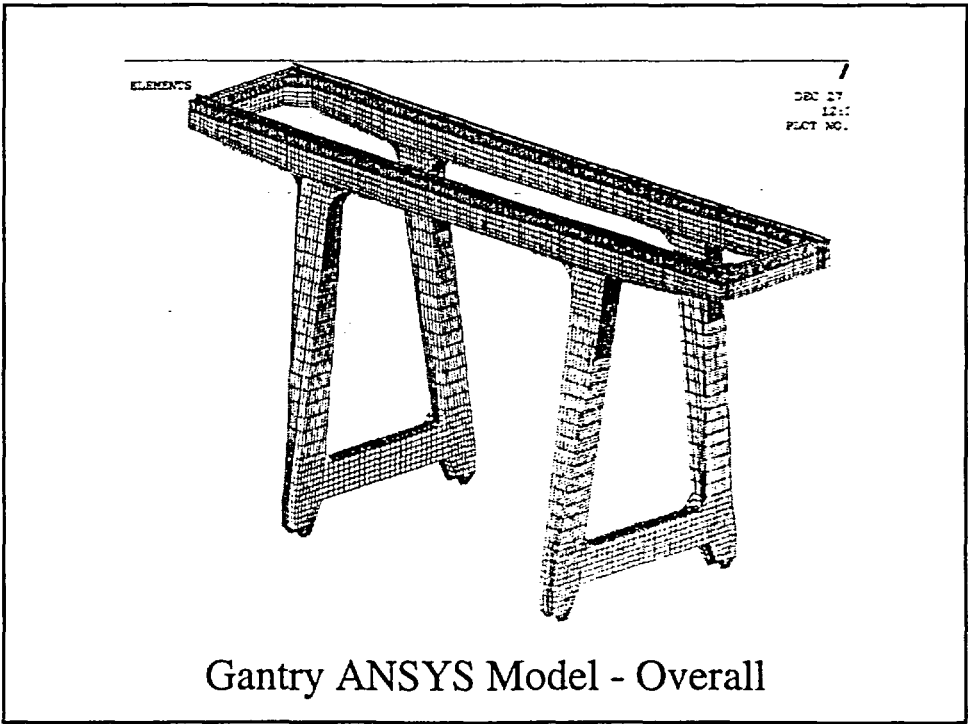
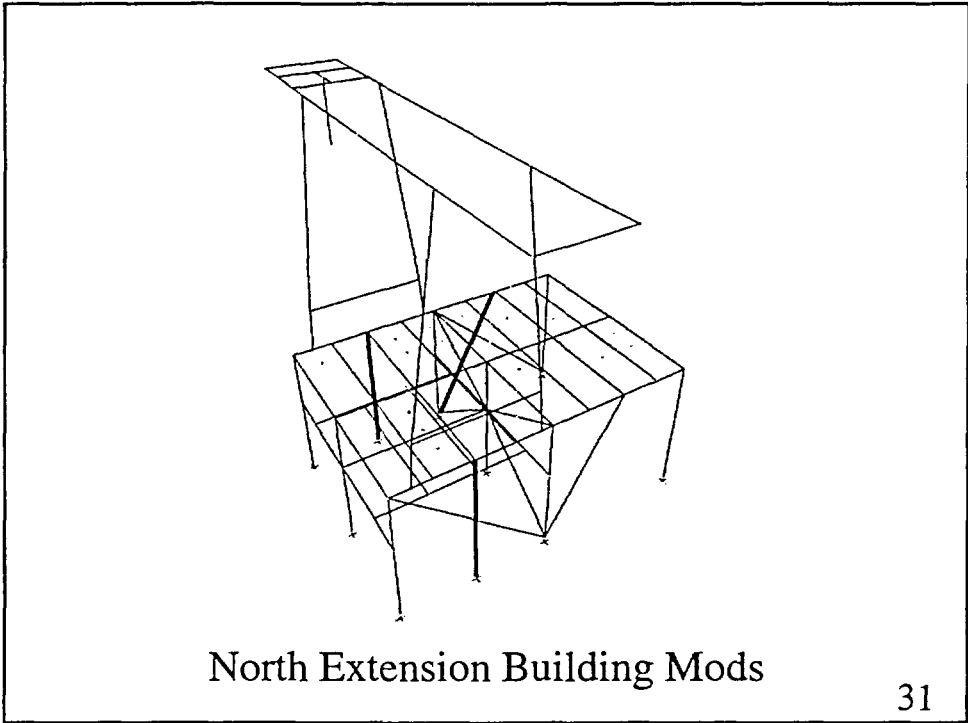
STRUCTURAL ANALYSIS

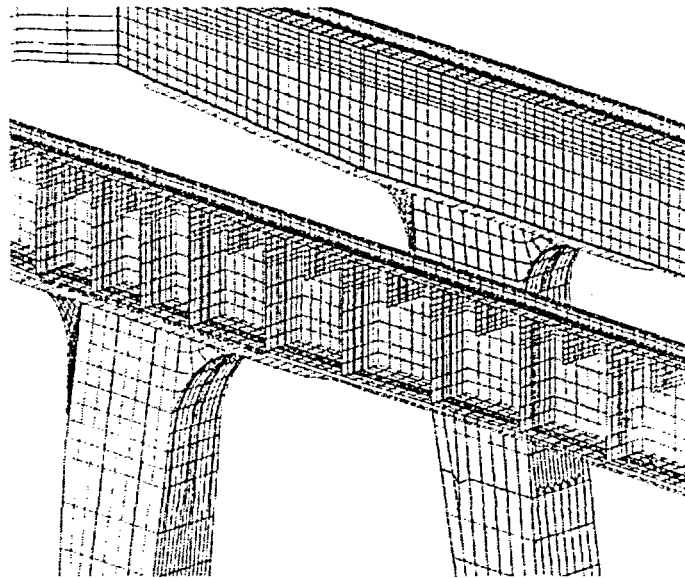
- Analyzed a total of 14 hook positions
- Used the maximum induced forces and moments from any position to calculate stress

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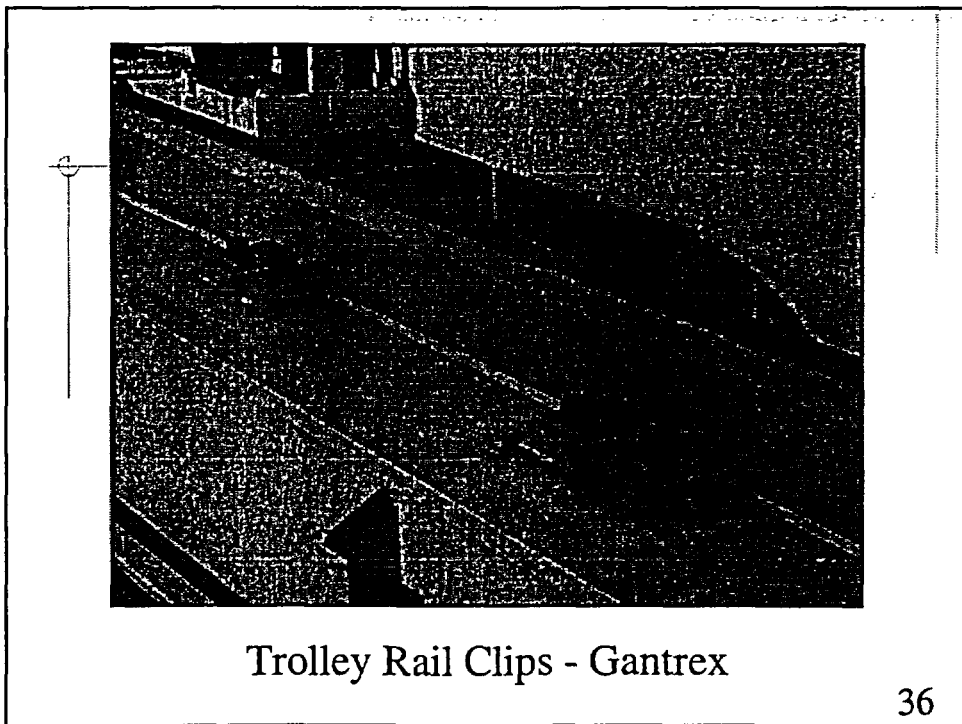
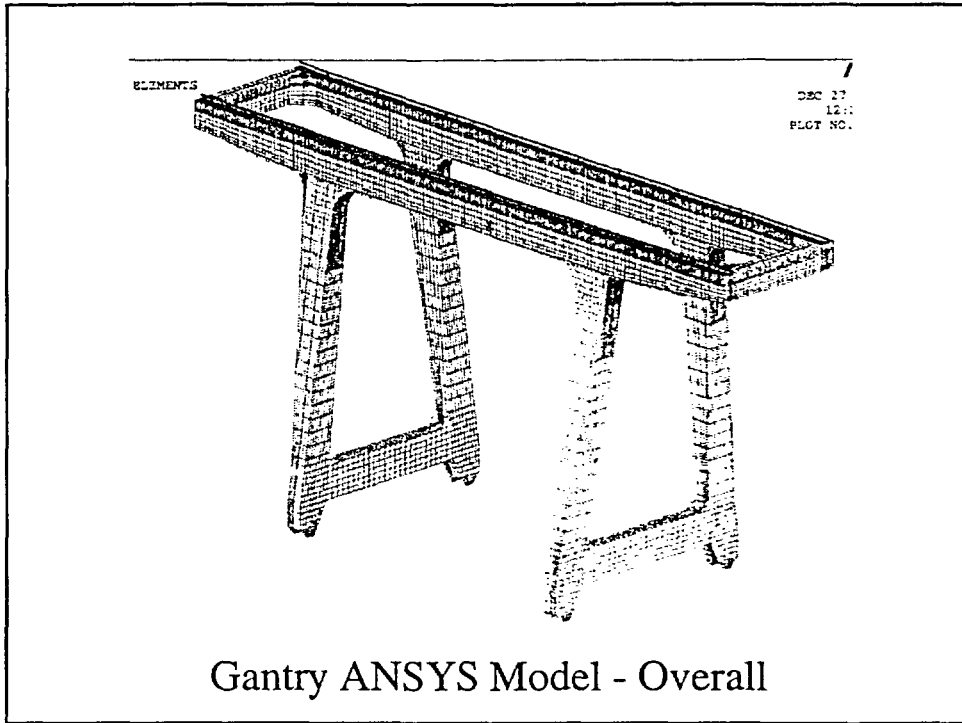


Gantry ANSYS Model - Detail

STRUCTURAL ANALYSIS

◆ RESULTS SUMMARY

- Added to the building two columns and two brace beams
- Strengthened 7 building connections
- Added 12 hold-down restraints to the gantry
- Strengthened gantry girders, joints and columns
- Reinforced gantry wheel trucks
- Increased number of trolley rail clips
- Met design criteria



Cask Drop Consequences

- ◆ Safety analysis does not postulate cask drop because crane meets NUREG-0554 single-failure-proof criteria
- ◆ Consequences of hypothetical cask drop
 - Cask drop causes all fuel rods to rupture and breaches confinement of internal gases
 - Puff release made directly to atmosphere
 - Atmospheric dispersion using 5th percentile most adverse conditions (consistent with SAR accident dose calculations)
 - Source term bounds all Unit 1 fuel (calculated for 10 years' decay)

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Cask Drop Consequences

- ◆ Krypton-85 is only gaseous isotope remaining (iodines and other noble gases have decayed away)
- ◆ 30% gas activity is released
- ◆ Dose receptor is at the closest point of exclusion area boundary at plume centerline
- ◆ Hypothetical dose consequences:
 - Whole body gamma immersion dose is 9.35 mrem
 - Beta skin immersion dose is 777 mrem

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Safety Analysis for Cask Handling

- ◆ Ensure Safe Storage of Spent Fuel in Pool
- ◆ Ensure Safe Transfer of Spent Fuel to the ISFSI

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Safety Analysis for Cask Handling

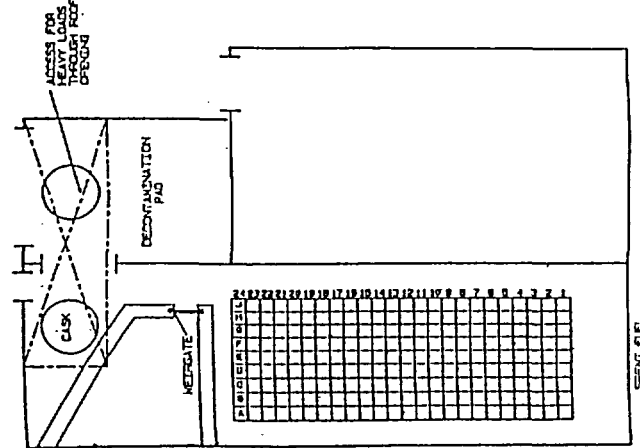
- ◆ **Protection of Spent Fuel in Pool**
 - No heavy load lifts over the spent fuel pool
 - Cask Pool is physically separated from spent fuel pool
 - Single Failure Proof Crane to prevent load drops
 - Hypothetical load drop in cask pool would not cause spent fuel to be uncovered
 - Crane upgraded for Design Basis Earthquake

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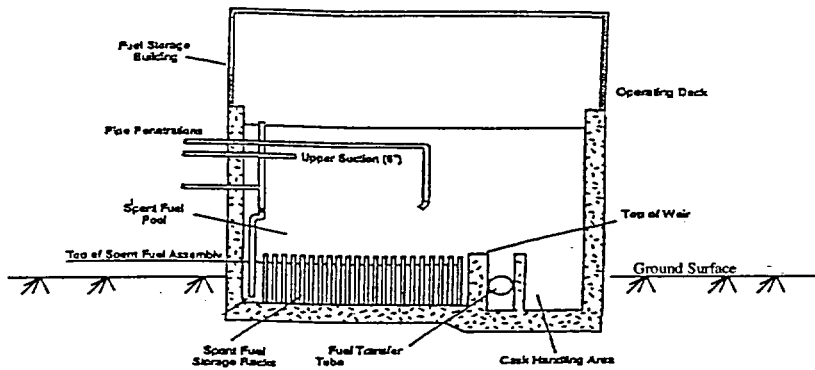
Safety Analysis for Cask Handling



SONGS 1 Spent Fuel Pool

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Safety Analysis for Cask Handling



SONGS 1 Spent Fuel Pool

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Safety Analysis for Cask Handling

◆ Safe Transfer of Spent Fuel

- Single Failure Proof Crane to prevent load drops
 - ◆ Transfer Cask is qualified for maximum drop height of 80 inches
- Crane and Turbine Building upgraded for Design Basis Earthquake
- Decontamination Area modified to prevent potential overturning of the Transfer Cask

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Licensing Process

◆ Licensing Process

- Submit amendment to Unit 1 Safety Analysis Report (DSAR)
 - ◆ Crane qualification being increased from 100 tons to 105 tons
 - ◆ Ederer X-SAM single failure proof trolley
 - ◆ Lifting devices have 10:1 safety factor
 - ◆ Structural enhancements to gantry frame
 - ◆ Structural enhancements to support building
 - ◆ Structural enhancements to gantry rails
 - ◆ Seismic restraints applied to gantry wheels

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Schedule

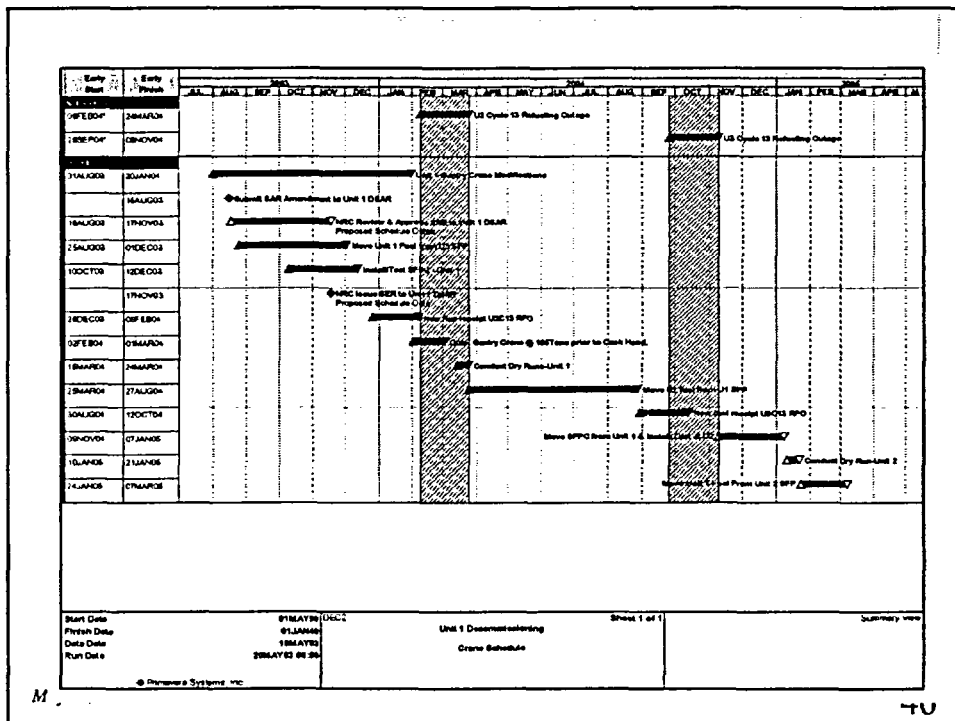
◆ Schedule

- Submit SAR amendment by August 15, 2003
- Request 3 month NRC review
 - ◆ SER issued by November 15, 2003
- Unit 1 cask handling dry runs commence March 15, 2004
- Unit 1 spent fuel handling from March 25 to August 27, 2004

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CONCLUSION

- ◆ “Single Failure Proof” Turbine Gantry Crane
- ◆ Seismic Building Upgrades
- ◆ Maintained NUREG-0612 “Defense-In-Depth” Approach

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