# Nuclear Fuel Update

**Palo Verde Nuclear Generating Station**

**May 30, 2002**
**Meeting with US NRC**

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# Review of 2001

- March 2001 Meeting with NRR
- Approval of new MDNBR Limit
- Progress with Clad Performance
- Alloy A LFA Approved For 4th Burn
- CENTS Code Added to COLR
- Begin Transition to Westinghouse Rod
- Zirlo Tech Spec Submitted

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# Agenda Today

- Review of Unit 2 Cycle 11
- CENTS Implementation & Licensing
- Integrated Clad Performance Strategy
- Update on CEA Investigation
- Dry Cask Storage Update

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# Unit 2 Cycle 11

**Activities Incorporated in the Reload Safety Analyses**

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# U2C11 Reload Analyses

- Implementation of New MDNBR Limit
- Manufacturing Transition to Columbia
- Implementation of Zirlo Clad & New LOCA Methodology
- Implementation of New CENTS AORs

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# CENTS System Code

Implementation & Licensing

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# CENTS Implementation Plan

- Generic Letter 83-11 Supplement 1
- All UFSAR Chapter 15 Analyses
- Two Events Remain In Progress
  - Steam Generator Tube Rupture
  - CEA Ejection Dose Consequences



# Steam Generator Tube Rupture

- Consequences Increase > Minimal
- Principal Contributors
  - Timing of Aux FW & ADV opening
  - New Limiting SG Level
- Retain Current CESEC AOR Until CENTS Analysis Reviewed & Approved
- Consistent With RSG/PUR Submittal

# CEA Ejection Dose Consequences

- Evaluating CENTS Applicability
- Will Submit if Required
- Retain Current CESEC AOR Until CENTS Implemented
- Will Not Impact RSG/PUR Submittal



# Palo Verde Integrated Clad Performance Strategy

Review of Recent Capabilities

U2 Uprate Corrosion Strategy

# Integrated Fuel Clad Strategy

- Advanced Clad Alloys
- Primary System Chemistry
- Higher Order Modeling
- Low Duty Core Designs

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# Advanced Clad Alloys

- Full Batch Zirlo starting U2C11 (Spring 2002)
- Alloy A LTA in U3C10 (Spring 2003)
- Continuing Discussions with Westinghouse

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# Primary Chemistry

- Additional RCS Cleaning at EOC Shutdown
- Early Lithium Injection During Startups
- Elevated-Coordinated Lithium Strategy
  - Currently 7.1 pH
  - Inspection U1R10 (Fall 2002)
  - Gradual Increase to $\geq$ 7.2 pH

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# Higher Order Modeling

- Uncertainty in Behaviors $\Rightarrow$ Multiple Models
- Steaming Rate Function in Design Tools
  - U3C9 Benchmark
- APS CRUD/Oxide Model
  - Pin x Pin Colorset and Coarse Mesh Octant
- Vendor Fuel Duty Model
  - Oxide and FDI for all Clads

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# Low Duty Core Designs

- Increase Feed Batch Size
  - 104 vs 96 Assemblies
- Minimal Feed-Face-Feed
- U2 Uprate Corrosion Strategy
  - 3% Power and 2ºF Coolant Temperature
  - Zirlo Clad
  - Re-design Lattice Pattern

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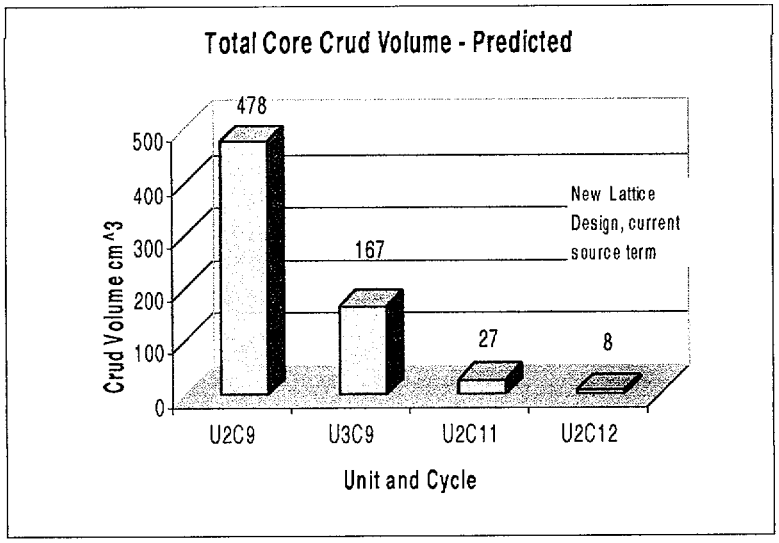


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# Palo Verde CEA Replacement

Update on CEA Investigation

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# Review of CEA Replacement

- CEA Finger Failures Observed - all Units
  - Significant Cracks in High Fluence CEAs
  - Boron Loss in U1 Lead Group
  - Some Medium Fluence CEA Cracking
  - U2R8 CEA Found Cracked (Jan. 2002)
- All Full Length CEAs Replaced
  - Two Different Tip Designs
  - Replaced by Design with Smallest Pellet

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# Apparent Cause of Failures

- IASCC of Cladding
  - Irradiation Sensitized Inconel
  - Swelling-induced Strain
- Less than Adequate Design Testing
  - Feltmetal Properties Unverified at High Duty
  - Pellet-Feltmetal Interaction
- Lifetime Predictive Software
  - Models Not Fully Benchmarked

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# Remaining Actions

- Determine Conservative Estimate of Life
  - 2 Cycle Fingers OK
  - Possible YGN Inspections
  - Possible Hot Cell Exams
  - $2 \times 10^{21}$ n/cm$^2$ Threshold?
- CEA re-Design for the Future

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# Palo Verde
# Dry Cask Storage

## Plan Overview

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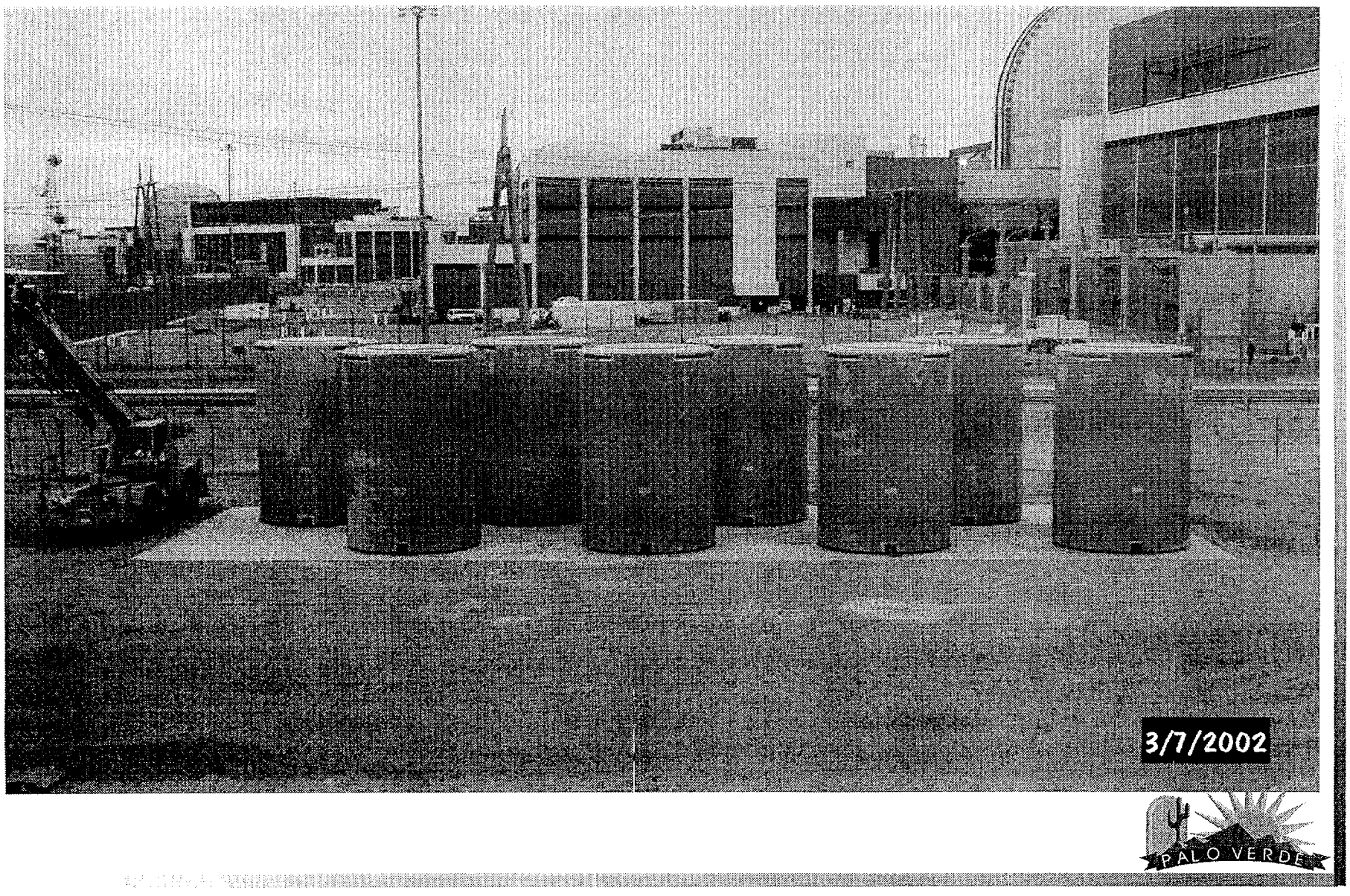
# Project Schedule

- Concrete Cask fab completed 3/31/02
- First Canister delivery 6/28/02
- ISFSI Construction complete 8/19/02
- Security features installed 9/15/02
- Dry run practice begins 8/1/02
- NRC dry run observations mid November
- First system on the pad by Christmas

# Completed VCCs



# Palo Verde Dry Cask Storage Principal Components

**(Cut-away View)**

[redacted]

**Dimensions:**

| | |
|---|---|
| Transfer cask | Ht. 16 ft. 11 in. |
| | Dia. 7 ft. 1 in. |
| Loaded canister | Ht. 15 ft. 11 in. |
| | Dia. 5 ft. 7 in. |
| VCC | Ht. 18 ft. 10 in. |
| | Dia. 11 ft. 4 in. |

**Weight:**

| | |
|---|---|
| Transfer cask | 60 tons |
| Loaded canister | 35 tons |
| VCC | 119 tons |
| Loaded system | 154 tons |