NRC FORM 658
(9-1999)

U.S. NUCLEAR REGULATORY COMMISSION

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Do not include proprietary materials.

DATE OF MEETING
03/10/2000

The attached document(s), which was/were handed out in this meeting, is/are to be placed in the public domain as soon as possible. The minutes of the meeting will be issued in the near future. Following are administrative details regarding this meeting:

Docket Number(s)	**50-528, 50-529, 50-530**
Plant/Facility Name	**Palo Verde Nucear Generating Station, Units 1, 2, and 3**
TAC Number(s) (if available)	**N/A**
Reference Meeting Notice	**February 28, 2000**
Purpose of Meeting (copy from meeting notice)	**To discuss the progress made by APS in developing in-house capability to conduct fuel reload analysis**

NAME OF PERSON WHO ISSUED MEETING NOTICE	TITLE
Mel Fields	**Project Manager**

OFFICE
NRR

DIVISION
DLPM

BRANCH
PD IV-2

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DF01

PVNGS
Nuclear Fuel Management
Update

March 9, 2000

Purpose

- Progress - 1999
  - » Spent Fuel Storage
  - » Models and Methods
  - » Clad Testing
  - » Unit 2 Steam Generator Replacement / Power Uprate
  - » Fuel Performance

Purpose

- Current and Future
  - » Spent Fuel Storage
  - » Models and Methods
  - » Clad Testing
  - » Unit 2 Steam Generator Replacement / Power Uprate
  - » Fuel Performance

Dry Spent Fuel Storage Update

March 9, 2000

Significant Milestones

- Engineering Design Work for 2000
  - » ISFSI Design
  - » Site Interface Mods with ISFSI
  - » Transportation Route Modes and Equipment Spec
  - » Support Structure for Cask Loading Process
  - » 72.212 Documentation
- Site Work
  - » Crane Testing
  - » Modification of Unit 1 Load Pit Gate Seals

Project Work

- Prepare for Canister Fabrication
  - » Develop 72.48 Program
  - » Develop QA & Engineering Fab Follow Program
  - » Select and Qualify Fabricator
- Development of PVNGS Load Process
  - » Test Crane for Reliability & Capability
  - » Develop Procedures
  - » Resolve Licensing Issues for PVNGS Process
  - » Evaluate Welding Processes & Equipment
  - » Develop Automated Weld Inspection Capability
- Develop Initial Training Program

NAC Status

- UMS CoC in Rulemaking Process
  - » Public Comments due April 5th
  - » Final CoC Schedule for October,2000
- Maine Yankee Fabrication Starts April, 2000
- PVNGS Early Fabrication Start is December, 2000
  - » First Canister Delivery December, 2001

Schedule Overview

CASK ACTIVITIES

1/15/00 – 10/1/00	12/1/00 – 12/15/01	5/1/01 – 5/1/02
UMS Lic	Fab 1st UMS System	Fab 7 UMS Systems

ISFSI PREPARATION

4/01/00 – 12/31/00	1/01/01 – 12/31/01
•ISFSI Design •Plant MOD Design	•ISFSI Construction •Plant MOD Install

LOADING PREPARATION

6/01/00 – 12/31/01	1/1/02 – 3/31/02	5/12/02 – 7/19/02	7/22/02 – 9/15/02
Develop Procedures & Training	•Deliver Training •Perform Pre op Testing	Dry Run Practice	Load 1st Systems

Models & Methods

Palo Verde Nuclear Generating Station

March 9, 2000 Status

Major Projects

- CASMO/SIMULATE Topical
- CENTS Implementation
- 1D Thermal Hydraulics
- Fuel Clad Performance

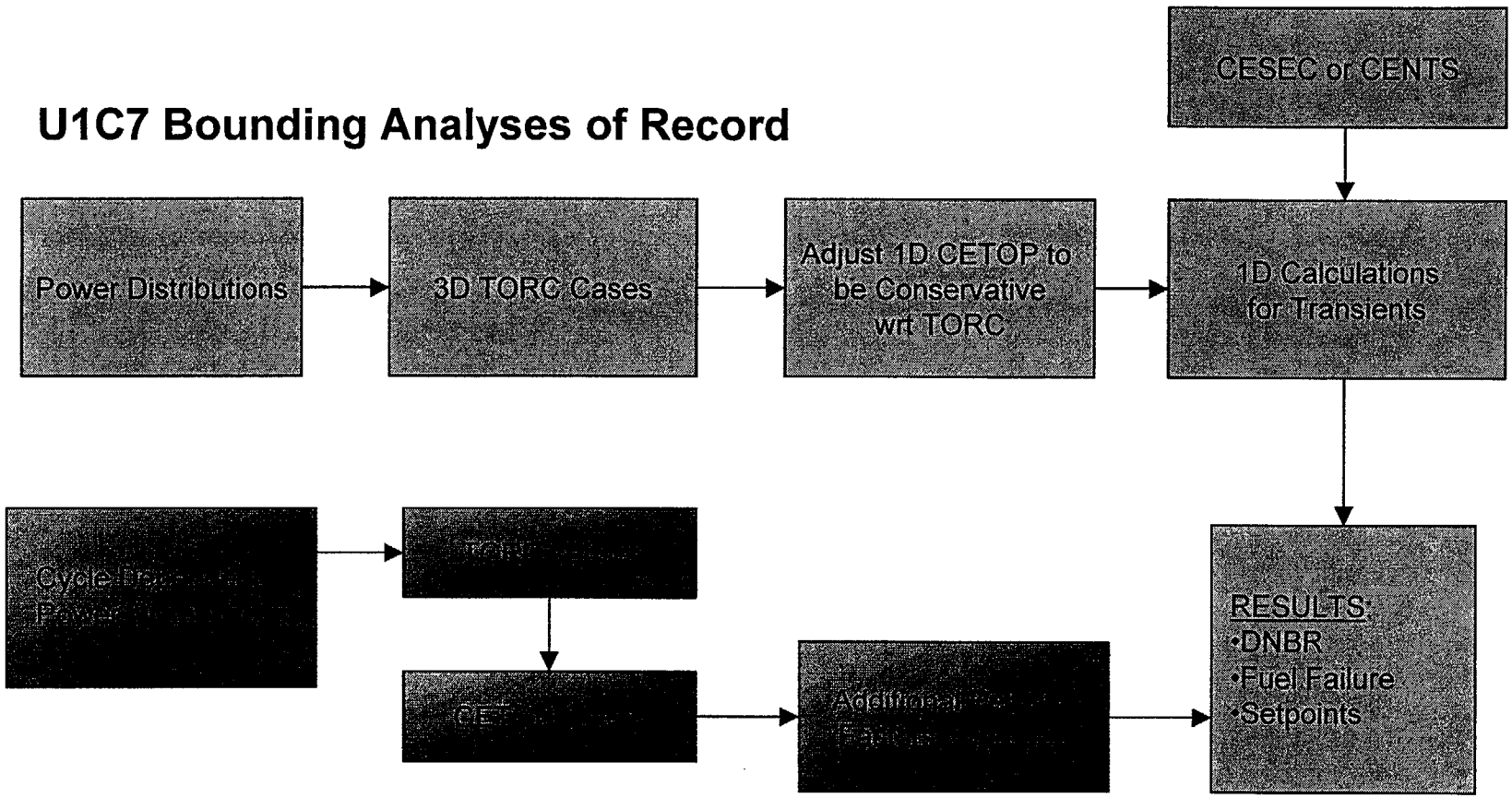
CASMO/SIMULATE

- Replace
  - » DIT & ROCS/MC with CASMO-4 & SIMULATE-3
  - » Consistent Physics Codes in All Analyses
  - » Implementation in PAC Underway
- Benchmark Completed September 1999
- Topical Submittal in Early June
  - » CASMO/SIMULATE Not Generically Approved
  - » Tech Spec Change to COLR References

CENTS Implementation

- Replace CESEC with CENTS
  - » Code Generically Approved By NRC
  - » Using for U2 Steam Generator Replacement & Power Uprate Analyses
  - » 3876MW UFSAR Chapter 15 Reanalysis Nearly Complete
  - » Tech Spec Submittal late 2000
- GL 83-11 Supplement 1 Program
  - » Design Control Committee
  - » Safety Analysis Basis Document
  - » Technical Review Committee
  - » 10CFR50.59 Program

Reload TH Process Map



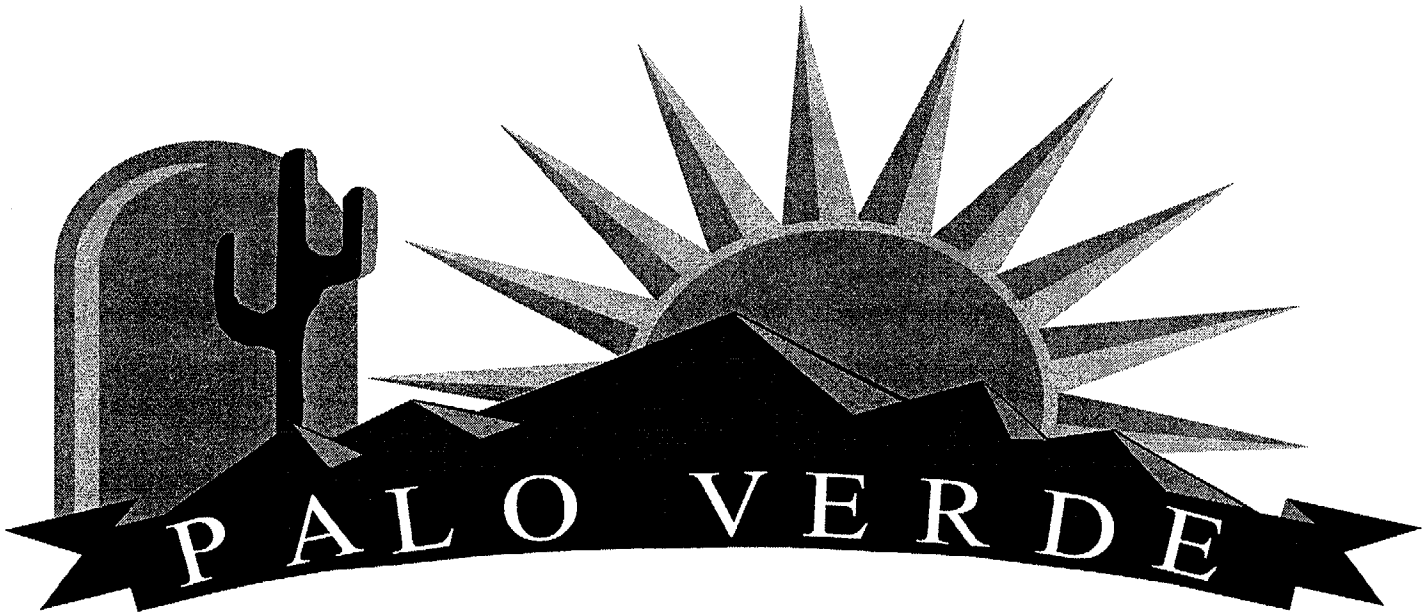
1D Thermal Hydraulics

- Same Method, More Adverse Results
  - » 10CFR21 -- Modern Flat Power Distributions
  - » More Screening Cases
  - » New MDNBR Limit
  - » Expanded Geometry Capability for 3D TORC

1D Thermal Hydraulics

- New Bounding Analyses In Preparation
  - » U2 SG Replacement/Uprate Analyses
  - » U1/U3 @ 3876 MW
  - » Automation Tools
  - » Training in August - Screening in September
  - » Tech Spec Submittal Early 2001

High Burnup Program



March 9, 2000 Status

PVNGS/ABB Joint Program

- OPTIN Clad Performance
  - » High Burnup Extension Topical
- Advanced Alloy Test Program
  - » Anikuloy
  - » Alloy A

OPTIN Clad Performance

- OPTIN Test Rods
  - » Burned to ~65 GWD/T in 4 Cycles
  - » High Duty in U3C7
- Oxide Thickness
  - » On Prediction, First 3 Cycles
  - » Above Prediction, 4th Cycle
  - » Little CRUD
- Spallation

ABB High Burnup Topical

- OPTIN Topical in NRC Review
  - » 62 GWD/T Maximum Rod Burnup
  - » 100 µm Maximum Oxide Thickness
- Issue - High Duty Fuel
  - » Corrosion Model Comparison to PV High Duty Fuel
  - » High Duty Fuel Observations at Other ABB/CE Plants
  - » 9-Pin Corrosion Model

Advanced Alloy Test Program

- Current LTAs Under Irradiation
  - » Anikuloy & Alloy A LTAs in U3C8 (2nd Burn)
  - » Anikuloy & Alloy A Test Rods in U2C9 (3rd Burn)
- Anikuloy Status
  - » Dimensional Stability
  - » Corrosion Resistance
  - » All to Be Discharged at Next Refuelings
- Alloy A Status
  - » Corrosion Resistance
  - » Continue Irradiation & Measurements as Planned

Palo Verde Fuel Clad Performance Strategy

Summary of Activities

April 1999 - February 2000

Background

- 1997 Switch from Checkerboard to Fresh-on-Fresh Loading Patterns
- 1998 High Duty Fuel Exams
  - » CRUD Seen on Peripheral Fuel Rods
- 1998 Fuel Management Guidelines
  - » Decreased Number of Fresh-Fresh Interfaces
  - » Lowered Radial Peaking Targets

Planned for 1999

- Continued Fuel Inspections
  - » Oxide Thickness Measurements
  - » Crud Sampling
- Clad Model Development
  - » Oxide Calculations into Fuel Management
  - » Chen Correlation into TORC

1999 Fuel Inspections

- Qualitative Observations
  - » CRUD on High Duty Assemblies
  - » CRUD Correlates to Interface Power
- Unit 2 Quantitative Data
  - » Once Burned Assembly P2K410 from "Ring"
  - » CRUD/Oxide Measurements of 10 Rods
  - » CRUD Pattern - Peripheral Rods Only
  - » Interior Rods of Same Power - No CRUD
- Unit 1 - Visuals Only (CRUD Scraping)

CRUD Analysis Program

- Two CRUD Samples
  - » U1R8 - Once Burned Fuel Assembly
  - » U2R8 - Once Burned Rod from U2R8
- Chalk River Lab
  - » Same Tests as EPRI Robust Fuel Program
  - » Elements, Compounds, Morphology
  - » Samples Shipped February 8, 2000

Clad Oxide Model Development

- U3 Four Cycle OPTIN Benchmark
  - » Corrosion Model "Misses" 4th (High Duty) Cycle
- U2 Measurements on P2K410 Require Advanced Modeling
  - » CORETRAN Model
  - » 9-Pin Model
- Interim Guideline - Interface Power

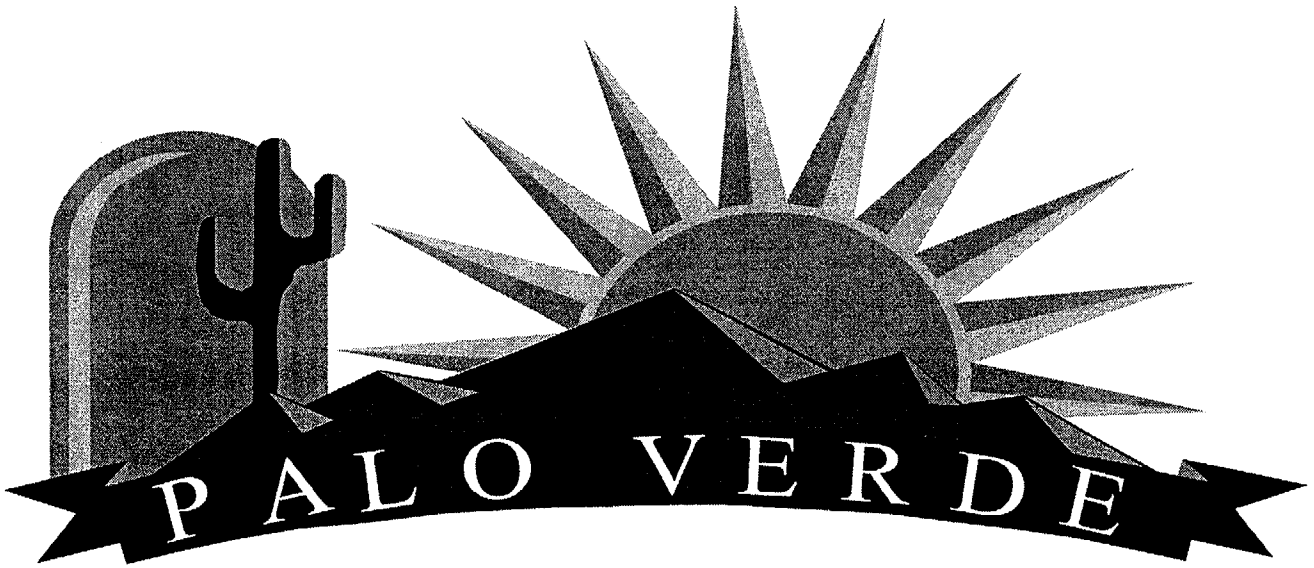
Steaming Rate Calculations

- Obtained Steaming Rate Utility Code
- Modified to Palo Verde Geometry & TH
- Reviewed by ABB
- Enhancements Underway
  - » Chen and Thom Correlations
  - » Quarter Assembly and Max Rod
- Screened U2C10 Core Design

Plans for 2000

- Continued Visuals
- CRUD/Oxide Measurements (P3J321)
- U2R9
  - » CRUD Sample
  - » Visuals on Peripheral & Interior Rods

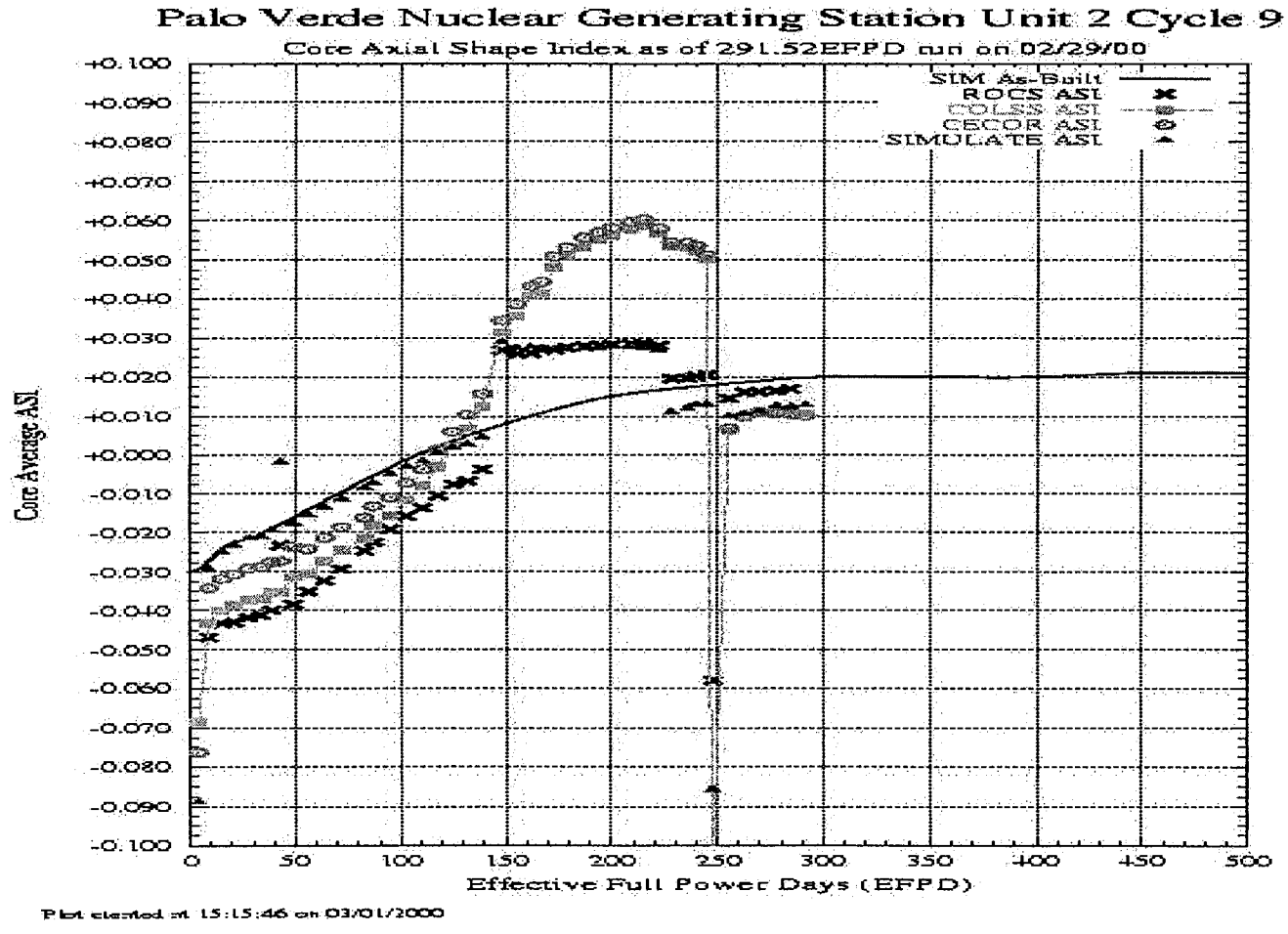
Palo Verde
Unit 2 Cycle 9
Power Distribution Anomaly



Summary for US NRC

March 9, 2000

Core Average Axial Shape Index (AO)



CECOR & COLSS - Measured Data
ROCS & SIMULATE - Calculated

Preliminary Conclusions

- U2C9 Behavior Similar To Mild AOA
  - » Azimuthal Variation Possibly Triggered by Initial Tilt
- Root Cause Likely Combination of Events
  - » Core Design (Steaming Rate)
  - » Initial Axial Offset (+4%)
  - » Unit 2 Specific TH (Flow and Temp)
  - » High Corrosion Products Mobile in Core

Safety Impacts from AOA

- Shutdown Margin
  - » Excess HFP SDM ~ 1090 pcm
  - » Precipitated Boron Worth ~200 pcm Max
- Core Depletion History
  - » Wide Axial Shape Band in Safety Analyses
  - » Carry-over to Next Cycle Analyses
- LHR Margin (115 minimum POL during anomaly)
- Reactivity Transients
  - » Conservatisms Bound Small Reactivity Insertion

Operational Impacts from AOA

- Core Depletes with Different History
  - » Axial Control When Power is Reduced
  - » Increased Uncertainty in ECPs
  - » Increased Uncertainty in 300 EFPD MTC
  - » Increased Uncertainty post RPCB
- Increased Co-58 Generation
- Possible Carry-over to Next Cycle
  - » Fuel Isotopics, CRUD Inventory, Lower Threshold

Prior Palo Verde Actions

- ABB Advanced Clad LTAs
- Enhanced Core Follow - Detected U2C9
- Increased Fuel Assembly Inspections
  - » Continuing Visuals with Periodic ECT Measurements
  - » U1 CRUD Sample Taken for Chalk River Analysis
- Additional Core Design Guidelines
  - » Decreased Number of Fresh-to-Fresh Interfaces
  - » Lowered Radial Peaking Target
  - » Established "Interface Power" CRUD Indicator
- Benchmarked Oxide Model

Recent Palo Verde Actions

- Modeling Core Behavior
  - » Built Empirical Core Physics Model
  - » Added Assembly Average Steaming Rate Calculation
  - » Initiated CORETRAN Coupled Physics-TH Study
  - » 9-pin Oxide Model Planned
- New Core Design Guideline
  - » Design within (less than) U2C9 Steaming Rates
- Chemistry
  - » Continue Clean-up Activities
  - » Investigate Recent Industry Practices
- CRUD Analysis
  - » Scrape U2 Once Burned Rod A5 (P2K410)

Potential Mitigation Strategies

- Core Design
  - » Increase Feed Batch Size (U2C10)
  - » Modify Assembly Burnup Rate w/BA's (U2C10)
  - » Axially Offset Burnable Absorbers
- Chemistry
  - » Nickel-Iron Chemistry Management (higher pH)
  - » Enriched Boron
- Operations
  - » Increase RCS Cleanup
  - » Increase RCS Pressure or Decrease T-inlet
  - » Ultrasound Fuel Assembly Cleaning