UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
611 RYAN PLAZA DRIVE, SUITE 400
ARLINGTON, TEXAS 76011-8064

May 24, 2002

Mr. J. V. Parrish
Chief Executive Officer
Energy Northwest
P.O. Box 968; MD 1023
Richland, Washington 99352-0968

SUBJECT: MEETING WITH COLUMBIA GENERATING STATION

Dear Mr. Parrish:

This refers to the public meeting conducted at the NRC Region IV offices, 611 Ryan Plaza Drive, Arlington, TX, on May 24, 2002. This meeting was conducted to discuss plant fuel corrosion issues and engineering initiatives. The meeting attendance list and licensee presentation are enclosed with this summary.

In accordance with 10 CFR 2.790 of the NRC's "Rules of Practice," Part 2, Title 10, Code of Federal Regulations, a copy of this letter and its enclosures will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Website at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room).

Sincerely,

Charles S. Marschall, Chief
Engineering and Maintenance Branch
Division of Reactor Safety

Docket: 50-397
License: NPF-21

Enclosures:
1. Attendance List
2. Licensee Presentation

cc with Enclosure 1:
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ENCLOSURE 1
Columbia Generating Station
Emergency Preparedness Regulatory Performance Meeting
February 21, 2002

ATTENDANCE LIST		
NAME	ORGANIZATION	POSITION/TITLE
Dale Atkinson	Energy Northwest	Engineering Manager
Mike Humphries	Energy Northwest	Reactor and Fuels Engineering Manager
Carl King	Energy Northwest	Design Engneering Manager
Christina Perino	Energy Northwest	Licensing Manager
Douge Coleman	Energy Northwest	Performance Assessment and Regulatory Programs Manager
Charles Marschall	NRC, Region IV	Chief, Engineering and Maintenance Branch, Division of Reactor Safety
William Jones	NRC, Region IV	Chief, Project Branch E, Division of Reactor Projects
Dale Powers	NRC, Region IV	Senior Technical Analyst, Division of Reactor Safety
George Replogle	NRC, Region IV	Senior Resident Inspector, Columbia Generating Station
John Hickman	NRC, NRR	Senior Project Manager
Shih-liang Wu	NRC, NRR	

Enclosure 2

Licensee Presentation

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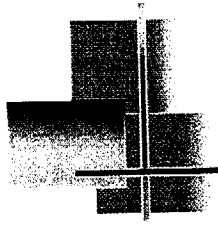
Columbia Generating Station Engineering Initiatives



Presentation to NRC Personnel

By

Carl King

Design Engineering Manager

May 24, 2002

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Columbia Generating Station Engineering Successes and Improvements

- Engineering Electronic Database Project
- Engineering Optimization
- Engineering Work Management
- Engineering Product Quality
- FSAR/TS Discrepancy Project

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Engineering Electronic Database Project (EEDB Project)

- Electronic database allowing search and retrieval of design database documents and Engineering information
- Passport/Curator platform utilized – LAN network
- Full text search engine
- Two year project to complete in June 2003
- Seven Man years internal labor and $1.0 million of outside or project employee resources
- Over 150,000 documents to be included
- Scope includes all top tier drawings, all autocad drawings, all electrical wiring diagrams, all architectural and structural drawings, system and topical design requirements, technical memos, GE design specifications, and calculation summaries

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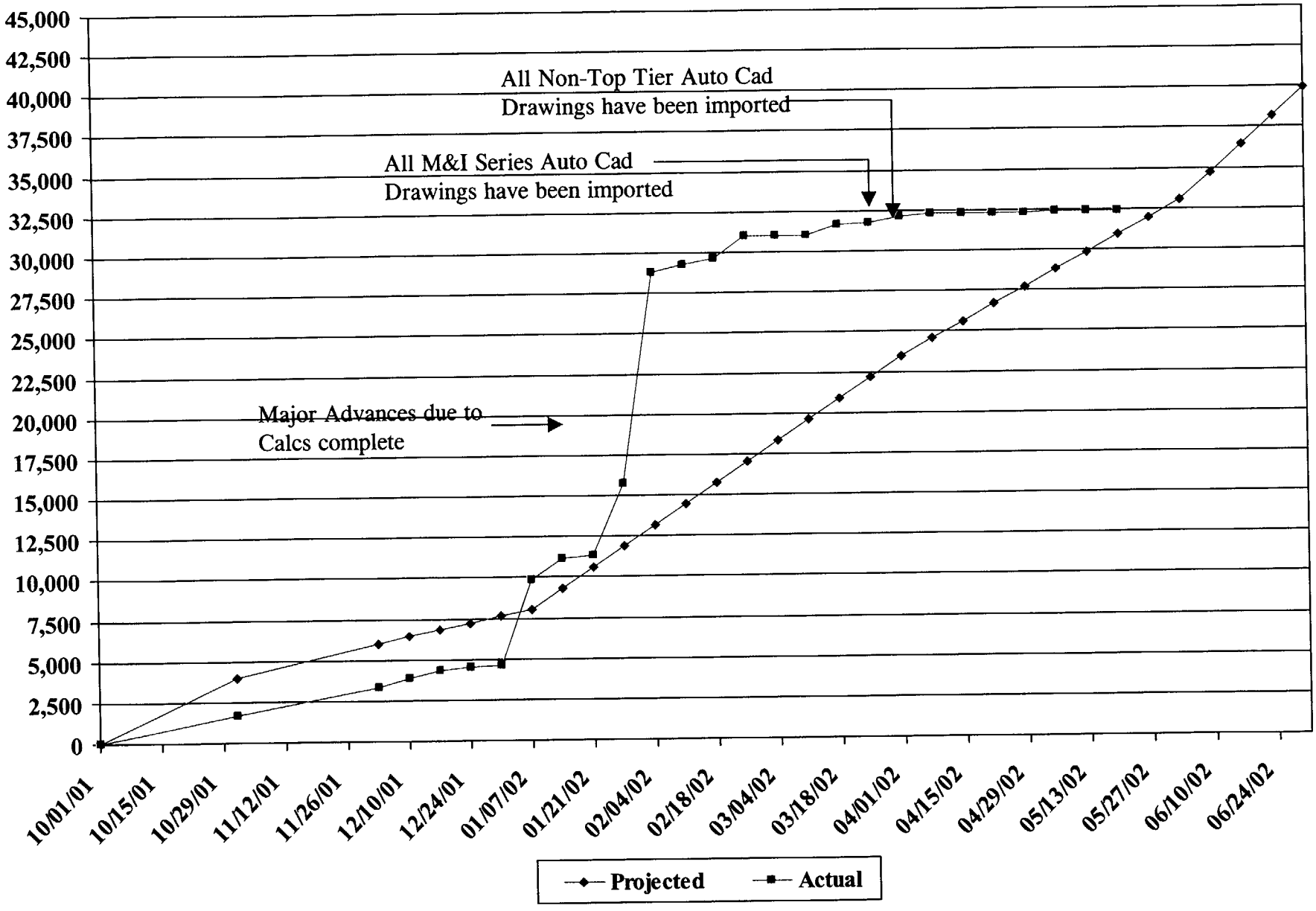
Engineering Electronic Database Project (EEDB Project) – Continued

- Project is ahead of schedule
- User Feedback is positive
- Key step to resolve design database discrepancies by utilizing word searchable features

05/17/02

123,312 DOCUMENTS QA IMPORTED (26% Complete)
(Starting 1/1/02 - Goal is ~ 5,167 Images a Month)
(Starting 6/1/02 – Goal is ~ 6,947 Images a Month)
10/1/01 – 7/1/03



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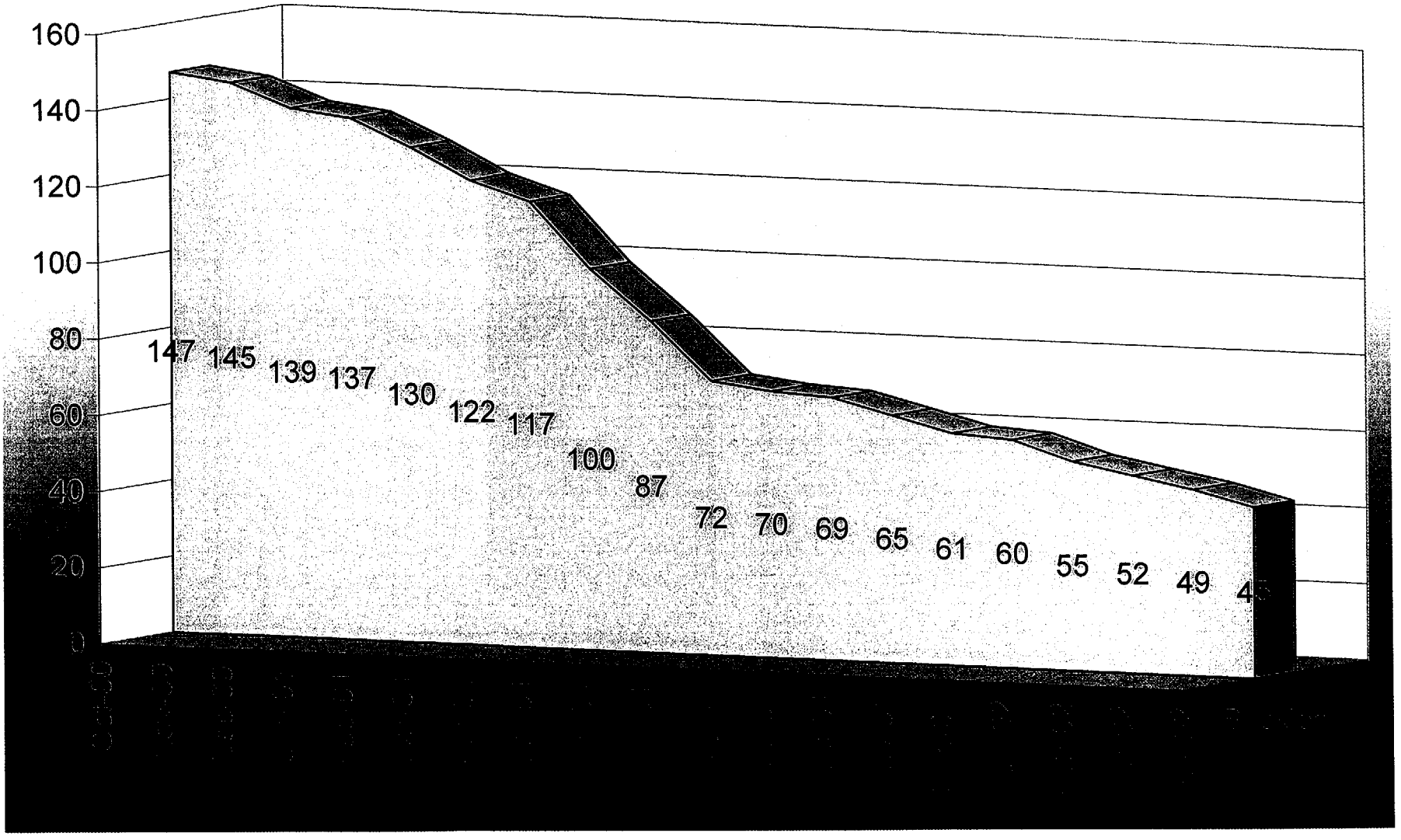
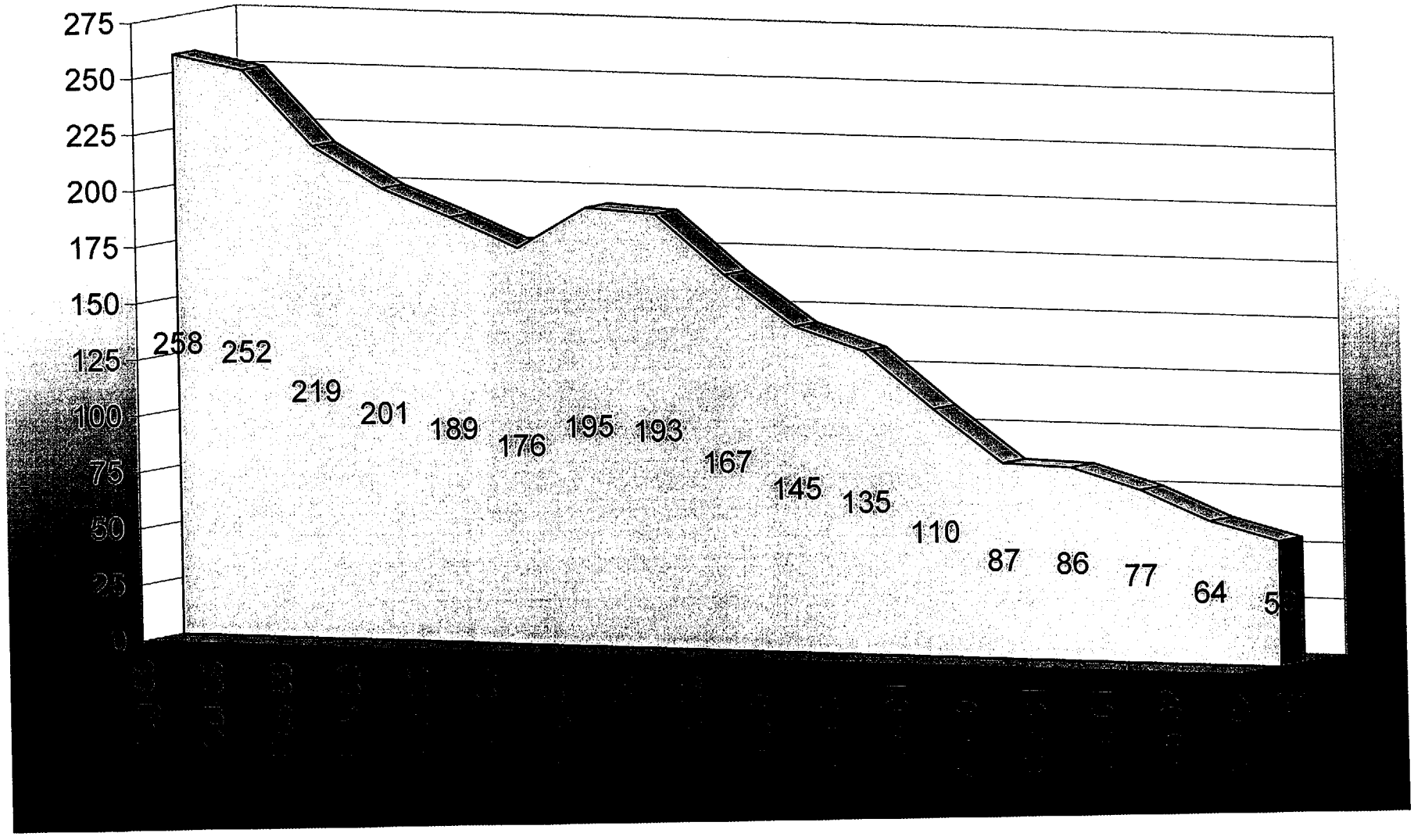
Engineering Optimization

- Electrical/I&C Engineering focus and improvement areas
  - Two year project with dedicated resources and over $1.1 million external resources – Complete in June 2003
  - Significant progress on setpoint process and calculations – Priority led with PRA importance
  - Topical Design Requirements documents complete: Human factors, control system failure, electrical separation, SBO, ATWS, flooding
  - Design Criteria documents: Post Fire Safe Shutdown, Cable routing and design
  - AC calculations updated
  - New AC/DC electrical calculation tool (EDSA)
  - Long standing corrective action program actions completed and closed
  - Backlog reduced from 122 to 49 in one year, currently at 45

Electrical/I&C Design Engineering Backlog PTL



Design Engineering PTL Backlog



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Engineering Work Management

- Resource loaded Project Management
  - Pacific Edge Project Office Platform
- Significant Projects/Activities/Assessments are tracked
- Project Milestones at >92% of milestone dates met
- Used to focus resources on priority tasks

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Engineering Product Quality

- Engineering Performance Indicator for Product Quality
  - Design changes are scored by the Design Review Board
    - Attributes specified by the design change procedure plus lessons learned.
  - Design change input from Plant Operations Committee
  - Calculations are scored
- Started in July 2000

FSAR/TS Discrepancy Project

- Discrepancies in the FSAR, Technical Specifications and design documents have been identified by NRC inspections, INPO assessments, self-assessments, and the corrective action program
- Additional project established to identify and resolve these discrepancies for FSAR, TS and design documents
- Ongoing through FY05
- Project tool will be the existing electronic Licensing Database and the newly developed Engineering Electronic Database (EEDB) to review the Technical Specifications and Design Requirements documents to ensure consistency
- Searches will include the FSAR, Tech. Spec. bases, calculations and Design Specifications (all design documents in the EEDB)

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FSAR/TS Discrepancy Project - Continued

- Phase 1 – Pilot will use RHR System for discrepancy identification to verify project approach, cost and schedule FY03
- Phase 2 – Identify discrepancies. Review all DRD's to TS and FSAR (10 manyears – June 2005)
- Phase 3 – Discrepancy resolution and document revisions (10 manyears – June 2005)

Conclusion

- New tools and processes being used to enhance the Engineering Database
- Managing Personnel resources to ensure priority tasks are worked
- Monitoring Product Quality
- All these tasks are to improve the integrity of the Design Database

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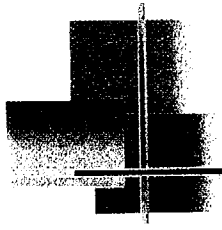
Columbia Generating Station Fuel Corrosion Investigation Status Report



Presentation to NRC Region IV Personnel

By

Mike Humphreys

Rx/Fuels Engineering Manager

May 24, 2002

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Overview

- Summary Status
- Background
- Summary of Inspection Results
- Draft Root Cause Report
  - Primary Root Cause / Contributing Causes
- Corrective Actions
- Operability Determination
- Industry Updates
- Further Investigations
- Conclusions

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Summary Status

- R15 fuel inspections revealed corrosion greater than what has been typically observed at Columbia Generating Station.
- Energy Northwest has proactively pursued a full understanding of the corrosion problem.
  - Created a Task Force, assigned dedicated resources
  - Using external, expert consultants
  - Extensive review of industry experience, US & world wide
- Operability / licensing issues are being addressed conservatively.
  - Cycle 16 (current cycle) complete
  - Cycle 17 underway
- We have developed a good understanding of the problem and associated causes.
  - We are currently implementing corrective actions to mitigate the accelerated corrosion observed.

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Background

- Columbia Generating Station background
  - CILC susceptible plant (Admiralty Brass condenser, filter demineralizers)
  - Use of Late Beta Quenched (LBQ) Cladding since ~ Cycle 2
- Fuel Performance History
  - Cycle 5 (1989-90)
    - 2 bundles (3 fuel pins) failed from CILC failures (susceptible cladding)
    - 1 debris failure
  - Cycle 15
    - 1 debris failure, confirmed by inspection
    - no other failures since Cycle 5 (no failures from the observed corrosion)
- Planned chemistry changes
  - Iron oxalate injection, since cycle 12 (fall 1996)
  - Depleted Zinc Oxide injection, since cycle 12
  - Noble Metal Chemical Application (NMCA) loading, during R15 shutdown, May 2001 (25 $\mu g/cm^2$)
  - H_2 injection– current schedule ~ 9/03
- Transition to 24 Month Cycle Complete in Cycle 16

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Summary of Inspection Results

- Cycle 5
  - Evidence of nodular corrosion on LBQ cladding
- Cycles 13 & 14
  - Thin, black oxide layer
- Inspections during Refueling Outage R15 (June 2001)
  - Indications of significant nodular corrosion on 1 Cycle fuel
  - High oxide thickness measured (zinc effect suspected)
- Additional Inspections during October 2001
  - High exposure fuel
    - Confirmed zinc effect, oxide thicknesses within ABB database, towards high side, limited spallation.
    - Strong axial peak on the limiting rod (70 microns oxide thickness, peak), highly correlated to the maximum crud thickness location.
    - Indications of accelerated localized (nodule like) corrosion.
  - 1 Cycle fuel
    - high oxide thickness, due to presence of nodules (48 microns peak liftoff).
    - Cu deposition accelerated, particularly on LK3 Gadolinium rod.

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Draft Root Cause Report

- Purpose / Goal
  - Document / communicate current understanding of root cause (investigation continues)
  - Support Problem Evaluation Report 201-2842 disposition, including establishment of Corrective Actions
- Content
  - Inspection Results – Photos, Eddy Current results, scraping sample analysis results
  - Water Chemistry Review – Rx Metals, Sulfates, pH, Conductivity, Filter Demineralizer Performance, etc.
  - Root Cause and Contributing Causes
  - Recommended Corrective Actions

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Root Draft Cause Report

- Primary Root Cause
  - One or more substances are depositing on the fuel surface, causing increased fuel corrosion.
  - This root cause must be considered tentative, in that;
    - the substance in question has not been positively identified,
    - not all of the physical mechanisms involved are fully understood, and
    - certainly they have not all been demonstrated.
- Contributing Root Causes
  - Condenser Leak
  - Degraded Filter Demineralizer Performance
  - Fe & Zn Injection
  - Presence of Copper

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Draft Root Cause Report

- Contributing Root Causes
  - **Condenser Leak**
    - Existed for a long period of time.
      - roughly the last 17 months of Cycle 15 operation.
      - A condenser leak of this duration had not occurred previously in recent operating history (within the last 7 years at least).
      - Allowed the presence of potentially damaging contaminants in the condenser for an extended period of time.
  - **Degraded Filter Demineralizer Performance**
    - A significant degradation in demineralizer performance was observed, beginning around June 2000, and continuing through the end of Cycle 15 and into Cycle 16.
      - Copper ratio (RW to FW) drops (indicating an increase in the rate Cu is being incorporated into the crud), pH, conductivity increase, and Na+ concentrations increase in this time period.
      - Conductivity behavior indicates organic intrusion
        - The increase in reactor water conductivity seen beginning in June of 2000 is NOT reflected in the feedwater conductivity
        - Indicates that the increased RW conductivity is due to the breakdown of an organic compound or the dissolving of an insoluble compound at reactor temperatures.
        - Potential candidates for impurities include organic compounds from the condenser leak, or resin beads from the cleanup systems.

Draft Root Cause Report

- Contributing Root Causes
  - **Fe & Zn Injection**
    - Initiated in Cycle 12 (1996), for ALARA dose reduction purposes.
      - Fe and Zn injected to form stable metal oxides on the fuel surfaces
        - traps cobalt and the associated activation product, Co-60
        - Co-60 is the major contributor to drywell dose.
      - Zinc also helps prevent deposition of Co-60 on out of core surfaces
        - competes directly with the Co for deposition at those sites.
    - As expected, the total CRUD loading has generally increased from Cycle 12 to Cycle 15, the time frame during which Fe & Zn injection have been utilized for dose control.
      - an increase in the amount of hard, stable, spinel type crud formation, relative to the amount of fluffy hematite crud deposited.
    - Fe and Zn injection has been demonstrated to increase the rate of Cu deposition (incorporation into the crud layer) recently in Cycle 16.
    - Fe and Zn may also play a role in the observed increase in localized corrosion, particularly at the axial regions of the core where subcooled or nucleate boiling takes place.
      - A "wick boiling" effect is suspected to be the cause of the increased concentrations of contaminants at that elevation, including copper.
      - Fe and Zn injection has increased the amount of crud deposited, and therefore may help increase this wick boiling effect.

Draft Root Cause Report

- **Presence of Copper**
  - May be the substance directly responsible for the increased corrosion observed, although this has not been positively demonstrated.
  - Copper is known to play an important role in any postulated accelerated corrosion mechanism, the most likely being Crud Induced Localized Corrosion (CILC), whether or not it is responsible for the nodular corrosion and increased localized corrosion.
  - NMCA Impact on Copper Deposition in Cycle 16

    NMCA without HWC is not believed to directly cause any increase in fuel corrosion. There is an indirect effect, however, in that startup following NMCA put significant amounts of Zn, and other crud constituents, most notably copper, back in solution at BOC 16.

    Cu deposition rate was very high initially (700-800 ug/sec), has since dropped to < 400 ug/sec.

    Rx Cu concentration and ratio (to feedwater conc.) recovered over Cycle 16 following suspension of Fe & Zn injection
    - More recently it dropped off with resumption of Fe and Zn injection.

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Corrective Actions

- CAP 1: Implement Optimized Fe & Zn Targets
  - Fe injection target implemented March 02 = .6-.9 ppb
  - Zn injection target implemented April 02 = 3-5 ppb
- CAP 2 : Perform Copper Reduction Conceptual Study
  - Scheduled for September 2002
  - Implementation scheduled for R17 (May 05)
- CAP 3: Eliminate Condenser Leak
  - Condenser Reliability Project established January 2002
- CAP 4 : Optimize Filter Demineralizer Performance
  - Perform an Independent Review of Condensate Filter Demineralizer and RWCU System
  - Near Term Actions
    - Increased effluent monitoring of individual CFDs
    - Precoat Optimization

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Operability Determination Report

- Purpose / Goal
- Approach / Methodology
  - Developed semi-empirical corrosion model, to fit our corrosion data
    - Model early oxide growth, linear region
    - Included capability to model localized corrosion later in life – modeled accelerated corrosion based on (Cycle 14-15 increment oxide delta) / (exposure delta)
  - Tuned Westinghouse fuel rod thermal/mechanical computer code model to bound above result
  - Assume bounding initial oxide layer
    - Evaluated impact on design limits for fuel rod performance
    - Performed LOCA evaluation
- Results
  - Model predicted bounding oxide thickness ~ 90 micron at EOC 16
  - Minor impact on design parameters, large margin to limits remaining
  - ECCS Acceptance Criteria still met

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Industry Updates

- River Bend
  - Significant Fe intrusion, significant Cu deposition in adherent crud.
- Vermont Yankee
  - Cu plant, NMCA w/o Hydrogen Water Chemistry (HWC)
  - 5 fuel failures since December 01, shutdown May 11, 2002
  - GE-13 fuel, 9x9 design (10x10 fuel in Columbia has lower heat flux)
- Noble Metal Chemical Application (NMCA) Experts Mtg. 3/12/02
  - Reviewed available data, including Plant A which injected NMCA w/o HWC, performed fuel inspection following once cycle of operation – no NMCA effect found (~ 40 GWD/MT exposure)
  - European BWR – very low loading, NMCA + HWC, no impact noted (> 50 GWD/MT exposure)
- W-ABB SVEA-96 Experience
  - No directly comparable experience has been identified in W-ABB European BWR experience to date. KKB has had some spallation occur on pre-oxidized rods, and also some similarities to our results – nodular corrosion, increased Cu deposition. No inspection results have been made available, however.

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Followup Activities

- Continued monitoring and assessment of potential NMCA impacts on fuel corrosion
- Ongoing CRUD analysis (XRD, SEM)
- Ongoing evaluation of water chemistry effects
- Improve monitoring of potential chemistry impacts on fuel performance
- Continue to revise and edit the Draft Root Cause Report
- Additional fuel examinations planned
  - January, 2003: examine more exposed fuel in the pool
  - R16: examine fuel currently in the core
  - Other future refueling outages

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Conclusions

- R15 fuel inspections revealed corrosion greater than what has been typically observed at Columbia Generating Station.
- Energy Northwest has proactively pursued a full understanding of the corrosion problem.
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