MRP Assessment of Generic Implications of Davis-Besse RPV Head Corrosion

MRP-NRC Staff Meeting

3/19/02

EPRI MRP

Agenda

- Davis-Besse Condition
- NRC Questions
- Industry Survey
- GL 88-05 Programs
- MRP Response Plan
- Conclusions

NRC Letter to NEI, 3/11/02

- Industry Actions to Address 3 Questions
  - For plants that have completed their Bulletin 2001-01 inspections, discuss whether the inspections have been sufficient to detect degradation similar to that found at Davis Besse.
  - For plants that have not completed their Bulletin 2001-01 inspections, justify their basis for continued operation.
  - Address the risk significance of this occurrence including an assessment of the effect of such degradation on the structural integrity of the RCS pressure boundary

NRC Question 1

- Industry Survey preliminary conclusions
  - Bulletin 2001-01 inspections are sufficient to identify cracking which could lead to head wastage
  - Plants that detect through wall flaws need to ensure wastage has not occurred

NRC Question 2

- Basis for Continued Operation
  - Previous baseline inspections
  - Susceptibility ranking used in response to Bulletin 2001-01
  - Plant inspections performed per GL 88-05
  - Industry Survey results
  - Routine maintenance and testing
  - Review of Final Root Cause from Davis-Besse

NRC Question 3

- MRP Safety Analysis Work
  - Specific structural analysis in progress by plant
  - MRP PFM evaluation model under review pending root cause
- Risk Analysis
  - Pending the safety analysis work
- Schedule
  - Previously planned for May
  - Impact of Davis-Besse condition pending root cause

Industry Survey

- Based on Initial Information from Davis-Besse
  - 3 potential root causes
    - 1. Leakage from sources above head (flanges, etc.)
      - Sufficient boric acid accumulates to produce wastage
    - 2. Leakage of reactor coolant through flaws in penetration nozzles
      - Sufficient to produce wastage
    - 3. Previous stable accumulation of boric acid deposits wetted by leakage through flaws in penetration nozzles
      - Resultant wastage is a combination of the two effects
- On-going Davis-Besse Root Cause Work

Industry Survey (cont.)

- 4 Questions
  - At most recent inspection
    - sufficient visual examination over 100% of the head
      - detect external surface corrosion or accumulation of boric acid crystals?
    - If visual inspection < 100%/some way hampered
      - Confident no external head corrosion?
    - If UT/other non-visual approach was used
      - examination capable of detecting corrosion of the low alloy steel head material ?
      - was examination full-length of nozzles to the top of the head?
  - For plants with spring 02 outages
    - plans to show no significant boric acid corrosion?
- Responses Received from all US PWRs

Survey Assessment

- Assessment in Progress
  - Following up with some plants for additional information
  - Acceptance criteria have been developed
  - Being applied to plant survey responses along with the MRP susceptibility ranking for nozzle cracking

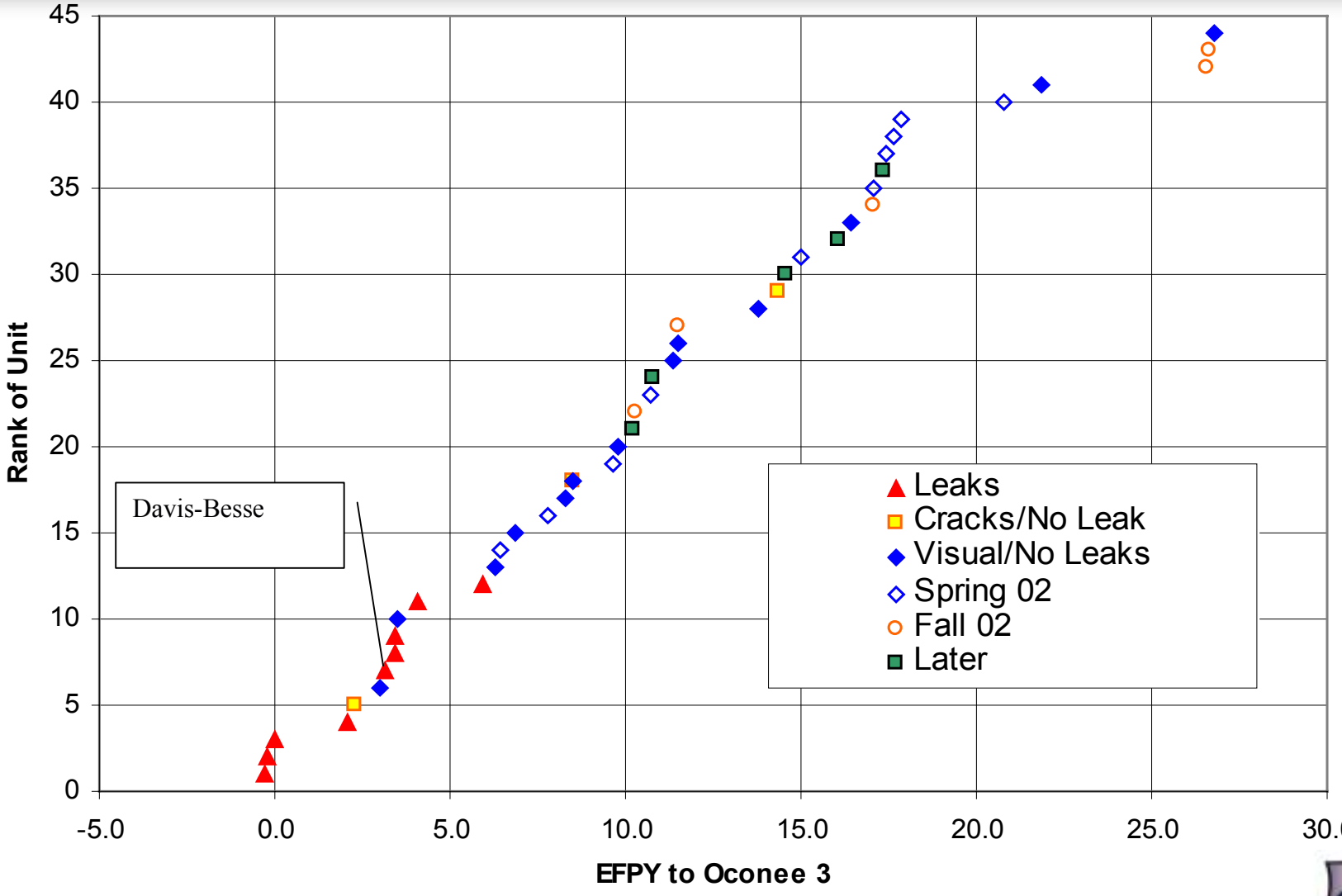
Assessment (cont'd)

- Acceptance Criteria
  - Category 1
    - At most recent outage 100% bare-metal VT of RPV head and region above head
      - No boric acid on head and none above head
  - Category 2
    - During Category 1 examination,
      - Boric acid accumulation detected
        - Boric acid deposits removed, head inspected, source determined and corrected
  - Category 3
    - Bare-metal inspection limited/not able to be performed
      - Plant history and above head inspections show no evidence of leakage

Assessment (cont'd)

- Acceptance Criteria (cont'd)
  - Category 4
    - Bare-metal inspection limited/not able to be performed
      - Above-head inspections indicate boric acid leakage, but leakage managed
        - None reached outer surface of head, OR
        - Affected area(s) cleaned and inspected
  - "Other" Category
    - Bare-metal inspection limited/not able to be performed
      - Above-head inspections indicate boric acid leakage, and leakage may have accumulated on outer surface of head
    - Or, plant situation does not specifically fit first 4 categories

MRP Nozzle Cracking Susceptibility Ranking



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Results Summary

- Evaluation approach in light of Davis-Besse event:
  - Plants tentatively assigned to categories (1 through 5, described earlier) based on reviews of survey responses
  - Combined with plant-specific responses to NRC Bulletin 2001-01
  - Plant categorizations need to be considered in light of:
    - Past inspection experience and current inspection plans
    - Additional factors, e.g., insulation configurations
    - Root Cause is in progress

Results Summary (cont.)

- All 11 plants in <5 EFPY susceptibility group (except Davis-Besse) have already performed 100% bare-head inspections (i.e. Category 1 or 2)
  - Returned to service with no significant boric acid deposits
  - Confirmed no or only minor corrosion
- All 9 plants in 5-10 EFPY group have either done 100% bare-head inspections or are doing them Spring 2002
  - 6 plants did 100% bare-head inspections (Category 1 or 2)
    - Returned to service with no significant boric acid deposits
    - Confirmed no or only minor corrosion
  - Remaining 3 plants scheduled for Spring 2002 refueling outages and are planning 100% bare-metal inspections (Category 1 or 2)

Results Summary (cont.)

- Of the 11 plants in the 10-15 EFPY susceptibility group:
  - 2 plants are in Category 1 (i.e., recent bare-head inspections/cleaning ensured no deposits & wastage)
  - 3 plants are in Category 3 (no above-head leak events):
    - 2 plants have Spring 2002 outages and plan inspections
  - 5 plants are in Category 4 (boric acid has not accumulated from above-head sources based on review of plant experience and maintenance)
    - 1 plant supplemented bulletin inspections in response to Davis-Besse and is returning to service
    - Remaining 4 plants have inspections scheduled beyond Spring
  - 1 plant is in “Other” Category
    - identified boric acid and evaluated minor wastage of head OD

Results Summary (cont.)

- Remaining plants are in >15 EFPYs susceptibility
  - 8 plants in 15-20 EFPY group
    - 1 plant in Category 1
    - 3 plants are in Category 3 (Spring 2002 inspections)
    - 3 plants are in Category 4 (inspections beyond Spring 2002)
    - 1 plant in the “Other” Category (Spring 2002 inspection)
  - 5 plants in 20-30 EFPY group
    - 2 plants in Category 1
    - 1 plant in Category 3 (inspection beyond Spring 2002)
    - 2 plants in Category 4 (1 with Spring 2002 inspection)
  - 25 plants in >30 EFPY group
    - 9 plants in Category 3
    - 12 plants in Category 4
    - 4 plants in “Other” Category

Summary

- Plants at <10 EFPY will all have been inspected by end of Spring 2002 (highest ranked 20 units)
  - Reasonable assurance of no significant corrosion of the head or CRDM leakage
- 34 out of 44 plants <30 EFPY will have performed inspections by Spring 2002
  - 5 Fall 2002 and 5 Spring 2003

Survey Summary <30 EFPY

	<5EFPY	5-10 EFPY	10-15 EFPY	15-20 EFPY	20-30 EFPY
Other	1		1	1	
Category 4		3	5	3	2
Category 3			3	3	1
Category 2	8	1			
Category 1	2	5	2	1	2

Generic Letter 88-05

- GL 88-05 'Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants', 3/17/88
  - Preceded by 5 Information Notices
    - Leaks had resulted in corrosion (e.g., RPV head surface, RPV head bolts, valve bolting, etc.)
  - Required program
    - Systematic measures
      - Ensure boric acid corrosion does not lead to degradation of RC pressure boundary
    - 4 specific areas to be addressed
      - Determination of locations where < TS allowable leaks can cause pressure boundary corrosion by boric acid
      - Procedures for locating small primary coolant leaks and leak paths
      - Methods for conducting examinations and performing engineering evaluations (when leakage is identified)
      - Corrective actions to prevent recurrences

Generic Letter 88-05 (cont'd)

- Conclusions
  - All plants have boric acid program
  - Program details vary among plants
    - Programs include
      - ISI of Class 1 & 2 components
      - Containment walk-down at start of outages
      - Class 1 pressure test at end of outages
      - Containment entries during operation
      - Normal rounds outside containment
      - Leakage monitoring
    - Removal of insulation for walk-downs not typically required
      - Some ISI and pressure tests do require insulation removal
      - Insulation removal may be required for assessment once leakage is identified

Generic Letter 88-05 (cont'd)

- MRP Actions
  - Letter to Senior Representatives, March 1, 2001
    - Pertinent Recommendations for Spring 01 outages (still stands)
      - Review GL 88-05 Boron Inspection and ASME Pressure Testing Programs considering the events at Oconee and V. C. Summer. Enhance sensitivity of those performing these inspections, with emphasis placed on areas know to contain Alloy 82/182 weld materials.
      - Review leak detection programs considering the events at Oconee and V. C. Summer. Sensitize operators and inspectors to small changes in leak rates and to potential leak sources.

MRP Response Plan

- Review of Davis-Besse 'root-cause' analysis when available for generic implications, using November 2001 Boric Acid Corrosion Guidebook
- Review early 90s Owners Group work relative to RPV head corrosion/wastage – determine applicability in light of above
- Review the Davis-Besse condition for impact on the MRP nozzle cracking risk and safety assessment
- Incorporation of Davis-Besse lessons learned into future MRP inspection guidance

Conclusions for RPV Head

- Bulletin 2001-01 inspections are sufficient to identify cracking which could lead to head wastage
- Plants that detect through wall flaws need to ensure wastage has not occurred
- All plants have programs for managing leak sources
- Responses to MRP survey questions will assist plants in responding to proposed NRC bulletin

Discussion