PVNGS License Renewal Application
Metal Fatigue Topics

April 1, 2010

Discussion Topics

- Historical and general background
- Metal Fatigue Monitoring Program
- Cycle Counting Questions
- Class 1 Fatigue TLAA Evaluation Process
- Future actions
- NRC staff questions

Historical and general background

Initial development of PVNGS metal fatigue monitoring program

- Program required by PVNGS Technical Specification 5.5.5
- SYS80-PE-DE “Compilation of NSSS Responses to Design Bases Dynamic Events for the System 80 Standard Design” established applicable design cycles and their 40-year expected accumulation
- Class I metal fatigue analyses incorporated the SYS80-PE-DE limits and in some cases identified additional items of concern

Initial development of PVNGS metal fatigue monitoring program

- The initial Technical Specification program did not require all UFSAR transients to be monitored
- The UFSAR does not incorporate all of the additional limits (e.g. RCP stud tensioning/de-tensioning) – to be discussed later in this presentation

Program Review - 1995

- PV staff identified that not all UFSAR transients were being counted
- Implemented expanded list of transients in January 1996
- ITS upgrade in 1998 established current requirements
- Not counted data between ‘85 and ‘95 was assumed to be an accumulation of 25% of the design allowed transients in all but a few cases

Performance of cycle counting since January 1996

- Actual event counting has been in place since January 1996
- Unit 1, 2 and 3 records have now been reviewed for LRA support

Metal Fatigue Monitoring Program

Current PVNGS Metal Fatigue Monitoring Program

- Current methodology:
  - Cycle counting to ensure design assumptions are not exceeded
  - Specific component locations are not specified
  - Exception: Partial cycle (CBF-PC) methodology is used to track spray nozzle usage

Addressing Cycle Count Assumptions

- LRA development prompted PVNGS staff to revisit the assumptions for 1985 – 1995
- Recounts of all three units were reported in the response to RAI B3.1-4 (see RAI response Table 3.1-4)
  - Recount Methodology
    - Best source selected (logs, MORs, LERs, WOs, interviews)
    - Validated assumptions

Cycle Recount

- Recount Methodology
  - Best source selected (logs, MORs, LERs, WOs, interviews)
  - Reviewed assumption of 25% accumulated cycles
    - Actual data
    - Comparison to ‘95 – ’05 operating history

Enhanced Metal Fatigue Monitoring Program

- Required by 10 CFR54.21 (c)(1)(iii)
- Scope - All Class I components
- Methodology:
  - Based on component locations
  - Adds SBF for high usage locations (not discussed in this presentation)
  - Continues cycle counting for “Global” monitoring
    - Used for low 40-year design CUF
    - No new industry issues since original design
    - Industry experience indicates not a problem location
  - Expands CUF monitoring
    - CBF-C (CUF based on design cycle)
    - CBF-PC (CUF based on partial cycle)
    - CBF-EP (CUF based on event pairing)
  - Establishes appropriate action limits and corrective actions

Enhanced Program Status

- SBF methodology (to be determined)
- FatiguePro is under evaluation for cycle counting and CBF monitoring
- Current manual cycle counting will continue until a suitable software program has been validated
- Enhanced program will be implemented no later than two years prior to the PEO (LRA commitment #39 as revised in Amendment 9)

Cycle Counting NRC Questions

Cycle Counting RAIs and Amendments

- Amendment 3 (annual update)
  - Added Unit 3 record review results and revised one transient total to replace an estimate with data
  - Revised current program action limit discussion to avoid confusion with the enhanced program limits
  - Minor clarifications were included in the AMP OE discussion

Cycle Counting RAIs and Amendments (continued)

- Amendment 9 (result of RAI B3.1-1 thru 8)
  - RAI B3.1-4 response provided the individual unit cycle totals from best available sources
  - Corrected typographical errors
  - Included enhanced monitoring implementation schedule
  - Committed to selection of a suitable SBF methodology
  - Clarified cycle projection methodology

Cycle Counting RAIs and Amendments (continued)

- Most recent cycle count related DRAI set (DRAI 4.3-1 thru 9
  - DRAI 4.3-1 Transients projected to exceed 40-year limits
    - Projections are conservative and may not be reached
    - 10CFR54.21(c)(1)(iii) permits aging management for TLAAs that are not validated or projected for the PEO
    - NUREG 1800 paragraph 4.3.3.1.1.3 permits the use of GALL programs for aging management
    - NUREG 1801 Vol 2 AMP X.M1 allows use of this program to manage aging and recommends “no further evaluation” if this program is selected to satisfy 10CFR54.21(c)(1)(iii)
    - PVNGS took no exceptions to X.M1 and concludes fatigue reanalyses are not required based on projections . Corrective action will be initiated if needed based on program action limits

Cycle Counting RAIs and Amendments (continued)

- DRAI 4.3-1 LRA Transient projection methodology
  - Presented for information only
  - Concept of a worst case bounding unit
  - Conservative Assumptions
    - Highest unit total was used for ‘85-’95 and for ‘95-’05
    - Lowest operating years was used for accumulation rate
    - 42 years were used for projecting and added to above
    - ‘Zero accumulation’ assumed to be linear times 22/40
      - If not expected still assumed 1 event

Cycle Counting RAIs and Amendments (continued)

- DRAI 4.3-2 Global monitoring criteria does not seem consistent
  - Exceptions are explained in LRA table notes
- DRAI 4.3-3 Clarify the CBF-PC method
- DRAI 4.3-4 Program action limits (see commitment #39)
- DRAI 4.3-5 Some cycles do not agree with the UFSAR
  - Some are derived from UFSAR sections other than 3.9.1
  - Some come from specific analyses (e.g. RCP studs)
  - Addition of cycles to the UFSAR is under consideration

Cycle Counting RAIs and Amendments (continued)

- DRAI 4.3-6 25% cycle assumption
  - Review of best source data was presented in the response to RAI B3.1-4
  - Compared assumption to actual data from recount efforts or data from ‘95-’05
  - Result:
    - Four assumptions of 25% cycle accumulation are being reviewed: Rx Trip, Load Reject, Turbine Trip w/o Rx Trip and Depressurization by MSSV at 100% power
    - Remaining 25 % assumptions are conservative

Cycle Counting RAIs and Amendments (continued)

- DRAI 4.3-7 Not all cycles were recounted
  - Some had accurate data and did not require recount
  - Some were not significant (e.g. plant loading at 5%/min)
  - Some could not be recovered so the 25% assumption was used and validated from ‘95-’05 data

Cycle Counting RAIs and Amendments (continued)

- DRAI 4.3-8 Questioned an incorrect table note (had been corrected in Amendment 9)
- DRAI 4.3-9 Some cycles are not included in the UFSAR (similar to DRAI 4.3-5)
  - Some come from specific analyses (e.g. RCP studs)
  - Addition of cycles to the UFSAR is under consideration

Class 1 Fatigue TLAA Evaluation Process – LRA Section 4.3.2

Class 1 Fatigue TLAA Evaluation Process

- Identify TLAAs and Affected Components
  - SRP Guidance, Industry Experience, CLB Search
- Retrieve Component Current Licensing and Design Basis Documents (CLB and CDB)
- Evaluate and Summarize CDB TLAAs
  - Analysis Results - Analyzed Locations, CUFs, etc.
  - Effects of Modification, Analysis, and Op. History
  - Effects of Differences in Analysis Methods
  - Identify Disposition

Identify TLAAs and Affected Components

- SRP Guidance
  - NUREG-1800 Sect. 4.3 and Tables for Class 1
  - Based on ASME III Subsection NB and NG and Industry Experience
- Industry Experience – Examples:
  - Other LRAs
  - NRC and NSSS vendor Bulletins, Notices, etc.
- CLB Search
  - Word Search of CLB (FSAR, Docketed Reports, Letters, etc.)
  - Confirm applicability to Palo Verde
  - Identify other plant-specific TLAAs

Retrieve Component Current Licensing and Design Basis Documents (CLB and CDB)

- Research and Summarize History of CLB
  - Confirm *Current* Licensing Basis
- Research Design and Analysis History
  - Confirm *Current Design* Basis
  - TLAAs are *analyses,* are therefore part of the *CDB*
  - TLAAs are usually *bases of* the CLB ("incorporated by reference") rather than included verbatim

Evaluate and Summarize CDB TLAAs

- Analysis Results
  - All TLAA Results (e.g., all reported fatigue summaries)
  - All Analyzed Locations
  - Tabulated for Complex Components

- Effects of Modification, Analysis, and Operating History – *Examples:*
  - Instrument Nozzle Half-Nozzle and MNSA Repairs (Several LRA Sections)
  - Pressurizer Surge Line Thermal Stratification (LRA Section 4.3.2.9)
  - Unit 2 Head Vent Repair - high part-life CUF, head replaced Fall 2009 (LRA p. 4.3-34)

Evaluate and Summarize CDB TLAAs (Continued)

- Identify Disposition
  - Based on Analysis History, Results, and Methods
    - 10 CFR 54.21(c)(1)(i) - If simple design life or cycle ratios, etc., confirm adequate margin at 60 years
    - 10 CFR 54.21(c)(1)(iii) - Used in most other cases
      - Requires Aging Management
    - 10 CFR 54.21(c)(1)(ii) – Reanalysis performed

Evaluate and Summarize CDB TLAAs (Continued)

- Identify Disposition (Continued)
  - 10 CFR 54.21(c)(1)(iii) monitoring methods are described in LRA 4.3.1, summarized by monitored location in Table 4.3-4
  - Details of 10 CFR 54.21(c)(1)(iii) monitoring methods are location and analysis-specific. *Examples:*
    - Global – monitor transients
    - Cycle-based fatigue (CBF) – monitor transients, possible CUF impacts
    - Stress-based fatigue (SBF) – impact of transients require reevaluation of CUF

NRC Staff Questions

- Have we answered the questions and issues stated in this presentation?
- Does the staff have additional questions with respect to cycle counting or the PVNGS approach to metal fatigue?
- Review action items
- Future topics

Thank you for your participation