ASSUMPTIONS

- Operators use Integrated Plant Emergency Operating Procedures, just as in an internal event.
- Human error probabilities are at their normal levels at and below the design basis earthquake and increase above that with increasing ground motion. Above 3 times the design basis earthquake all human actions are assumed failed.

ASSUMPTIONS

- The deterministic analysis demonstrates the strainers would not plug in this event.
- This assessment uses a probability of 0.5 representing the mean value with maximum uncertainty.

HUMAN ERROR

- The Inspection Report used 0.1 as the human error probability for bleed & feed based on high stress due to the earthquake. The initiating event assumed was a 0.1 g earthquake.
- The Modified Mercalli Intensity Scale (Referenced in AEC TID-7024) provides guidance for determination of effects of a given earthquake.

HUMAN ERROR

- According to AEC document TID-7024, 0.1g corresponds to Mercalli intensity VII. "Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motor cars."

HUMAN ERROR

- Modified Mercalli intensity level VII should not result in significant difference from normal human error probability values.

RESULTS

- The base-case seismic core damage frequency (SCDF) is 1.06×10^{-5}/year
- With strainer-plugging included, the SCDF becomes 1.13×10^{-5}/year
- The increase due to plugging is 7×10^{-7}/year

CONCLUSION

- The increased risk of core damage due to strainer plugging is below $1x10^{-6}$ and therefore has very low safety significance

ROOT CAUSE SEQUENCE OF EVENTS

Lori Sutton

1970

- SW and FW flow diagrams show temporary strainers
- SW and FW flow diagrams revised to show strainers as permanent
- Purchase order issued

1971

- Strainers Received
- Deficiency Report
- (Between 8/71 and 5/72) Strainers installed

1972

- Pre-op construction flush

1974

- Commercial operation

1975

- Resin from mixed bed demin clogs strainers
- Strainers cleaned several times
- A/E letter to WPS Corporate Licensing (remove strainers)
- A/E fax to KNPP site (remove liners)
- Abnormal Occurrence 75-20 submitted

1975 (cont.)

- Liners removed from strainers
- A/E design change to remove strainers (basket and liners)
- A/E revises FW flow diagram and not SW flow diagram

1976

- KNPP design change (remove strainers)
- KNPP design change modified
  (remove only liners and change drawings)

1977

- Post-filters installed on mixed bed demins
- KNPP design change, to remove liners and change drawing, cancelled

1986

- In response to Information Notice 85-96
  - verified SI, RHR, ICS and CC strainers removed
  - restated AFWP strainers will remain
  - inspected AFWP Strainers
- Revised FW flow diagram and added perforation size to drawing

1990

- SSFI of SW System
  - verified selected components
  - did not require intrusive examinations
  - recommended adding SW lines to AFWPs in SW radiography program to detect silt buildup

1991-1992

- In response to SER 3-90 evaluation
- Concluded strainers could remain as-is

2000

- NRC SW design inspection
- Strainers inspected and perforation size discrepancy found
- All 3 pumps declared inoperable and strainers removed

ROOT CAUSE and EXTENT of CONDITION

Jim Schweitzer

AFWP SUCTION STRAINERS CONCLUSIONS

- Reason why the strainers were made permanent could not be determined
- Vendor supplied strainers that didn't match written PO
- Receipt inspection did not identify perforation size discrepancy
- Strainers were missed during initial configuration control scoping efforts
- Engineering staff failed to question lack of configuration control and maintenance

AFWP SUCTION STRAINERS ROOT AND CONTRIBUTING CAUSES

- **ROOT CAUSES:**
  - ***Why 1/16 inch perforations?***
    - Inadequate receipt inspection for strainer on 2/8/71
  - ***Why not discovered?***
    - Inadequate configuration control and maintenance for strainers
- **CONTRIBUTING CAUSES:**
  - Strainers maintained as permanent equipment
  - Vendor supplied strainers that didn't match written P.O.
  - Plant Architect/Engineer miscommunicated removal recommendation
  - Engineering evaluations failed to identify lack of configuration control and maintenance

AFWP SUCTION STRAINERS CORRECTIVE ACTIONS

- Permanently remove from service (design change)
- Verify in-place SW pump discharge strainer perforation sizes
- Discuss configuration control needs and identification in training

AFWP SUCTION STRAINERS EXTENT OF CONDITION

- Receipt inspection KAP review
- Evaluation of safety related system strainers
- Verified correct QA classification for other strainers
- Adequacy of design controls

DESIGN CONTROL EXTENT OF CONDITION

- To identify scope and areas to focus on used:
  - WANO Evaluation
  - INPO Assist Visits
  - NRC Inspections
  - Self Assessments
  - KAP
- Improvement Areas
  - Calculation control
  - Calculation program updates
  - Design Basis
  - System Descriptions
  - Design Change Implementation

DESIGN CONTROL
EXTENT OF CONDITION

- Kewaunee overall gap analysis and business plan developed
- Focused calculation process self assessment performed based on KAP trend
- Open ESR, SSFI, and Incident Report items rolled into KAP system for priority and due date assignment
- Design Basis pilot project planned and system description updates started
- Calculation program updates initiated
  - Fuse control, electrical load flow, loop uncertainty
- Design change milestones set, project plan expectations developed and process improvements identified
- Established self assessment plan and schedule

SIGNIFICANCE DETERMINATION

Tom Webb

SIGNIFICANCE DETERMINATION

- Based on the results of the deterministic and probabilistic assessments, NMC has determined that this event has very low safety significance, and therefore is a green finding
- The deterministic analysis:
  - Made conservative assumptions.
  - Demonstrated that the conclusions of the analysis were not sensitive to minor variations in inputs.
- The probabilistic analysis:
  - used realistic assumptions for seismic damage
  - used accepted assumptions for human performance during an earthquake
  - recognized the uncertainty that the strainers would plug and fail the pumps

CONCLUSION

Charlie Schrock