

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 $1.06 \times 10^{-5}/\text{year}$
- ✓ With strainer-plugging included, the SCDF becomes $1.13 \times 10^{-5}/\text{year}$
- ✓ The increase due to plugging is $7 \times 10^{-7}/\text{year}$

CONCLUSION

- ✓ The increased risk of core damage due to strainer plugging is below 1×10^{-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