# *PG&E/NRC Meeting on PWSCC ARC*

June 28, 2001

## *Agenda*

- Management overview – Larry Womack
- History of PWSCC ARC – Bob Exner
- Review of outstanding issues – Bob Exner
- Mixed mode indications – John Arhar/Tom Pitterle
  - History of circumferential cracking at DCPP
  - Characterization of circumferential cracks at localized dents
  - Structural and leakage integrity considerations
- Proposed schedule – Tom Grozan
- Discussion and feedback - All

## Management Overview

- Objectives for meeting
  - Determine if we can obtain PWSCC ARC approval
  - Gain understanding of issues and possible resolutions
  - Agree on schedule leading to 1R11 (April 2002)
- Importance of PWSCC ARC
  - Dented tubes continue to crack
  - Crack growth is slow but eventually Max Depth >40%
  - PG&E is evaluating SGR
  - Strategy for next few years is tied to PWSCC ARC

## History of PWSCC ARC

- PG&E started work on PWSCC ARC with TVA and Westinghouse in 1997
- Completed performance demonstration for PWSCC detection and sizing
- TVA received LA for ARC in March 2000
- PG&E submitted similar LAR in June 2000
- Because of several industry issues PG&E submitted LAR supplement in September 2000
  - One cycle only
  - Use combined ANL ligament tearing model and EPRI TW model for determining need for repair
  - Mixed mode indications

## History of PWSCC ARC

- Insufficient review time for 1R10 (October 2000)
- Further discussions resulted in PG&E submittal of LAR supplement 2 in February 2001, including WCAP-15573 Revision 0
  - Mixed mode criteria (return to null testing)
  - Noise review
- Insufficient review time for 2R10 (May 2001)
- PG&E now desires ARC approval for 1R11 (April 28, 2002)
  - Long term mixed mode methodology
  - Permanent ARC

## Outstanding Issues

- Burst model for tube repair (OA)
  - PG&E changed to ANL ligament tearing/EPRI thru wall model because of ANO ramp rate issue
  - Industry report and test program shows foil effect responsible for ramp rate issue
  - Request that when NRC accepts ramp rate resolution PG&E be allowed to change back to Westinghouse burst model (used by TVA) without additional LAR.

## *Outstanding Issues*

- Eddy current noise
  - NRC request in January 2001
  - Reviewed noise (Vmax and Vp-p) in >240 TSP NDD intersections from all 8 SG (both DCPP Units) at < 2 to > 5 volt dents
  - Reviewed noise in PWSCC detection/sizing PD data set
  - Comparison shows data set noise is conservative for detection of PWSCC with bobbin and +Point and for sizing with +Point
  - Documented in WCAP-15573

## *Outstanding Issues - TVA SER*

1. Revise WCAP-15128, Revision 2 to include clarifications from March 2, 2000 TVA letter.
   - All clarifications were made to WCAP-15128 Revision 3 – submitted by July 13, 2000 PG&E letter. Changes were included in WCAP-15573 Revision 0.

## Outstanding Issues - TVA SER

2. Consider incorporating refinements into OA methodology to permit consideration of a more complete amount of growth rate data from the most recent operating cycle.
   - As described in WCAP-15573, "as a minimum, growth rates for large indications that could impact the upper tail of the growth distribution shall be evaluated during an inspection outage. If the new growth data cause the growth distribution above 90% probability to be more conservative, the new growth data shall be added to the growth distribution for the operational assessment."
   - Growth rates of all prior indications left in service will be evaluated. In addition, if new indications which have prior inspection data are detected that have MD or AD comparable to the largest indications left in service in prior inspection, growth rates for these new indications will also be evaluated.

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## Outstanding Issues - TVA SER

3. Assess the operational assessment methodology performance in predicting flaw size distributions. Assess differences between predicted and actual flaw size distributions in terms of impact on limiting tube burst pressure and total SG accident leak rate.
   - PG&E will assess the performance of the OA methodologies for predicting EOC flaw distributions and reporting the results and any corrective actions in the 120 day report
   - PG&E will document DCPP experience with predicted and actual indications based on prior application of 40% repair limit in WCAP-15573
   - PG&E will also attempt to assess the November 2001 SQN Unit 1 experience

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## Outstanding Issues - TVA SER

4. Assess the early experience with number and size of indications not previously detected and the need for accounting for the appearance of such new indications in the operational assessment burst evaluation.
   - PG&E committed to assessing the performance of the OA methodologies for predicting EOC flaw distributions and reporting the results and any corrective actions in the 120 day report
   - PG&E will document DCPP experience with new indications based on prior application of 40% repair limit in WCAP-15573
   - PG&E will also attempt to assess the November 2001 SQN Unit 1 experience

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## Outstanding Issues - TVA SER

5. Consider refinements to the accident leakage model such that the leak test regression calibration of the deterministic model includes a calibration of the model to predict pop-through of crack ligaments. In addition, refinements to the breakthrough model should be incorporated to ensure that all significant ligaments are included in the leakage assessment.
   - PG&E's understanding of this issue is that these refinements would result in a less conservative leakage model. PG&E has decided that this work is not necessary at this time.

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## *Outstanding Issues*

- Permanent ARC Issues
  - Burst model
  - Issues 3 and 4 from TVA SER
  - Mixed mode methodology (next)
- Inspection scope in LAR vs current practice?
  - Dent inspection based on "two previous" vs "prior" inspection results
- Other NRC issues??

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## *Mixed Mode Indications*

- Summary of the issue
  - Axial PWSCC cracks left in service under ARC must maintain adequate burst and leakage integrity over next cycle even if circumferential indications initiate at the same TSP and are detected at the next inspection
- Plan for mixed mode indications is a slight variation of method proposed in September 2000
  - Mix mode burst assessment method not necessary based on low probability of unacceptable mix mode burst pressure
  - ARC leakage multiplier is applied for interacting mix mode flaws that have leakage potential

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CIRCUMFERENTIAL INDICATIONS AT DENTED TSP
DCPP UNITS 1 AND 2

| Date | Outage | ID/OD | SG | R | C | TSP | Inch | Dent Volt | Max +P Volt | Arc deg | Arc inch | %TW MD at max amplitude | Detect in Prior Outage Based on RPC Lookup | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Oct-95 | 1R7 | ID | 12 | 36 | 51 | 2H | 0.11 | 8.7 | 1.0 | 40 | 0.29 | 45 | not inspected | |
| Oct-95 | 1R7 | ID | 12 | 14 | 69 | 1H | 0.24 | 22.1 | 1.6 | 32 | 0.23 | 54 | not inspected | Tube pull DE is 27 deg, 50% MD. |
| Oct-95 | 1R7 | ID | 12 | 8 | 70 | 1H | 0.12 | 7.8 | 1.3 | 36 | 0.26 | 37 | not inspected | |
| Oct-95 | 1R7 | ID | 12 | 11 | 79 | 1H | 0.02 | 27.9 | 1.3 | 36 | 0.26 | 42 | not inspected | |
| Apr-96 | 2R7 | ID | 22 | 16 | 8 | 1H | -0.21 | 25.1 | 0.9 | 36 | 0.26 | 57 | not inspected | |
| Apr-96 | 2R7 | ID | 22 | 13 | 9 | 1H | 0.29 | 16.5 | 0.9 | 24 | 0.17 | 42 | not inspected | |
| Apr-96 | 2R7 | ID | 22 | 14 | 12 | 1H | 0 | 2.4 | 0.6 | 32 | 0.23 | 50 | not inspected | Non interacting Mix Mode |
| Apr-96 | 2R7 | ID | 22 | 13 | 15 | 1H | -0.18 | 22.9 | 0.6 | 31 | 0.23 | 51 | not inspected | |
| Apr-96 | 2R7 | ID | 22 | 6 | 16 | 1H | -0.06 | 13.8 | 0.8 | 44 | 0.31 | 48 | not inspected | |
| Apr-96 | 2R7 | ID | 22 | 4 | 17 | 1H | 0.11 | 6.8 | 0.8 | 31 | 0.23 | 48 | not inspected | |
| Apr-96 | 2R7 | ID | 22 | 3 | 25 | 1H | -0.01 | 31.2 | 0.8 | 35 | 0.25 | 44 | Yes | |
| Apr-96 | 2R7 | ID | 22 | 12 | 25 | 1H | 0.15 | 24.1 | 1.1 | 43 | 0.31 | 75 | Yes | Non interacting Mix Mode |
| Apr-96 | 2R7 | ID | 22 | 14 | 26 | 1H | -0.14 | 26.6 | 0.3 | 26 | 0.19 | 61 | not inspected | |
| Apr-96 | 2R7 | ID | 22 | 20 | 26 | 1H | 0.08 | 5.4 | 0.5 | 29 | 0.21 | 52 | not inspected | |
| Apr-96 | 2R7 | ID | 22 | 13 | 28 | 2H | 0.2 | 7.0 | 0.5 | 34 | 0.24 | 32 | Yes | |
| Apr-96 | 2R7 | ID | 22 | 14 | 28 | 1H | 0.08 | 7.1 | 0.7 | 25 | 0.18 | 43 | not inspected | |
| Apr-96 | 2R7 | ID | 22 | 12 | 29 | 4H | 0 | 15.6 | 1.4 | 67 | 0.48 | 52 | not inspected | |
| Apr-96 | 2R7 | ID | 22 | 13 | 29 | 1H | -0.13 | 28.6 | 0.3 | 38 | 0.27 | 30 | not inspected | |
| Apr-96 | 2R7 | ID | 22 | 8 | 32 | 1H | 0.22 | 9.2 | 0.8 | 50 | 0.36 | 32 | not inspected | |
| Apr-96 | 2R7 | ID | 22 | 8 | 34 | 1H | -0.05 | 15.5 | 0.3 | 29 | 0.21 | 40 | No | |
| Apr-96 | 2R7 | ID | 22 | 8 | 34 | 1H | 0.04 | 15.5 | 0.4 | 33 | 0.24 | 19 | No | |
| Apr-96 | 2R7 | ID | 22 | 13 | 34 | 1H | -0.02 | 14.7 | 0.8 | 29 | 0.21 | 27 | not inspected | |
| Apr-96 | 2R7 | ID | 22 | 11 | 39 | 1H | -0.33 | 22.3 | 0.5 | 29 | 0.21 | 40 | not inspected | |
| Apr-96 | 2R7 | ID | 22 | 14 | 53 | 1H | 0.09 | 5.3 | 1.0 | 37 | 0.26 | 52 | not inspected | |
| Apr-96 | 2R7 | ID | 22 | 14 | 53 | 1H | 0.26 | 5.3 | 0.5 | 25 | 0.18 | 36 | not inspected | |
| May-97 | 1R8 | ID | 12 | 31 | 73 | 4H | 0.2 | 8.4 | 0.4 | 34 | 0.24 | 58 | not inspected | |
| Feb-98 | 2R8 | ID | 22 | 32 | 24 | 1H | 0.14 | 39.7 | 0.6 | 36 | 0.26 | 50 | No | |
| Feb-98 | 2R8 | ID | 22 | 3 | 26 | 1H | 0.16 | 9.2 | 0.4 | 23 | 0.17 | 19 | No | |
| Feb-98 | 2R8 | ID | 22 | 5 | 35 | 1H | 0.01 | 20.3 | 0.8 | 19 | 0.14 | 43 | Yes | |
| Feb-98 | 2R8 | ID | 22 | 10 | 36 | 1H | 0.22 | 2.8 | 0.4 | 35 | 0.25 | 26 | No | |
| Feb-98 | 2R8 | ID | 22 | 17 | 50 | 1H | -0.29 | 17.3 | 0.5 | 48 | 0.35 | 39 | Yes | |
| Feb-98 | 2R8 | ID | 22 | 12 | 51 | 1H | 0.06 | 8.3 | 0.3 | 31 | 0.22 | 37 | Yes | |
| Feb-99 | 1R9 | ID | 12 | 21 | 33 | 3H | 0.27 | 3.0 | 0.5 | 73 | 0.52 | 61 | No | "Interacting" Mix Mode (no return to null) |
| Feb-99 | 1R9 | ID | 12 | 18 | 75 | 4H | 0 | 10.6 | 0.5 | 24 | 0.17 | 55 | Yes | |
| Feb-99 | 1R9 | ID | 12 | 8 | 80 | 4H | 0.18 | 6.4 | 0.5 | 38 | 0.27 | 24 | Yes | |
| Oct-99 | 2R9 | OD | 22 | 2 | 15 | 1H | -0.16 | 19.7 | 0.2 | 27 | 0.20 | 53 | No | |
| Oct-99 | 2R9 | ID | 22 | 28 | 16 | 1H | 0.05 | 3.1 | 0.3 | 27 | 0.20 | 36 | Yes | |
| Oct-99 | 2R9 | OD | 22 | 10 | 20 | 1H | -0.05 | 12.7 | 0.2 | 33 | 0.24 | 46 | Yes | |
| Oct-99 | 2R9 | ID | 22 | 29 | 22 | 1H | 0.13 | 13.0 | 0.3 | 24 | 0.17 | 39 | Yes | |
| Oct-99 | 2R9 | ID | 22 | 11 | 23 | 1H | -0.13 | 18.9 | 0.4 | 24 | 0.17 | 31 | Yes | |
| Oct-99 | 2R9 | ID | 22 | 7 | 24 | 1H | -0.06 | 15.0 | 0.6 | 19 | 0.13 | 31 | Yes | |
| Oct-99 | 2R9 | OD | 22 | 14 | 27 | 1H | -0.26 | 39.3 | 0.3 | 31 | 0.22 | 20 | Yes | |
| Oct-99 | 2R9 | OD | 22 | 5 | 29 | 1H | -0.07 | 38.9 | 0.4 | 47 | 0.34 | 15 | Yes | |
| Oct-99 | 2R9 | OD | 22 | 6 | 33 | 1H | -0.25 | 51.3 | 0.3 | 70 | 0.50 | 35 | No | |
| Oct-99 | 2R9 | ID | 22 | 12 | 35 | 4H | 0.27 | 9.1 | 0.6 | 33 | 0.24 | 42 | NA | deplugged in 2R9 |
| Oct-99 | 2R9 | ID | 22 | 22 | 46 | 1H | 0.18 | 6.1 | 0.3 | 22 | 0.16 | 41 | Yes | Non interacting Mix Mode |
| Oct-00 | 1R10 | ID | 11 | 36 | 34 | 1H | 0.05 | 4.0 | 0.7 | 35 | 0.25 | 24 | Yes | |
| Oct-00 | 1R10 | ID | 12 | 4 | 59 | 1H | -0.17 | 5.7 | 0.4 | 34 | 0.24 | 48 | Yes | |
| Oct-00 | 1R10 | OD | 12 | 4 | 59 | 1H | 0.04 | 5.7 | 0.2 | 30 | 0.22 | 49 | Yes | |
| Oct-00 | 1R10 | OD | 12 | 14 | 73 | 1H | 0.22 | 16.3 | 0.3 | 41 | 0.29 | 66 | Yes | |
| Oct-00 | 1R10 | OD | 12 | 3 | 79 | 1H | 0.29 | 3.5 | 0.3 | 11 | 0.08 | 17 | No | |
| Oct-00 | 1R10 | OD | 12 | 3 | 81 | 1H | -0.3 | 27.9 | 0.2 | 30 | 0.22 | 20 | No | |
| Oct-00 | 1R10 | OD | 12 | 3 | 81 | 1H | 0.28 | 27.9 | 0.2 | 30 | 0.22 | 57 | No | |
| Oct-00 | 1R10 | OD | 12 | 2 | 83 | 2H | -0.09 | 6.1 | 0.3 | 41 | 0.29 | 41 | No | |
| Oct-00 | 1R10 | OD | 14 | 2 | 68 | 1H | -0.21 | 6.8 | 0.2 | 20 | 0.14 | 17 | No | |
| May-01 | 2R10 | ID | 22 | 19 | 7 | 1H | 0.11 | 13.1 | 0.4 | 29 | 0.21 | 50 | Yes | |
| May-01 | 2R10 | ID | 22 | 19 | 9 | 1H | 0.24 | 16.7 | 0.5 | 24 | 0.17 | 61 | Yes | |
| May-01 | 2R10 | ID | 22 | 11 | 19 | 1H | 0.23 | 15.9 | 0.5 | 40 | 0.29 | 46 | Yes | Non interacting Mix Mode |
| May-01 | 2R10 | ID | 22 | 13 | 23 | 1H | 0.28 | 31.9 | 0.8 | 32 | 0.23 | 44 | Yes | |
| May-01 | 2R10 | OD | 22 | 6 | 29 | 1H | -0.19 | 41.7 | 0.3 | 54 | 0.39 | 37 | No | |
| May-01 | 2R10 | ID | 22 | 6 | 30 | 1H | 0.19 | 9.2 | 0.5 | 32 | 0.23 | 52 | Yes | |
| May-01 | 2R10 | OD | 22 | 2 | 36 | 1H | -0.15 | 16.4 | 0.2 | 40 | 0.29 | 26 | Yes | |
| | | | | | | | | | | | | | | |
| TOTAL | 62 circ in 59 tubes | | | | | 1H | | 16.0 | 0.6 | 34 | 0.24 | 41 | | MEAN |
| | | 48 ID | | | | 4H | 0.29 | 51.3 | 1.6 | 73 | 0.52 | 75 | 26 growth points | MAX |
| | | 14 OD | | | | | -0.33 | 2.4 | 0.2 | 11 | 0.08 | 15 | | MIN |

## *Circ and Mixed Mode History*

- Low rate of circ indication initiation - only 62 TSP circumferential indications at DCPP based on approximately 35,000 dented TSP RPC inspections conducted since 1993
- Only 5 mix mode flaws
- Numbers of PWSCC circ have decreased over time
- Peak +Point voltages have tended to decrease over time
- Max length was 73 degrees. Max depth was 75%.
- Most occur in large dents. 2.4 volt dent is smallest dent that circ has been detected.
- All circs located within dented TSP
- NDE conservatively predicted 1995 tube pull

## *Expected Trends for Circumferential Cracking at DCPP*

- New PWSCC sizes decrease in length and depth for successive +Point inspections
  - Same trend found for axial and circumferential indications
- Bases for expected trend toward smaller indications
  - Consistent or improving +Point detectability threshold as analyst experience and awareness increases
  - Indications in highest stress fields occur earliest and are repaired
  - New indications in lower stress fields are slow growing
  - Chemistry enhancements (Zinc addition) reduce PWSCC initiation and potentially growth rates

## Mixed Mode Indications
## Types of Circ Cracks with Localized Dents

- Localized dents found at Diablo Canyon (DC) and Sequoyah (SQ) as indicated by pulled tubes and NDE data
  - Local maximum deformation principally from a few mils to about 10 mils
- Pulled tubes show circ cracks at periphery of local dents with axial cracks near center of dent
- Cracks found to be short and shallow
- Contrasted to North Anna experience
  - North Anna had large ovalization (frequent probe restrictions) leading to larger circ cracks (up to 180 degrees)

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## Circumferential Cracks at Localized Dents

- Short cracks dominantly < 0.3" (<45°) with largest typically about 0.6" (<90°)
- Sequoyah Evaluation (DC would have similar expectations)
  - Nearly same max to average depth ratio of 1.25 to 1.3
  - Similar length distributions and profiles with longest circs shorter than longest axials
- Circ profiles for PWSCC and ODSCC approximately equivalent to axial PWSCC

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## Circumferential Cracks at Localized Dents

- Similarity of axial and circ profiles is a consequence of stress fields at localized dents
  - With dent deformation, axial tensile stresses develop on both ID and OD of the tubing but at different locations – hence both ID and OD circs may develop
  - Largest tensile hoop stress is on ID near maximum denting which leads to axial PWSCC, but separated from circs
  - Cylindrical tube geometry leads to tube distortions longer in axial direction than in circ direction
    - Consistent with longer axial cracks than circs
- Circ cracks located within TSP since largest circumferential deformation near center of localized dent.

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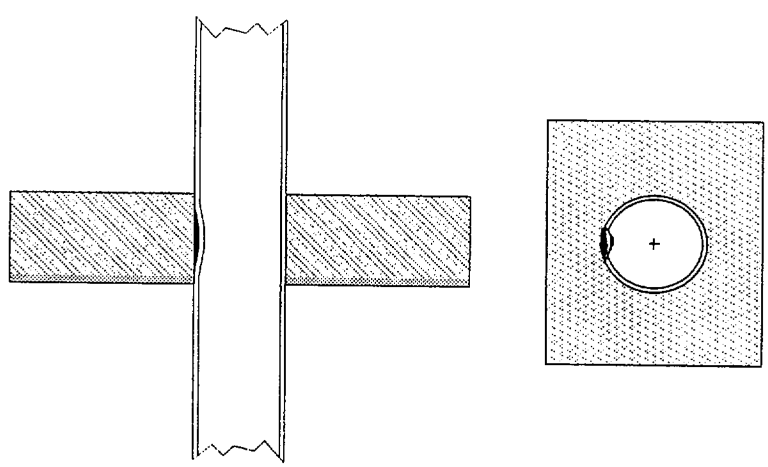
## Localized Dent Geometry



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## Detection Considerations

- Under PWSCC ARC applications, the EOC axial crack length and depths are limited to ensure that the structural margin of $1.4\Delta P_{SLB}$ is satisfied.
- Circ. crack depths are limited by plug on detection together with the low growth rates found for these indications at dented TSP intersections.
- Given these conditions, it can be expected that mixed mode interactions will not significantly reduce the axial indication burst pressure below the burst margin requirement even for tip-to-tip interaction.

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## Probability Considerations for Mixed Mode Interactions

- The probability is extremely low for a combination of an axial crack near the burst margin limit, a circ crack approaching TW depths and the cracks close enough for mixed mode effects
  - No mixed mode indications leading to a burst pressure reduction or leakage increase have been found in DC, SQ or North Anna (no known occurrences in any Westinghouse SG) and none are expected in the future.
- Low probability of mixed mode indications in close enough proximity to reduce axial burst pressure even if the axial and circ cracks are sufficiently deep.
- Most of the axial PWSCC cracks are too short (<0.3") to have burst pressure reductions more than about 10% even if intersecting a TW circ.

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## *Probability Considerations for Mixed Mode Interactions*

- For application of the PWSCC ARC, any potential increase in risk from mixed mode indications relative to no ARC is limited to TSP intersections for which an axial PWSCC indication was left in service.
  - ARC mixed mode requirements do not apply to intersections with no axial crack left in service.
- If an axial PWSCC indication is left in service, the intersection was +Point inspected so that +Point detection capability for circ indications is applicable.
  - This limits undetected circ cracks to shallow indications.
- Bobbin detectability of circ cracks in dents < 2 volts does not apply to the ARC mixed mode requirements.

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## *Estimate of Probability for a Mixed Mode Burst Pressure Reduction*

| | | |
|---|---|---|
| Number of PWSCC axial plugged and in service | (210p+111<40%) + (104p+34<40%) = 459 | Total number of axial ind. to date. Plugged (p) and <40% max depth left in service. |
| Number of circumferential indications | (10ID+7OD) + (38ID+7OD) = 62 | |
| Number circumferential ind. at TSP with axial ind. | 1 + 4 = 5 | |
| Number of circ ind. without a null point separation | 1 + 0 = 1 | |
| Number of circ. within separation distance & >70% max. depth | 0 + 0 = 0 | Single circ within separation distance was shallow as was axial |
| Probability per axial of a circ. crack close enough to interact | 1/459 = 0.0022 | 1 circ crack found within separation distance |
| Cond. probability that interacting axial crack is near burst margin | 0.05? | Assumes 1 in 20 axial ind. will be near burst margin at EOC |
| Cond. probability that interacting circ crack is deep enough to affect burst | 1/62 = 0.016 | None of the 62 circ. ind. were sufficiently deep (>≈70% avg. D) |
| Cond. probability that deep intersecting circ cuts axial at the end of the deeper section of the crack | 0.1? | Circ must cut axial near edge of burst effective length for a significant burst effect due to shallow tails |
| Estimated probability per axial of a mixed mode burst pressure reduction | $\approx 2\times10^{-7}$ | Negligible probability of a mixed mode effect on burst pressure |

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## *Estimate of Probability for a Mixed Mode Burst Pressure Reduction*

| | | |
|---|---|---|
| Estimated probability per axial of a mixed mode burst pressure reduction. **Assumes free span indications at SLB conditions.** | $\approx 2x10^{-7}$ | Negligible probability of a mixed mode effect on burst pressure |
| Probability that TSPs will displace in a SLB event given dented TSP intersections. | < 0.001? | SLB loads are well below values required to overcome dented TSP contact pressures to permit TSP displacement |
| Best estimate probability of a mixed mode burst pressure reduction | $\approx 2x10^{-10}$ | |
| | | |
| Estimated probability per cycle of a mixed mode burst pressure reduction | $6x10^{-5}$ to $6x10^{-8}$ | Assume 300 PWSCC indications left in service |
| | | |

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# *Leakage Integrity Considerations*

- Based on the depths of circ cracks found to date at DC and SQ, leakage from the circ indication by itself is very unlikely
  - +Point inspections performed with plugging of all circ indications.
  - This leakage potential is independent of the ARC application and further reduced by the ARC inspection requirements.
- Mixed mode leakage considerations
  - The ARC permits cracks with low EOC leakage to be left in service if structural margins are satisfied.
  - The potential may exist that a TW crack opening may slightly increase for intersecting mixed mode indications.

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## *CM Methods for Bounding Leakage Analysis of Mixed Mode Indications*

- If the axial component has predicted leakage AND circumferential component is ≥70% MD with no null point, then increase leak rate of specific axial flaw by factor of 10
  - Leak rate of axial PWSCC is upper 95% value calculated by single indication Monte Carlo
- Resultant axial flaw leak rate is applied to PWSCC ARC leakage in faulted loop, 12.8 gpm limit

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## *OA Methods for Bounding Leakage Analysis of Mixed Mode Indications*

- Must have detected an interacting mixed mode flaw in any outage AND at least one previously +Point inspected circumferential flaw ≥70% MD in the just completed outage. Otherwise, OA leakage assessment is not required.
- Determine frequency of interaction occurrence (f)
  - f = number of detected interacting flaws divided by total number of detected axial flaws from all completed inspections (historical probability)
- Determine axial flaw leak rate multiplier ($M_L$)
  - $M_L = 1 + 9f$
- Increase PWSCC ARC OA leak rates by $M_L$ in each SG

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## Mixed Mode Indication Summary

- Dent stress fields and repair of circs upon +Point detection limit significance of circumferential cracks at dents
- Negligible probability of mixed mode indications leading to significant effects on burst or leakage margins
- Short, shallow, infrequent circumferential cracks with flaw shapes similar to axial indications
- Different locations of axial and circumferential stresses in dents tend to cause separation of axial and circ cracks
- Leakage addressed in CM/OA by multiplier

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## Proposed Schedule

- Revised WCAP and LAR supplement submittal by 9-1-01
- NRC written RAI by 10-1-01
- PG&E answers to RAI by 11-15-01
- PG&E desires NRC approval of ARC by 4-01-02
- 1R11 outage starts 4-28-02
- Is this achievable?

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# Requested Feedback

- Acceptability of approach for mix mode issues
  - Leakage multiplier for CM and OA
  - Negligible burst probability
- Issues for permanent ARC
- Schedule