ODSCC ARC Submittal for Watts Bar Nuclear Plant

Tennessee Valley Authority
Watts Bar Nuclear Plant
NRC Meeting
7/17/01

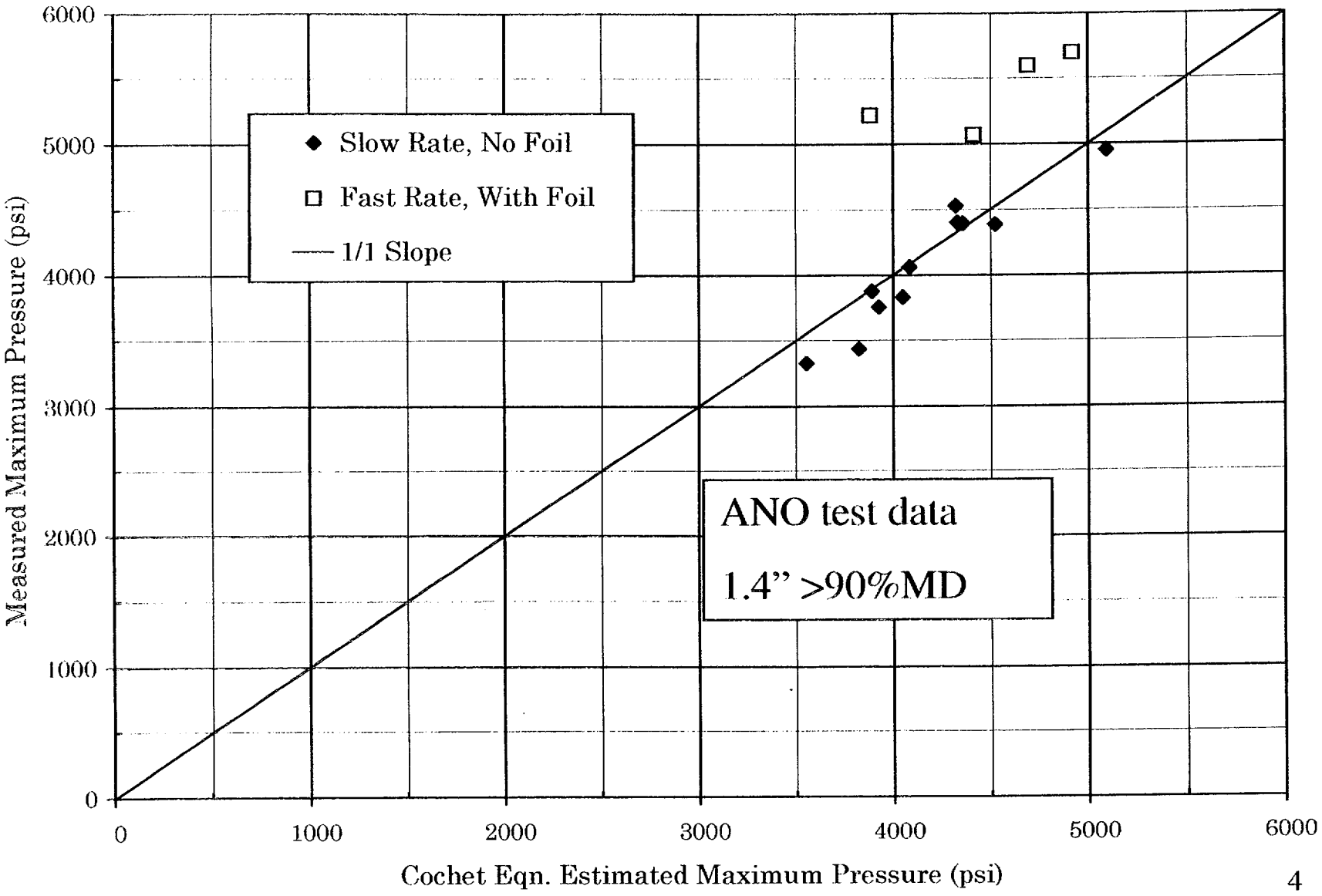
Answer to Outstanding RAIs

- TVA needs to address the pressurization rate affect on burst testing tubes that called into question the validity of the burst correlation developed for the voltage-based repair criteria

Background

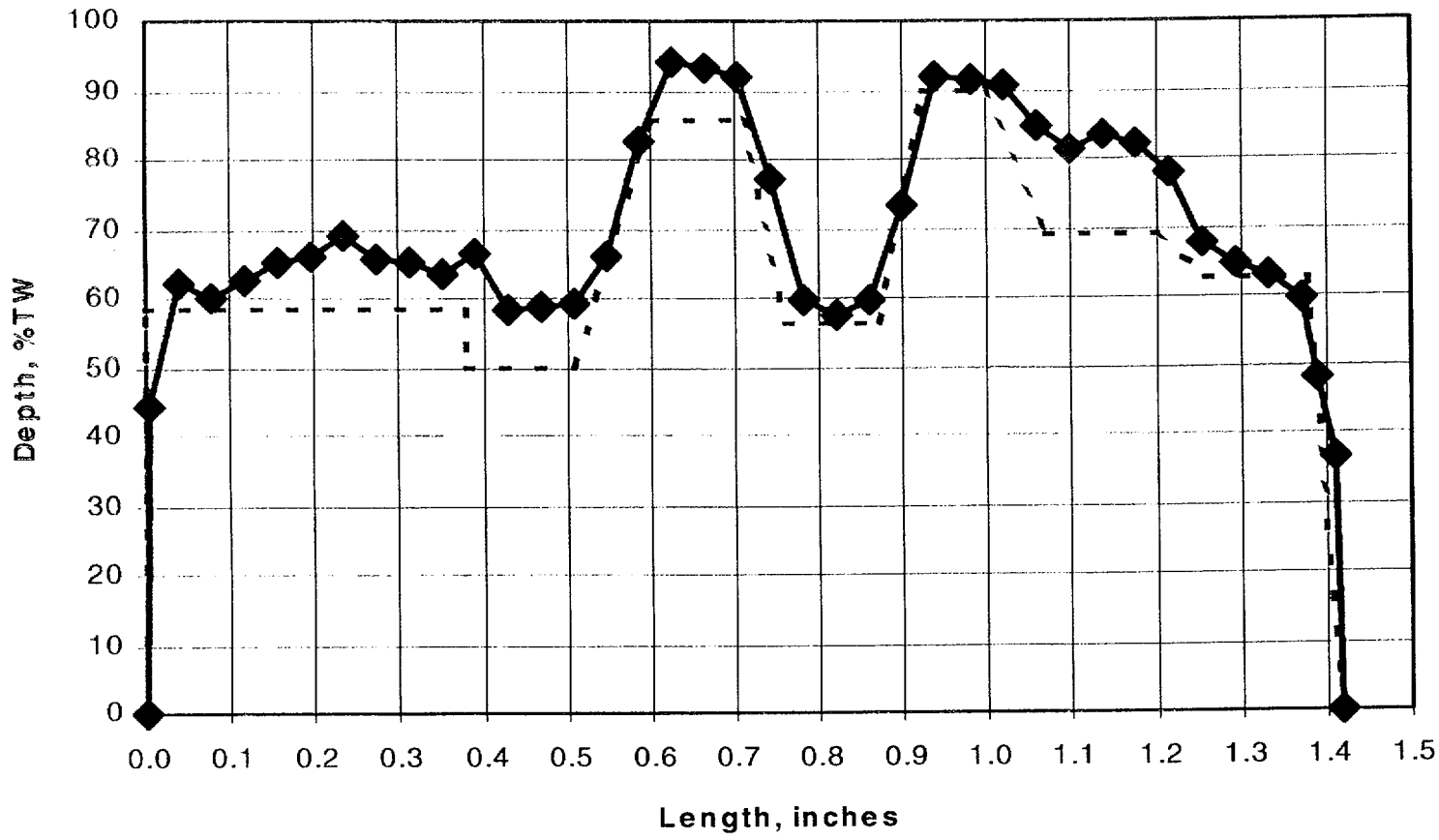
- Historical Experience – No measurable rate effect between 200 psi/sec and 2000psi/sec (fast rate)
- Testing performed by Westinghouse for ANO of long, deep, axial EDM slotted specimens (Type 14 Profile) called this position into question
- Burst pressures from fast rate tests were on the order of 20% higher than burst pressures from slow rate tests

Type 14 EDM Specimens with SEM Profiles
Slow & Fast Loading Rate Tests



Type 14 Depth/Length Profile

ANO-00-069



Measured EDM Profile Illustrative of
Typical Agreement with the Fabrication Drawing

Initial Evaluation by E&R IRG

- EPRI SGMP E&R IRG initiated a study of the effect
  - → Westinghouse / E-Mech performed the evaluation
  - → Deliverable - Technical Report 1001441
  - → E&R IRG decided no testing should be done until we fully understood the problem

Initial Evaluation by E&R IRG

- Summary of rate dependence in report
  - → Rate of pressurization does affect the burst pressure
    - →Only for long, deep flaws like the ANO-2 Type 14 specimen
    - →>90% and longer than about 0.4"
  - → Recommended that lab tests and in situ tests be performed at a rate not exceeding 200 psi/sec with 2 minute hold times
  - → The only circumstance where current analytical models may be non-conservative is for long, deep cracks
  - → Current ARC models do not appear to be affected

Initial Evaluation by E&R IRG

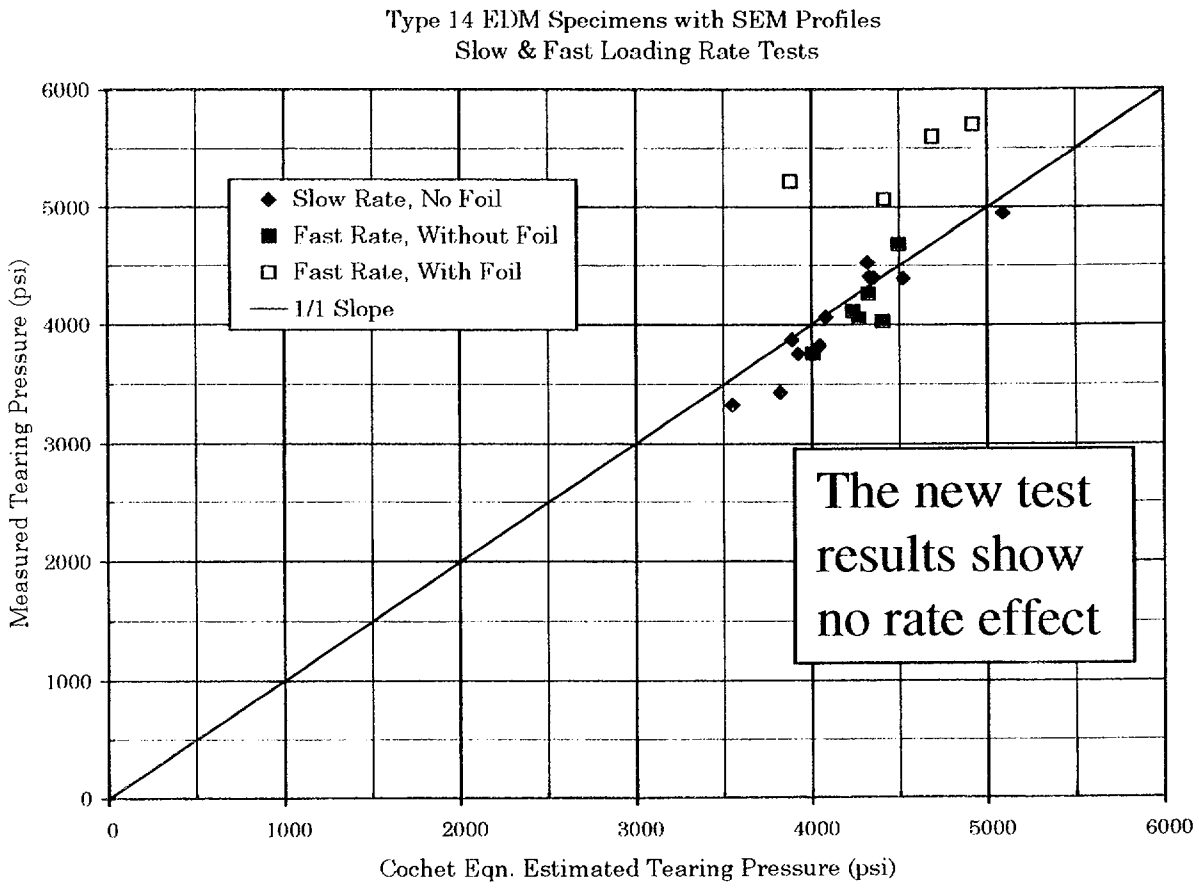
- Recommendations
  - → Testing to determine if foil strengthening effect may be present in burst tests of very deep, partial through wall cracks should be conducted as a high priority item
    - → Initial Type 14 slow tests were performed without a foil and bladder
    - → Initial Type 14 fast tests were performed with a foil and bladder
    - → What was missing from the test database are fast tests without a foil and bladder.

TVA's Participation

- TVA funded the additional testing
  - → TVA representatives were involved in the review of the draft report
  - → Began testing in parallel with finalizing the report
  - → Motivated by WBN's need for the ODSCC ARC approval
    - →Expecting 30-50 indications during the February inspection
    - →This ARC would eliminate the need to plug tubes with insignificant indications
    - →Average burst pressure for ARC indications is about 7000 psi compared to a performance criterion of 2560 psi

TVA's Tests

- Reproduced the Type 14 specimens
- Fast tests were conducted without a foil and bladder
- Results were very similar to the original slow tests



Pressurization Rate Conclusions

- There is no measurable pressurization rate effect on the burst pressure of degraded steam generator tubing for pressurization rates between 20 psi/sec and 2000 psi/sec
- A foil strengthening effect was apparently observed in the original fast rate tests of Type 14 specimens
  - → How does the foil strengthening affect the ODSCC database?

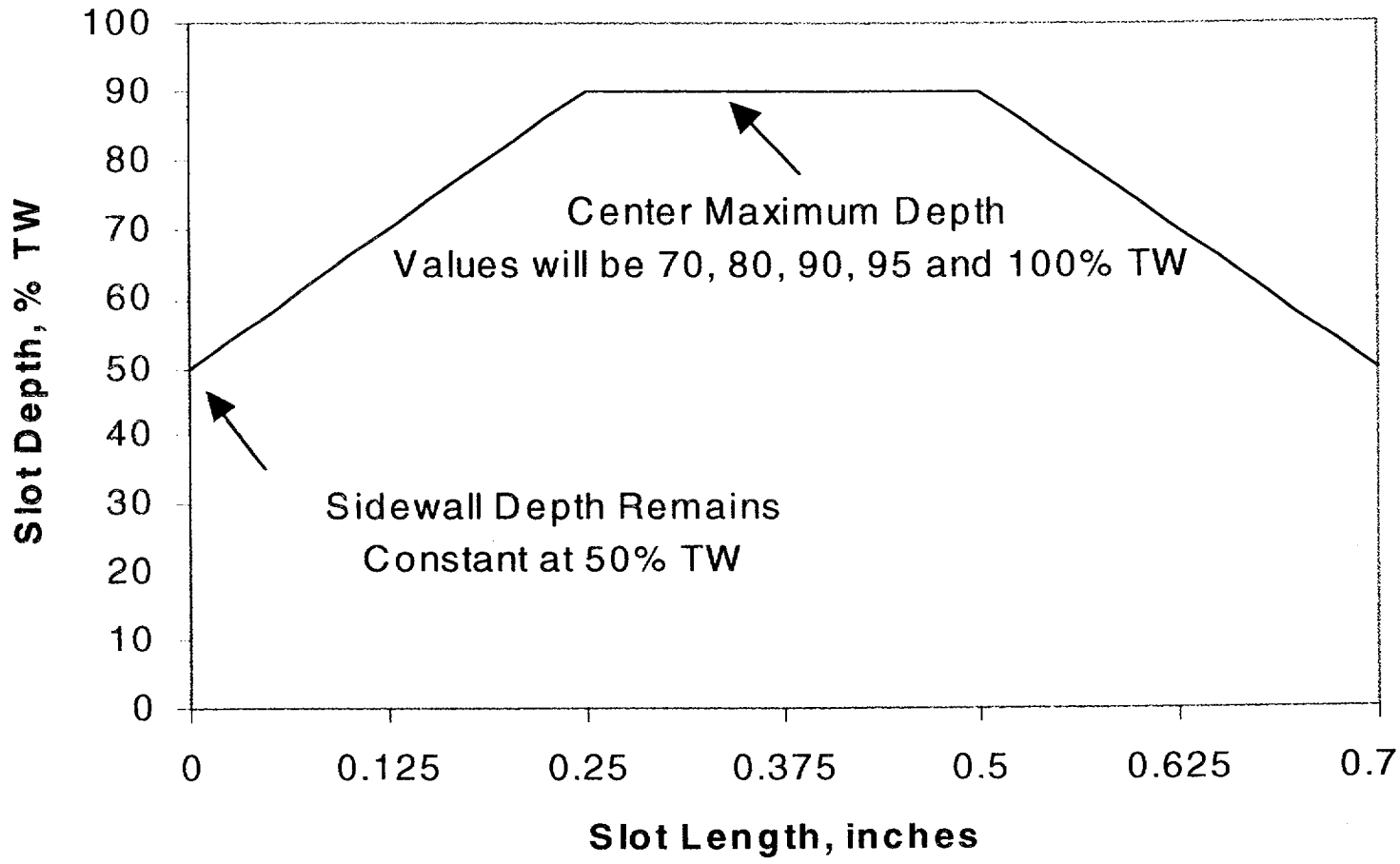
Foil Strengthening Effects

- Historical Experience – A small foil strengthening effect may be present based on burst tests of specimens with 100% TW axial EDM slots.
- A nominal 5% correction is typically applied based on the results from tests with non-lubricated foil
  - → EdF test results with lubricated foil indicate no effect
- TVA tested another set of specimens to determine if the ODSCC Database is affected by foil strengthening effects

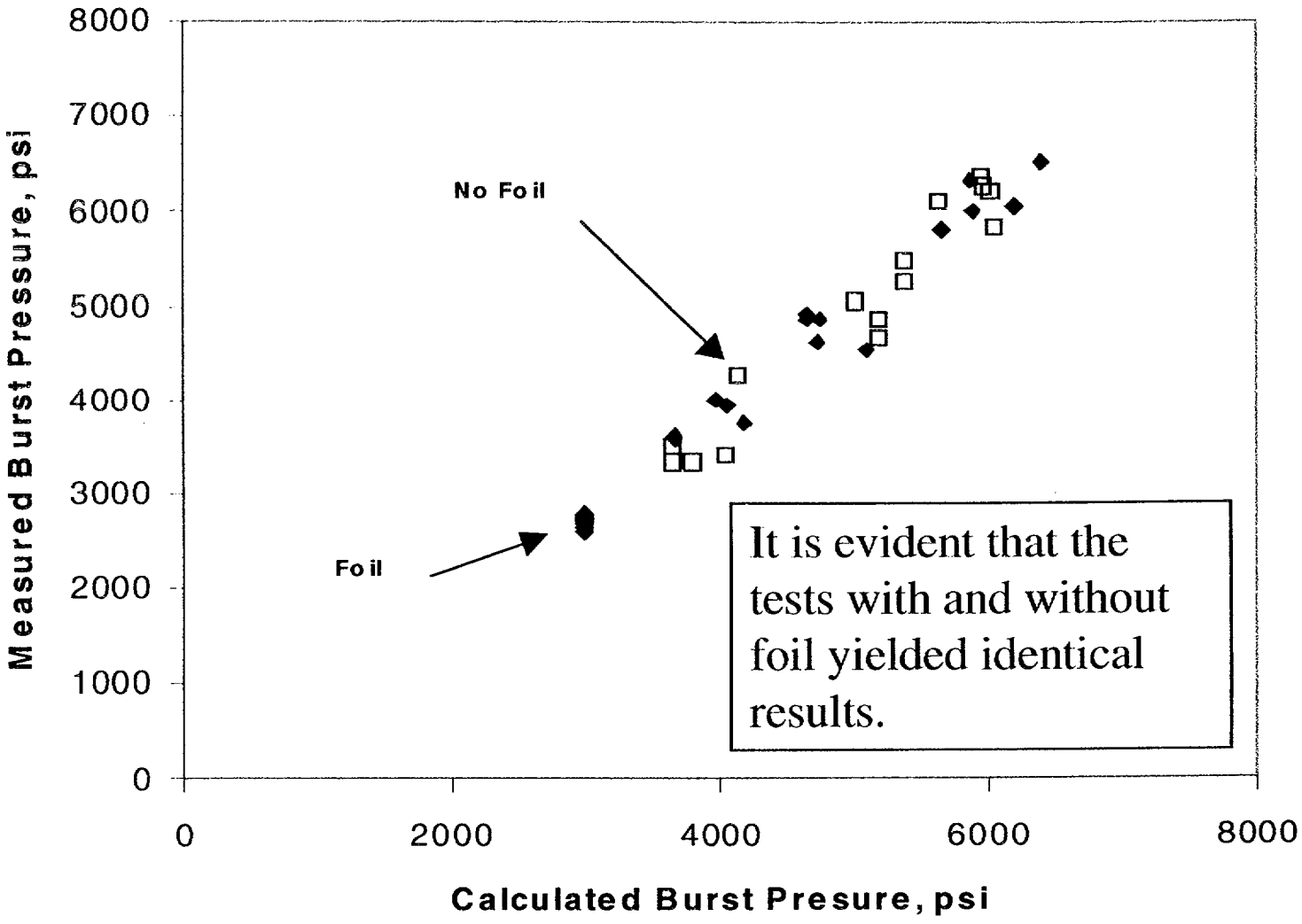
Foil Strengthening Effect Test

- Trapezoid profile specimens with partial through wall axial EDM slots, 0.75 inches in length
- Maximum depths from 55% TW to 100% TW
- Tests with and without reinforced (0.006 brass foil) sealing bladder
- Pressurization rates between 50 psi/sec and 300 psi/sec

Nominal Test Specimen Profiles



Results of Foil Strengthening Test



Conclusions

- There is no foil strengthening effect or pressurization rate effect for the data in the ODSCC database
- Long, part-through wall, axial crack profiles with short, very deep segments may exhibit a foil strengthening effect on burst pressure as exhibited by the Type 14 specimens
  - → ARC tubes would not be this size
- Hold times for in situ tests are still recommended
- The pressurization rate issue has been resolved relative to the ODSCC database

Plans

- The results of the TVA testing will be provided to EPRI to include in a revision to the pressurization rate report by end of July
- EPRI will issue the final report with the additional testing results and discussion included to the NRC by early fall

Answer to Outstanding RAIs

- TVA must propose a program that will lead to inspection of dents for circumferential cracks in dents below 2 volts if their inspections indicate that circumferential cracking is occurring in dents above 2 volts.

TSP Dented Intersection Inspection

- WBN denting is mechanically-induced (dings)
- Small numbers of dented intersections (159 total hot leg)
- No cracking has been identified

Hot Leg Dented Intersections >= 2 Volts (Tubes)

	H01	H02	H03	H04	H05	H06	H07	H08	Total
SG1	4	5	3	1	0	1	3	5	22
SG2	2	17	2	4	7	0	4	8	44
SG3	7	6	3	5	2	2	2	1	28
SG4	5	21	2	2	3	20	2	10	65

Number Of Indications (Not Tubes):

Voltage Range:	SG-1	SG-2	SG-3	SG-4
>=1.0v & <1.5v	0	3	24	2
>=1.5v & <2.0v	0	3	5	2
>=2.0v & <5.0v	22	51	30	61
>= 5.0v	0	9	2	18

TSP Dented Intersection Inspection

- WBN plans to inspect all hot leg dented intersections greater than or equal to 2 volts using +Point
- Dent calling threshold has been lowered to 1 volt
- If circumferential cracking is identified in dented intersections as low as 2 volts, the examination will be expanded to include dented intersections greater than or equal to 1 volt
  - → The uninspected population will be accounted for in the Condition Monitoring and Operational Assessment

ODSCC
DOSE PRESENTATION

TENNESSEE VALLEY AUTHORITY
WATTS BAR NUCLEAR PLANT
JULY 17, 2001

ODSCC/DOSE

- NRC commented on MSLB calculation in amendment request
- Revised MSLB dose calculation - provided to NRC in RAI response
- NRC provided additional comments on revised MSLB dose calculation
- Errors identified which impacted dose calculations

ODSCC/DOSE

- Changes in dose calculations
- Use ARCON 96 X/Q in lieu of Halitsky
- Updated from ICRP-2 to ICRP-30
- NUREG 0800 pre-accident spike and accident initiated iodine spike analysis
- Incorporate increased Main Control Room isolaton time
- Revised dose codes for TEDE and ICRP-30
- Incorporate NRC comments

ODSCC/DOSE

- ARCON 96/HALITSKI X/Qs

	2hr	8hr
ARC.	4.03E-3	3.35E-3
HAL.	4.07E-3	2.47E-3

- No releases after 8 hours.
- ARCON 96 produces higher Main Control Room dose for Main Steam Line Break.

ODSCC/DOSE

- ICRP-2 and ICRP-30

- ICRP-2 determines RCS DE I-131.
- ICRP-2 used by Chemistry to establish more restrictive RCS DE I-131 concentrations
- Calculation Methodology to determine dose has been upgraded to ICRP-30

ODSCC/DOSE

- NUREG 0800 METHODOLOGY

- Pre accident iodine spike (48 hour TS)
- Accident initiated (500 X production rate)

- Approved licensing bases used one analysis

ODSCC/DOSE

- Current design basis
  - 10 uCi/gm DE I-131 48 hour spike
  - Steady state DE I-131 concentration is 1 uCi/gm.

- Current TS 3.4.16 RCS Specific Activity
  - 60 uCi/gm DE I-131 48 hour concentration
  - 1 uCi/gm steady state.

- Interim guidance provided to Operations
  - Limit 48 hour iodine value to 1.0 uCi/gm
  - Steady state value to 0.265 uCi/gm

ODSCC/DOSE

■ Main Control Room Isolation Time

- Calculation revision will include an increased Main Control Room isolation time.
- Isolation time was 14 seconds and is now 20.6 seconds.
- Increase required due to MCR radiation monitor response time increase.

ODSCC/DOSE

- DOSE CODES-COROD AND FENCDOSE
  - Methodology described in WBN UFSAR
  - COROD used to determine dose to control room personnel
  - FENCDOSE used to determine dose at site boundary and offsite
  - Revisions included:
    - ICRP-30 Dose Conversion Factors
    - Total Effective Dose Equivalent

ODSCC/DOSE
NRC QUESTIONS/RESPONSE

- **Flows of 150,000 lb and 2509 lb should be considered separately since the 150,000 lb is secondary side at 0.1 uCi/gm and the 2509 lb is primary side at a higher concentration.**
- Response: Agree. The revised calculation model steps the 150,000 lb secondary side into the environment at time 0. The RCS primary side leakage is modeled separately as a flow from the RCS to the environment.

Figure 1: STP Model

Pre-accident Iodine Spike

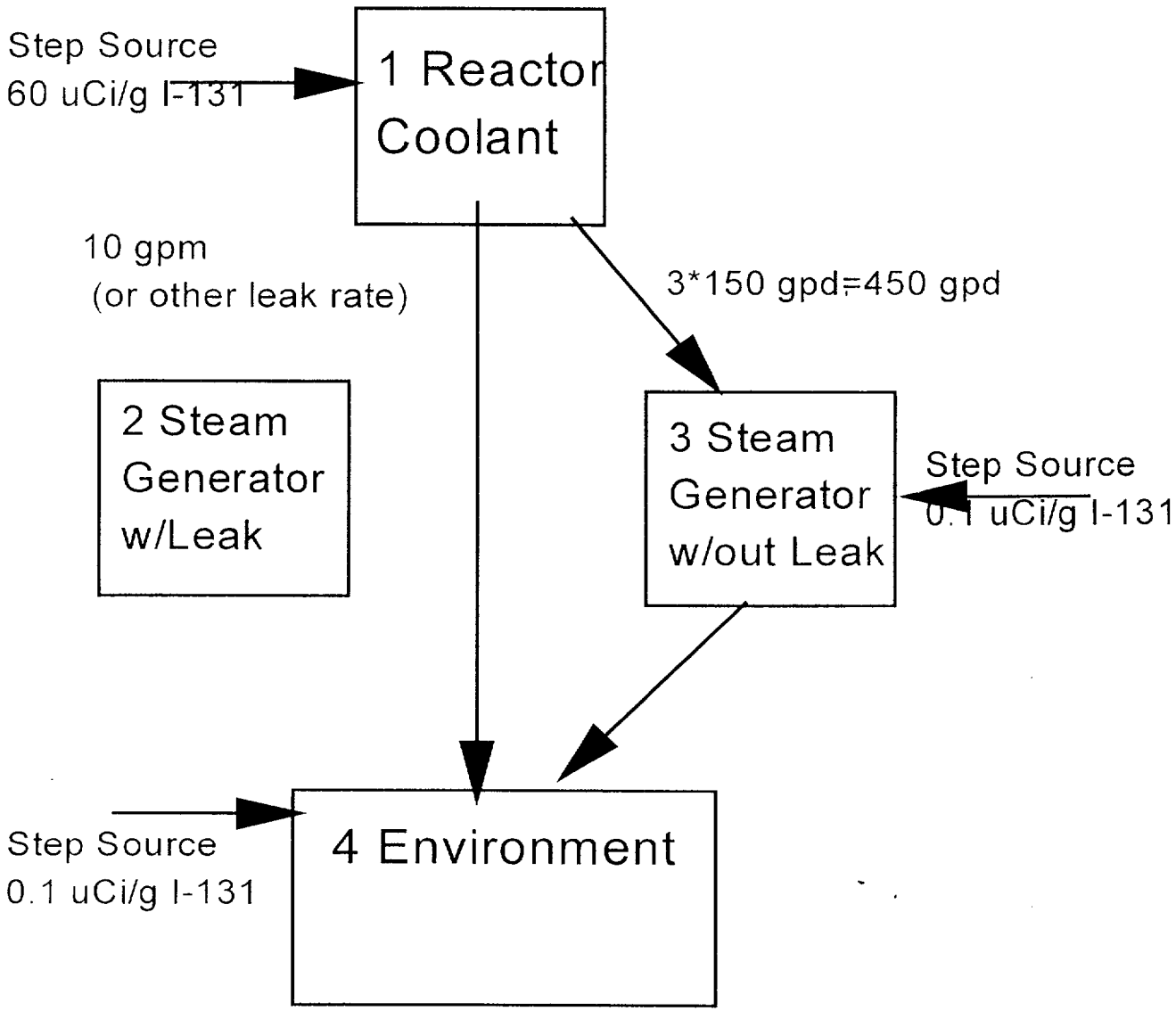
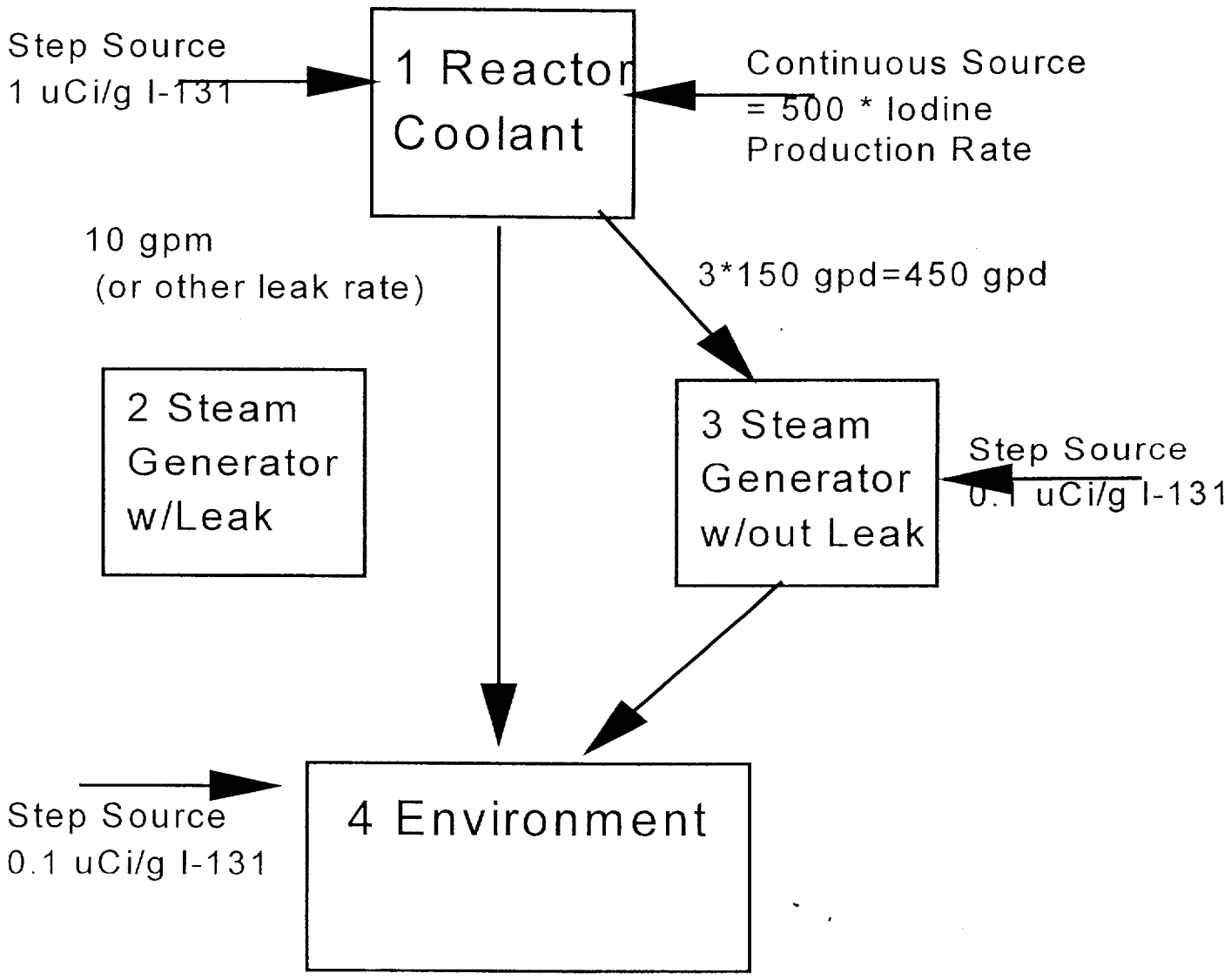


Figure 2: STP Model

Accident Initiated Iodine Spike



ODSCC/DOSE
NRC QUESTIONS/RESPONSE

- **NRC questioned the accuracy of the Halitsky method of determining the Main Control Room X/Qs.**
- Response: Halitsky method replaced with the ARCON 96 methodology for greater accuracy
- ARCON 96 methodology results in higher doses for MSLB.

ODSCC/DOSE
NRC QUESTIONS/RESPONSE

- **The Iodine source terms appear to be high by a factor of 21. A factor of 0.38 should be used instead of 7.965.**
- Response: NRC methodology of calculating the factor was provided. Using this example and the correct source terms, the NRC methodology gives the 7.965 factor.
- NRC example used source terms in FSAR table 11.1-2. This table was replaced with Table 11.1-7. (See FSAR Section 11.1.1)

ODSCC/DOSE
NRC QUESTIONS/RESPONSE

- **TVA used 75 gpm letdown flow rate for ANSI/ANS-18.1 adjusted source terms and 120 gpm for production rate. If 120 is used to adjust the activities, the result is an increase in the RCS activity levels to reach an equivalent activity level of @1 uCi/g dose equivalent I-131 and the iodine release rate from the fuel increases---.**

ODSCC/DOSE
NRC QUESTIONS/RESPONSE

- Response: If 120 gpm is used to adjust the ANSI values, the adjusted source terms will be reduced. However, the accident releases are at the Tech spec limit (ANSI scaled up to TS). With the letdown based on 75 gpm, the ANSI values must be increased by a factor of 7.965 to get to the Tech Spec concentrations. If the 120 gpm value were used, then the factor would be more than 7.965 . In either case, the source released is at the TS limit and the same amount of curies are released.

SUMMARY
ODSCC DOSE CALCULATION

Submittal	Pre Accident Iodine Spike	Accident Iodine Spike	Steady state Iodine conc.	X/Q Method	ICRP	Accident Primary to Sec. Leak Rate	MCR Isolation Time	Steam gen. Dry out	Leak Flow	Dose Code Rev
Original	10uCi/gm	NA	1uCi/gm	Halitsky	2	1gpm	14 sec	no	Volume based	COROD R4 FENCDOSE R3
RAI Response	60uCi/gm	500X prod	1uCi/gm	Halitsky	2	15.18 gpm	14 sec	no	Volume based	COROD R5 FENCDOSE R4
Pending RAI Response	21uCi/gm	500X prod	0.265uCi/gm	ARCON 96	2 & 30	1 gpm	20.6 sec	yes	Mass flow based	COROD R5 FENCDOSE R4

ODSCC/DOSE CONCLUSION

- SG ODSCC Alternate Repair Criteria RAI Response August 2001
  - Pressurization Rate During Tube Burst Test Results
  - Inspection Plan for Dented Tube-Support Plate Intersections
  - Dose Calculations Results

ODSCC/DOSE CONCLUSION

- Iodine Concentration Amendment Request in September, 2001
  - TS 3.4.16, RCS Specific Activity
  - Reduces Allowable Dose Equivalent Iodine