NRC Concerns Relating to Steam Generators at Indian Point Unit 2

Public Meeting with ConEd
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Staff Concerns Identified in July 20, 2000 Letter

NRC staff remains concerned about the ability of unplugged tubes with small radius u-bends to satisfy the applicable tube integrity performance (acceptance) criteria for the requested 4 month operating interval.

The staff's concerns stem from its review of the licensee's operational assessment.

Concerns fall into three main areas:

- probability of (flaw) detection assumptions
- flaw size measurement error assumptions
- material property assumptions

The licensee needs to address these concerns before the staff can make a final determination.

The staff requested additional information concerning these issues.

Probability of Detection (POD)

- The assumed POD performance of the high frequency plus-point in the IP-2 u-bends has not been validated.

- Assumed POD performance is based on performance demonstration data for the mid-range plus-point probe at tube dents.

- Staff is concerned that this assumption lacks technical justification and is potentially non-conservative due to differences in tube geometry, surface deposits, and signal to noise ratios.

- The staff believes the results of the licensee's analyses are very sensitive to the assumed POD. Note, POD is used to estimate the number and size of flaws which may remain undetected in tubes which are still in service.

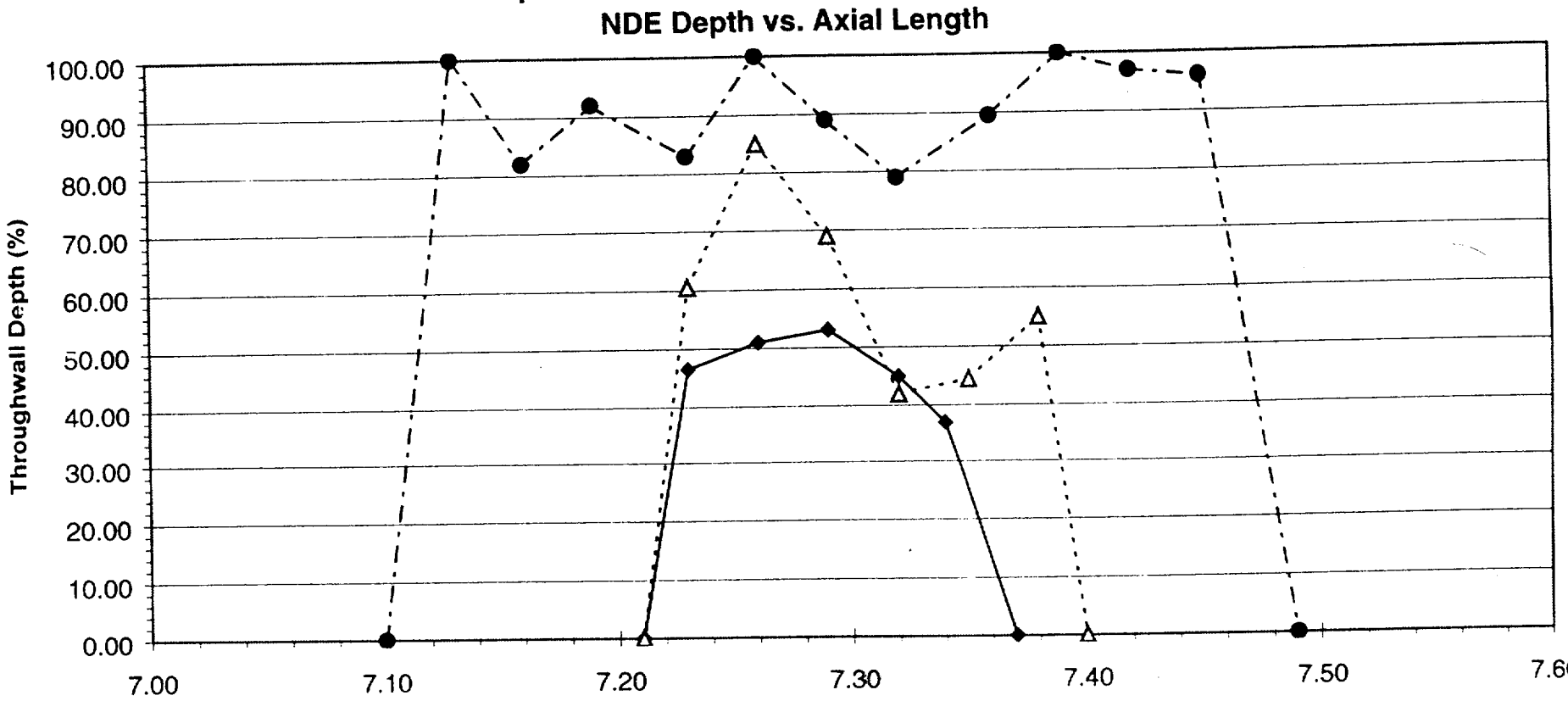
Flaw Size Measurement Error

- The assumed flaw size measurement error distribution associated with use of the mid-range and high frequency plus-point probes in the IP-2 u-bends has not been validated.

- Assumed measurement errors are based on performance demonstration data for the mid-range plus-point probe at tube dents.

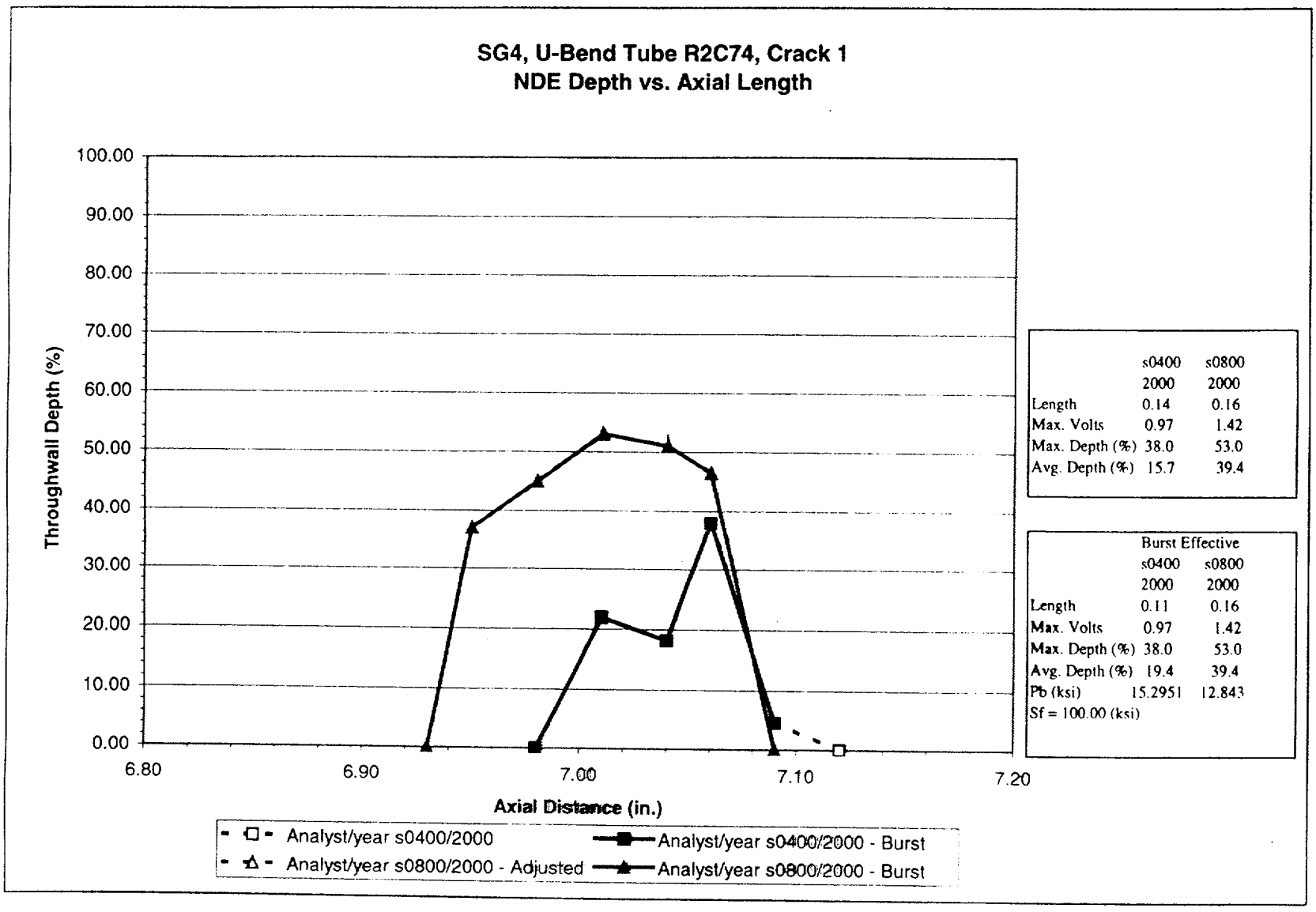
- The staff is concerned that this assumption lacks technical justification and is potentially non-conservative due to differences in tube geometry, surface deposits, and signal to noise ratios.

Figure 8-7
SG 4, U-Bend Tube R2C74, Crack Depth Profiles
Comparison of 800 kHz Pre and Post In Situ Test
NDE Depth vs. Axial Length



	Pre In Situ	Pre In Situ Max. Depth 2000	Post In Situ 2000
Length	0.16	0.19	0.39
Max. Volts	1.42	1.04	2.33
Max. D.(%)	53.0	85.0	100.0
Avg. D.(%)	39.4	53.2	83.1
Cal. Number	00240	00240	00245

Figure C.1-11


SG4, U-Bend Tube R2C74, Crack 1
NDE Depth vs. Axial Length
Throughwall Depth (%)
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
6.80
6.90
7.00
7.10
7.20
Axial Distance (in.)
s0400 2000
s0800 2000
Length 0.14 0.16
Max. Volts 0.97 1.42
Max. Depth (%) 38.0 53.0
Avg. Depth (%) 15.7 39.4
Burst Effective
s0400 2000
s0800 2000
Length 0.11 0.16
Max. Volts 0.97 1.42
Max. Depth (%) 38.0 53.0
Avg. Depth (%) 19.4 39.4
Pb (ksi) 15.2951 12.843
Sf = 100.00 (ksi)
Analyst/year s0400/2000
Analyst/year s0800/2000 - Adjusted
Analyst/year s0400/2000 - Burst
Analyst/year s0800/2000 - Burst

Flaw Size Measurement Error (Cont)

- The above concerns notwithstanding, the staff considers flaw sizing measurements based on the high frequency probe 800 KHz data to be more accurate than those based on the mid-range probe 400 KHz data due to significantly improved signal to noise.
  - Burst pressure estimates based on the 800 KHz flaw size measurements are 18% lower than those based on the 400 KHz measurements. Licensee needs to explain why its analysis appears insensitive to which set of measurements is used.
- The staff believes the results of the licensee's analyses are very sensitive to the assumed measurement error distribution. These distributions are used to estimate the number and size of flaws which may remain undetected in tubes which are still in service.

Table 6-3. Indian Point-2 U-Bend Indications: Comparison of Condition Monitoring Burst and Ligament Tearing Pressures with In Situ Test Results

Indication			NDE Profile Frequency	Burst Pressure Predictions psi		Ligament Tearing Pressure psi		In Situ Test Results	
SG	Tube	Crack No.		95/50	Best Estimate	95/50	Best Estimate	Burst Pressure psi	Initial Leakage Pressure psi
4	R2C69	1	400 kHz	4851	6503	2877	5796	>4834	4834 >2 gpm
		1	800 kHz	3749	5235	0.0	4580		
4	R2C71	1	400 kHz	4486	5799	0.0	5480	>4206	Steady Increase
		1	800 kHz	3823	4828	0.0	4096		
4	R2C72	1	400 kHz	4888	6219	2570	6022	>5140	>5140
		1	800 kHz	4432	5728	0.0	5466		
1	R2C87	1	400 kHz	6888	8838	6498	8835	>5140	>5140
		2		6968	8837	6553	8840		
		1	800 kHz	5680	7828	0.0	7665		
		2		5130	6834	2658	6688		
4	R2C4	1	400 kHz	9017	11314	9078	10664	>5140	>5140
			800 kHz	8879	11059	9041	10650		
4	R2C74	1	400 kHz	9850	12150	9470	11035	>5140 ~6000	4486
			800 kHz	8035	10202	8487	10202		
3	R2C85	1	400 kHz	7456	9578	7580	9422	>5140	>5140
			800 kHz	6827	8846	6945	8862		

Material Properties

- Reference analysis (W) appears based on a best estimate material flow strength adjusted for strain hardening. Flow strength was assumed invariant with the initial non-strain hardened material properties.

- This assumption does not appear to account for the wide variability of this parameter as indicated by the material certification data for non-strain hardened tube material at IP-2.

- Additional justification for the assumption is needed. Alternatively, the operational assessment should be revised to account for the flow strength variability from tube to tube.

- Flow stress is an important input parameter to the licensee's analysis since burst strength is a linear function of flow stress.