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August 4, 2000

Re: Indian Point Unit No. 2
Docket No. 50-247
NL-00-104

Document Control Desk
US Nuclear Regulatory Commission
Mail Station P1-137
Washington, DC 20555-0001

Subject: July 28, 2000 Steam Generator Inspection Meeting – Additional Question Responses

On July 28, 2000, a meeting was held between Con Edison and the NRC to discuss the results of the Condition Monitoring and Operational Assessment Reports (CMOA), which were based upon steam generator inspections performed in the Spring of 2000. At this meeting, an in-depth technical discussion occurred during which additional information was provided to the NRC to assist in their review of the CMOA. With respect to the additional questions identified by the NRC following the meeting, Con Edison hereby provides as an attachment to this letter the requested information.

No new regulatory commitments are being made by Con Edison in this correspondence.

Should you or your staff have any questions regarding this matter, please contact Mr. John F. McCann, Manager, Nuclear Safety and Licensing.

Sincerely,

A. Alan Blind

A001

Attachment

C: Mr. Hubert J. Miller
Regional Administrator-Region I
US Nuclear Regulatory Commission
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Mr. Patrick D. Milano, Senior Project Manager
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ATTACHMENT

Response to Questions Identified During the July 28, 2000 Meeting

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
INDIAN POINT UNIT NO. 2
DOCKET NO. 50-247
AUGUST 2000

July 28, 2000 NRC/Con Edison Meeting

Question: Evaluate the signal noise and signal to noise ratio for the data used with respect to the following:

a. What is the minimum signal detection level, expressed in terms of peak to peak signal voltage and vertical maximum voltage, for row 2 and row3 u-bends.
b. Compare the signal noise and signal to noise ratio for the data used to develop the u-bend POD with the noise and signal to noise ratio for the row 2 and row 3 u-bends.
c. For the database for POD, and for the IP2 u-bend indications, provide a plot that shows crack area vs indication voltage

Response:

Detection of ID Flaws in Indian Point 2 U-bends

1. Detectability Assessment Based on U-bend Noise Level Considerations

NDE analyses for +Point data are based on evaluations of strip chart and C-scan (terrain plots) data. The strip charts include the vertical and horizontal voltage components and the C-scan uses the vertical voltage component. The vertical component of the voltage is the primary basis for +Point detection. For evaluations of noise and signal to noise ratios relative to detectability, the vertical components provide a more direct basis for detectability assessments than peak to peak voltages. This section provides comparisons of noise levels for the Indian Point-2 row 2 and 3 U-bends for the 800 and 400 kHz inspection data. In addition, the noise levels for the high frequency 800 kHz probe are compared to the noise levels in the databases used to develop the POD and NDE sizing data applied in the U-bend CMOAs. The U-bend noise and signal to noise ratio data are then used to assess the magnitude of indications that can be expected to be detected based on adequate signal to noise ratios.

The phase angle range for inner diameter flaws such as PWSCC lies adjacent to the phase response for lift-off associated with probe motion. When the probe motion signals are set at horizontal, the 100% throughwall flaw lies at about 32°; the range between horizontal and 32° encompasses the expected responses for ID flaws < 100% TWD. When the 100% flaw is set at 40°, as applied at Indian Point-2, the probe motion signals are only slightly above horizontal and the vertical response is only slightly increased. The vertical component of the noise signal is ideally nearly zero, enabling detection of flaws by identification of the vertical component.

A summary of the results of the U-bend noise measurements for 28 row 2 and 29 row 3 tubes is given in Table 1-1. A complete listing of the data is given in Table 1-3. The 800 kHz noise signals indicate that the average vertical component of the noise vectors at Indian Point-2 are 0.17 volt in Row 3 and 0.21 volt in Row 2. The range of the noise signals is also given in the table. For 800 kHz, the range of noise vertical maximums ranged from 0.12 to 0.33 volt for row 2 and 0.09 to 0.36 volt for row 3. For a signal to noise ratio (S/N) of 1.5 as a guideline for detection (see discussion below), indications with 800 kHz vertical amplitudes in the range of 0.3 to about 0.45 volt in row 2 and about 0.21 to about 0.3 in row 3 would be expected to be detected. The results show that row 3 detection is enhanced compared to row 2 detection, and that detection of small flaws is significantly improved with the 800 kHz probe compared to the mid-range 400 kHz probe. The 800 kHz vertical amplitudes are a factor of 2 to 3 lower than the

400 kHz data. The horizontal component of the noise signal is larger for the 800 kHz data compared to the 400 kHz data, which leads to larger peak to peak noise signals for the 800 kHz data. These noise measurement results support the inspection results showing significant improvements in detectability with the high frequency probe.

Table 1-1 also includes noise measurement results for tubes included in the databases used to develop the POD and NDE sizing distributions applied in the U-bend CMOA. These data for PWSCC detection are developed at 300 kHz (little difference for 400 kHz) following the qualified +Point detection and sizing technique given in EPRI ETSS 96703. It is seen that the noise levels for the POD and sizing database are comparable to that obtained for the Indian Point U-bends with the high frequency probe. Therefore, large reductions in the POD or increases in NDE sizing uncertainties, such as requested for evaluation in the July 20 RAI Questions 2 to 4, are not appropriate for application of the data to Indian Point-2 evaluations. This comparison supports applicability of the POD distributions for the Indian Point-2 CMOA evaluations. Details of the POD database noise evaluation are given in Section 2

From the noise evaluation at 800 kHz, the source of a signal with a vertical component > ~0.3 to 0.5 volt in row 2 would be attributable to PWSCC (S/N > 1.5) since the vertical component of deposit signals is about 0.2 to 0.3 volt. This contrasts with the behavior of deposits at 400 kHz, where the vertical component is ~ 0.5 volt in row 2 and indications with a vertical component > 0.75 volt could be required for detection. The noise and flaw signal measurements for the U-bend indications are given in Table 1-2. The indications not detected at 400 kHz are shown by an asterisk in Table 1-2. The 400 kHz S/N ratio for these indications range from 1.03 to 1.43, while the 800 kHz ratios are 1.62 to 2.09. The 800 kHz signal vertical amplitudes for these indications are 0.34 to 0.48 and the vertical noise amplitudes are in the range of 0.21 to 0.29. These indications were readily detected with the high frequency probe. Based on this evaluation, the indication data support detection in row 2 for indications with vertical amplitudes in the range of 0.3 to 0.5 volt (resulting in S/N ratios > 1.5), dependent upon local noise conditions. These indications are seen to have 400 kHz peak to peak amplitudes as low as 0.9 volt. Indications above 1 volt peak to peak are expected to be detected in row 2. For row 3, detectability should be moderately improved (detect voltages lower by 0.1 to 0.2 volt) over row 2 due to the lower vertical amplitude of the noise signals and indications above 0.9 volt peak to peak are expected to be detected.

As noted in the response to the July 20 RAI Question 5, the indications found at R2C71, R2C72 and R2C69 have the most influence on the operating cycle length evaluation after applying the POD adjustment for potential undetected indications. From Table 1-2, the R2C72 and R2C69 indications have 400 kHz peak to peak S/N ratios of 5.64 and 1.84, respectively, and R2C71 is about 2.85. With these S/N ratios, the NDE sizing for the R2C72 indication can be expected to be very reliable, and the R2C69 and R2C71 S/N provide reasonable assurance of sufficiently accurate sizing. Thus, application of large NDE uncertainties for these indications (July 20 RAI Question 4) is not appropriate.

The following conclusions are developed from this evaluation:

- Detection in row 2 with the 800 kHz probe can be expected for indications with vertical amplitudes above about 0.3 to 0.5 volt (range dependent upon local noise levels) and peak to peak voltages > 1.0 volt, which would have vertical amplitude S/N ratios > 1.5. The moderately smaller noise levels in row 3 should result in a modest improvement for detectability vertical amplitudes at about 0.2 to 0.3 volt and peak to peak voltages > 0.9 volt.

- The vertical amplitude for the row 3 noise level has a range of about 0.09 to 0.36 volt with an average of 0.14 volt. These low noise levels support detection of low level indications in row 3.
- The row 3 indications with low vertical amplitudes that might have less than about 0.3 volt vertical amplitude can be expected to be relatively shallow due to the small phase angles. The detected data for the low voltage row 2 indications also indicates that any indications undetected due to the noise levels would also be short.
- The noise level +Point vertical amplitudes for the databases supporting the POD and NDE sizing uncertainties have average values of about 0.2 volt at the plate edge and 0.13 volt at the plate center, which equates to the noise level of 0.17 volts for the high frequency +Point probe used for the Indian Point-2 inspection. The very similar noise levels support application of the POD and sizing uncertainties for the operational assessments without additional conservatisms applied to the POD and sizing uncertainties.

2. Assessment of Noise Levels and Signal to Noise Ratios for the POD Database

Noise levels and signal to noise (S/N) ratios were evaluated for the database used to develop the POD applied to the IP2 U-bends in order to provide comparisons with the IP2 data of Tables 1-1 and 1-2. The POD database was developed for PWSCC at axial dents (denting of tube against a flat plate), and applied to define a lower bound database for 800 kHz detection in row 3 U-bends. The noise levels for these data are dependent on the location within the plate with the noise levels higher at the edge of the plate than near the center of the plate. The maximum vertical component of the noise signal is then generally at the edge of the plate. Flaws may be located near the center or edge of the plate, and the appropriate noise level to define the S/N ratio would be the noise level closest to the flaw. Noise levels and S/N ratios are defined for both noise locations.

The results of the noise and S/N evaluations are given in Table 2-1. Table 2-1 also includes the fraction detected from blind testing of four NDE analysts against the database. Destructive exam results for the specimens are also included in the table. A comparison with the row 3 U-bend data of Table 1-1 shows that the average vertical amplitude noise levels at the plate center are close to the row 3 averages (0.13 versus 0.17) and noise levels at the plate edges are higher than the row 3 values (average of 0.20 versus 0.17). Thus the vertical amplitudes of the noise signals for the POD database are in very good agreement with the 800 kHz row 3 U-bend noise levels.

Table 2-1 also includes the S/N ratios for the POD database. For indications not detected by at least one of the four analysts (i.e., analyst fraction detected ≤ ¾), the S/N based on noise levels at the center of the plate are in the range of 0.60 to 1.44 with the exception of one S/N ratio of about 2.1. The S/N values are even lower when assessed relative to the edge noise levels. From Table 1-2, the S/N ratios for U-bend indications not detected with the 400 kHz probe ranged from 1.03 to 1.43. Thus the undetected S/N ratios for the POD database are also in good agreement with the row 2 U-bend indications not reported for the 400 kHz inspection.

3. Assessment Based on Trends of +Point Voltage with Crack Depth

In the July 7 supplemental CMOA, the U-bend trends of +Point voltage with crack depth were evaluated based on a assumed one volt indication that may not have been detected. The above noise evaluation supports an upper limit of one volt as an indication potentially masked by noise in row 3. Based on the

year 2000 inspection results, the indications near one volt were found to be short (< 0.3 inch) with average depths less than about 45% and maximum depths < 60%. This is consistent, although conservative, with the above noise evaluation indicating that potential undetected indications in row 3 would have vertical amplitudes less than about 0.45 volt (S/N ratios < 1.5) since low vertical amplitudes correspond to small phase angles with associated shallow depths. It is further shown in the supplemental CMOA that these short indications, if assumed to be left in service, would result in acceptable burst pressures after more than one year of operation, since the length would satisfy burst margins even if assumed to be throughwall. It is also shown in the supplemental CMOA that leakage would not occur at 0.85 EFPY even if the BOC indication were assumed to be 75% deep. Consequently, potentially undetected indications, if any, would not challenge structural or leakage integrity over the operating cycle for Indian Point-2 set forth in the June 2nd CMOA.

4. Indication Voltage vs. Crack Area

Figure 1 provides the requested plot of indication voltage vs. crack area for the indications included in the POD database, and for the indication in the Indian Point-2 u-bends from both the 1997 data and 2000 data. The voltage shown is the peak voltage of the indication, and the crack area is expressed in %-in., based on the burst effective crack length and average depth. All indication for Indian Point 2 have been included, although the sizing data for R2C74 and R2C5 are considered less reliable than that for the other indications. The values for the POD database compare very well with the values for the IP-2 indications.

Table 1-1. Noise Measurements – IP2 U-Bends, POD Database and NDE Sizing Database

Parameter	800 kHz Vertical Volts	800 kHz Peak to Peak	400 kHz Vertical Volts	400 kHz Peak to Peak
Row 3 Average	0.17	1.07	0.37	0.65
Row 3 Range	0.09-0.36	0.37 - 1.37	0.25 - 0.56	0.41 - 1.2
Row 2 Average	0.21	1.03	0.45	0.60
Row 2 Range	0.12 - 0.33	0.35 - 1.32	0.12 - 0.66	0.29 - 1.09
	300 kHz Vertical	**300 kHz Peak to Peak**		
POD Database[(1)]				
• Near plate center	0.13	0.43		
• Near plate edge	0.20	0.67		
NDE Sizing Database[(2)]	0.18	0.29		

Notes:
1. Detection data for PWSCC in axial dents
2. Sizing data for PWSCC at dented TSP intersections

Table 1-2. Indian Point-2 U-bend Noise and Signal to Noise Ratio Measurements[1]												
Tube	Noise Signal Measurements				Flaw Signal Measurements				Signal to Noise Ratio			
	800 kHz Vertical	800 kHz p-p	400 kHz Vertical	400 kHz p-p	800 kHz Vertical	800 kHz p-p	400 kHz Vertical	400 kHz p-p	800 kHz Vertical	800 kHz p-p	400 kHz Vertical	400 kHz p-p
2/71	0.22	0.79	0.40	0.89	1.00	2.25	1.14	2.2	4.55	2.85	2.85	2.47
2/72	0.33	0.52	0.28	0.32	1.62	3.58	1.58	3.09	4.91	6.88	5.64	9.66
2/69	0.22	1.22	0.62	0.7	1.59	4.37	1.14	3.59	7.23	3.58	1.84	5.13
2/87	0.27	0.90	0.57	0.92	1.30	2.89	1.08	2.54	4.81	3.21	1.89	2.76
2/4	0.29	0.44	0.31	0.57	0.48	0.99	0.41*	0.86*	1.66	2.25	1.32*	1.51*
2/74	0.21	1.12	0.26	0.67	0.34	1.42	0.31*	0.97*	1.62	1.27	1.19*	1.45*
2/85	0.23	0.73	0.30	0.52	0.48	1.41	0.31*	1.20*	2.09	1.93	1.03*	2.31*
2/5			0.84	1.14			1.20*	2.47*			1.43*	2.17*

*Indications initially detected by high-frequency probe. Classified as bad data for mid-range probe.

1. Voltage measurements by separate analysis and differ by up to about 10% from depth profiling values in U-bend CMOA.

Table 1-3. IP2 U-bend +Point Noise and Signal to Noise Data															
			+Point Noise Measurements				Flaw + Noise Signal Measurements				Signal to Noise Ratio			
			800 kHz		400 kHz		800 kHz		400 kHz		800 kHz		400 kHz	
SG	ROW	COL	Vertical Volts	Peak to Peak Volts	Vertical Volts	Peak to Peak Volts	Vertical Volts	Peak to Peak Volts	Vertical Volts	Peak to Peak Volts	Vertical Volts	Peak to Peak Volts	Vertical Volts	Peak to Peak Volts
21	2	87	0.27	0.9	0.57	0.92	1.3	2.89	1.08	2.54	4.81	3.21	1.89	2.76
21	2	87					1.22	2.97	1.24	2.73				
21	2	87					1.21	2.83	1.12	2.63				
23	2	85	0.23	0.73	0.3	0.52	0.48	1.41	0.31	1.2	2.09	1.93	1.03	2.31
24	2	4	0.29	0.44	0.31	0.57	0.48	0.99	0.41	0.86	1.66	2.25	1.32	1.51
24	2	5							1.2	2.47				
24	2	69	0.22	1.22	0.62	0.7	1.59	4.37	1.14	3.59	7.23	3.58	1.84	5.13
24	2	69					0.46	0.95	0.46	1.24				
24	2	69					0.59	1.07	0.36	0.89				
24	2	71	0.22	0.79	0.4	0.89	1	2.25	1.14	2.2	4.55	2.85	2.85	2.47
24	2	72	0.33	0.52	0.28	0.32	1.62	3.58	1.58	3.09	4.91	6.88	5.64	9.66
24	2	74	0.21	1.02	0.26	0.67	0.34	0.68	0.31	0.51	1.62	0.67	1.19	0.76
21	2	2	0.19	1.12	0.49	0.49								
21	2	5	0.26	1.02	0.58	0.61								
21	2	6	0.27	1.32	0.66	0.72								
21	2	10	0.2	1.13	0.65	0.65								
21	2	12	0.16	1.03	0.5	0.51								
21	2	16	0.25	1.09	0.6	1.09								
21	2	17	0.19	0.79	0.44	0.54								
21	2	19	0.21	0.96	0.3	0.5								
21	2	20	0.23	0.73	0.37	0.4								
21	2	21	0.21	0.9	0.33	0.54								
21	2	35	0.2	0.67	0.27	0.33								
21	2	36	0.14	1.28	0.49	0.61								
21	2	37	0.12	1.28	0.46	0.57								
21	2	38	0.12	1.31	0.49	0.59								
21	2	43	0.19	1.24	0.52	0.58								
21	2	44	0.18	1.02	0.43	0.46								
21	2	45	0.17	1.32	0.39	0.66								
21	2	46	0.16	1.16	0.36	0.45								
21	2	48	0.21	1.22	0.48	0.61								
21	2	50	0.25	1.31	0.53	0.65								
21	2	52	0.23	1.31	0.58	0.63								
21	3	9	0.14	0.74	0.25	0.44								
21	3	10	0.14	0.9	0.32	0.5								
21	3	11	0.09	0.86	0.39	0.48								
21	3	12	0.21	0.98	0.37	0.46								
21	3	35	0.11	0.8	0.35	0.41								
21	3	36	0.12	0.98	0.4	0.44								
21	3	37	0.11	0.91	0.33	0.47								
21	3	39	0.1	1	0.36	0.41								
21	3	41	0.09	0.99	0.34	0.45								
21	3	42	0.15	1.19	0.38	0.62								
21	3	43	0.12	1.12	0.31	0.48								
21	3	44	0.1	1.19	0.25	0.51								
21	3	45	0.15	1.36	0.37	0.61								
21	3	46	0.13	1.23	0.35	0.47								
21	3	47	0.15	1.28	0.39	0.64								
21	3	48	0.18	1.31	0.43	0.77								
21	3	49	0.14	1.16	0.33	0.55								
21	3	50	0.19	1.2	0.49	0.64								
21	3	51	0.14	1.27	0.33	0.53								
21	3	52	0.14	1.3	0.52	0.54								
21	3	53	0.15	1.29	0.49	0.91								
23	3	85	0.17	0.37	0.25	0.42								
23	3	85	0.18	0.37	0.3	0.56								
24	3	4	0.27	1.32	0.29	1								
24	3	5	0.25	1.37	0.36	1.08								
24	3	69	0.34	0.73	0.56	1.08								
24	3	71	0.28	1.22	0.38	1.13								
24	3	72	0.36	1.25	0.33	1.2								
24	3	74	0.23	1.26	0.38	1.14								

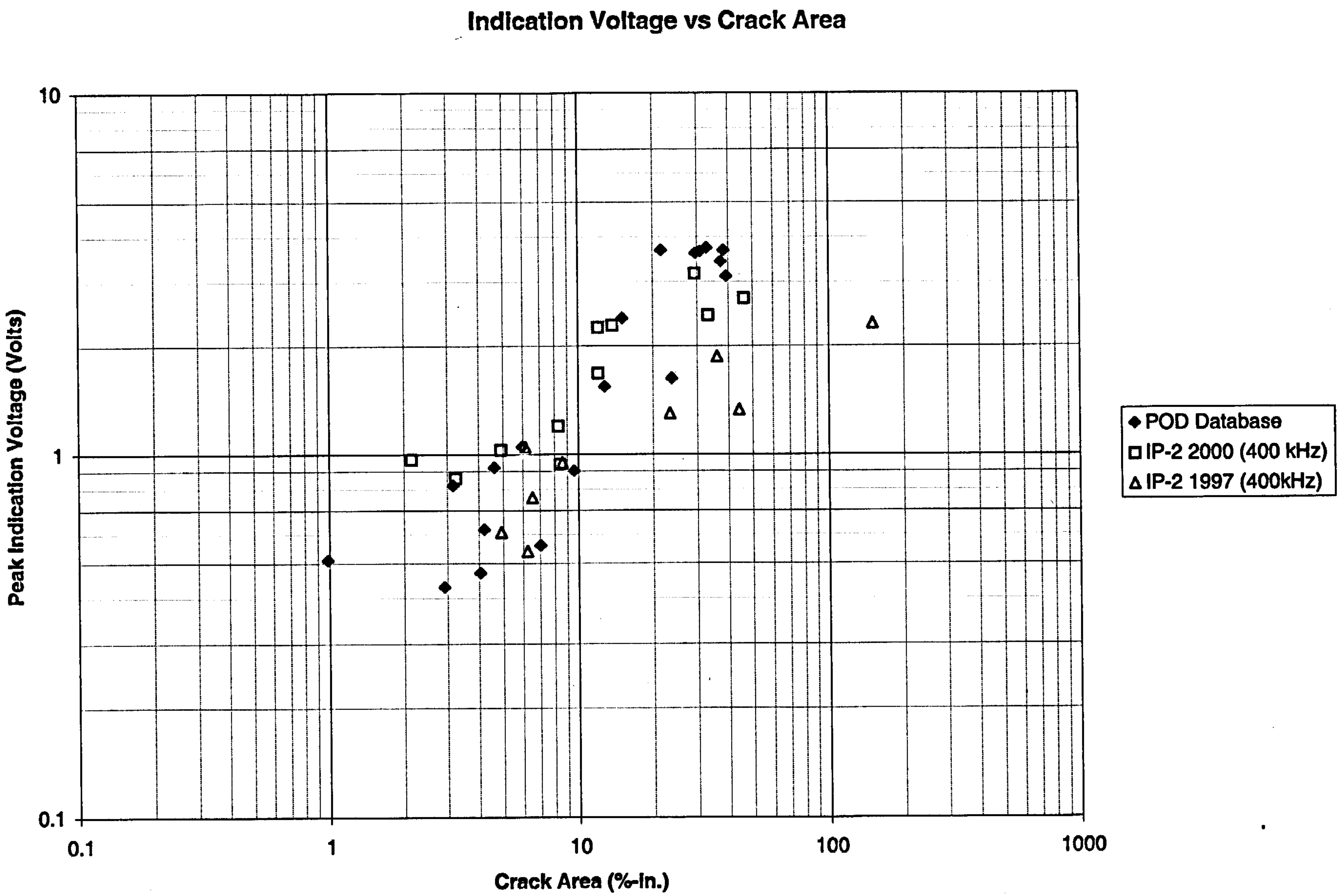
Table 1-3. IP2 U-bend +Point Noise and Signal to Noise Data (continued)

	+Point Noise Measurements				Flaw + Noise Signal Measurements							
	800 kHz		400 kHz		800 kHz		400 kHz					
	Vertical Volts	Peak to Peak Volts	Vertical Volts	Peak to Peak Volts	Vertical Volts	Peak to Peak Volts	Vertical Volts	Peak to Peak Volts				
Row 3 Ave. Vmax	0.17	1.07	0.37	0.65								
Row 3 Std. Dev.	0.07	0.27	0.08	0.26								
Row 3 Range	0.09-0.36	0.37 - 1.37	0.25 - 0.56	0.41 - 1.2								
Row 2 Ave. Vmax	0.21	1.03	0.45	0.60	0.94	2.18	0.86	2.00				
Row 2 Std. Dev.	0.05	0.25	0.12	0.17								
Row 2 Range	0.12 - 0.33	0.35 - 1.32	0.12 - 0.66	0.29 - 1.09								

Table 2-1. Noise and Signal to Noise Data for Database Applied for IP2 U-bend POD

			Destructive Exam Data						+Point 600 mil Mid-Range Probe, 300 kHz, 0.4 ips											
									Noise-Plate Center		Noise-Plate Edge		Flaw plus Noise		Signal/Noise-Center		Signal/Noise-Edge			
Row	Col	Dent Volts	Length	Coil Avg. Max. Depth	Avg. Depth	Burst Eff. Length	Burst Eff. Avg. Depth	Burst Eff. Crack Area	Vertical Volts	Peak to Peak Volts	Vertical Volts	Peak to Peak Volts	Vertical Volts	Peak to Peak Volts	Vertical Volts	Peak to Peak Volts	Vertical Volts	Peak to Peak Volts	Analyst Fraction Detected	Flaw Loca-tion
S909	C44-1H	3.19	0.030	32.8%	32.8%	0.030	32.8%	0.010	0.12	0.56	0.21	0.29	0.14	0.51	1.17	0.91	0.67	1.76	1/4	edge
S805	C13-2H	3.24	0.877	33.0%	27.4%	0.817	27.9%	0.228	0.11	0.29	0.20	0.56	NDD						0/4	
S927	C63-1H	---	0.112	39.5%	36.1%	0.112	36.1%	0.040	0.13	0.16	0.16	0.42	0.16	0.47	1.23	2.94	1.00	1.12	3/4	
S916	C17-1H	4.24	0.300	40.5%	24.0%	0.120	34.9%	0.042	0.13	0.38	0.23	0.85	0.14	0.62	1.08	1.63	0.61	0.73	3/4	center
S816	C19-1H	5.57	0.197	42.3%	23.4%	0.197	23.4%	0.046	0.10	0.25	0.19	0.70	0.21	0.92	2.10	3.68	1.11	1.31	1/4	
S804	C21-2H	4.02	0.170	45.7%	35.1%	0.170	35.1%	0.060	0.10	0.30	0.22	0.94	0.35	1.05	3.50	3.50	1.59	1.12	4/4	edge
S811	C15-1H	2.53	0.066	48.3%	48.3%	0.052	55.9%	0.029	0.09	0.30	0.17	0.58	0.13	0.43	1.44	1.43	0.76	0.74	2/4	
3	SCE507-2H	4.46	0.068	48.7%	48.7%	0.059	53.6%	0.032	0.15	0.44	0.19	0.70	0.15	0.82	1.00	1.86	0.79	1.17	2/4	
S909	C24-2H	3.61	0.213	52.1%	45.4%	0.210	45.6%	0.096	0.16	0.37	0.21	0.44	0.16	0.90	1.00	2.43	0.76	2.05	2/4	edge
S816	C18-2H	4.40	0.138	59.4%	50.9%	0.138	50.9%	0.070	0.15	0.39	0.25	0.73	0.09	0.56	0.60	1.44	0.36	0.77	3/4	edge,center
S927	C62-2H	1.25	0.483	73.9%	60.4%	0.350	67.6%	0.237	0.11	0.22	0.18	0.41	0.57	1.62	5.18	7.36	3.17	3.95	4/4	
S913	SCE535-2H	5.12	0.790	74.7%	62.4%	0.550	71.3%	0.392	0.09	0.35	0.12	0.36	1.07	3.11	11.89	8.89	8.92	8.64	4/4	
S912	SCE537-2H	4.4	0.519	76.1%	50.7%	0.230	65.4%	0.150	0.12	0.32	0.15	0.51	0.74	2.38	6.17	7.44	4.93	4.67	4/4	
S924	SCE539-2H	3.71	0.198	76.2%	64.3%	0.198	64.3%	0.127	0.08	0.22	0.15	0.44	0.43	1.54	2.87	3.50	2.87	3.50	4/4	
2	SCE504-1H	5.77	0.447	80.5%	59.8%	0.310	69.5%	0.215	0.19	0.39	0.16	0.24	1.08	3.67	6.75	15.29	6.75	15.29	4/4	center
2	SCE503-2H	5.76	0.600	81.0%	71.8%	0.510	75.1%	0.383	0.16	0.35	0.21	0.47	1.34	3.67	6.38	7.81	6.38	7.81	4/4	
S921	SCE531-2H	3.99	0.600	83.7%	74.4%	0.470	79.4%	0.373	0.09	0.27	0.17	0.32	1.48	3.42	8.71	10.69	8.71	10.69	4/4	
S812	SCE528-1H	5.07	0.543	84.6%	69.9%	0.400	77.1%	0.308	0.10	0.50	0.20	0.40	1.20	3.64	6.00	9.10	6.00	9.10	4/4	center
S920	SCE530-1H	4.24	0.575	86.5%	72.2%	0.410	79.9%	0.328	0.18	0.33	0.14	0.43	1.31	3.73	9.36	8.67	9.36	8.67	4/4	
94	32	---	0.765	86.9%	55.1%	0.365	80.9%	0.295	0.21	0.47	0.23	0.32	1.20	3.60	5.22	11.25	5.22	11.25	4/4	
3	SCE506-1H	3.53	NDD						0.10	0.38	0.26	0.71							1/3	
S801	C10-1H	---	NDD						0.15	0.51	0.23	0.87							0/4	
S802	C11-1H	---	NDD						0.19	0.82	0.25	1.26							0/4	
S902	C11-1H	4.91	NDD						0.20	0.71	0.30	0.86							0/4	
S905	C12-1H	2.09	NDD						0.15	0.20	0.16	0.59							0/4	
S924	SCE540-1H	4.17	NDD						0.13	0.55	0.16	0.68							0/4	
S810	C14-2H	4.13	NDD						0.12	0.54	0.20	0.74							0/4	
S811	C14-2H	1.93	NDD						0.11	0.28	0.19	0.51							0/4	
S910	C14-2H	4.63	NDD						0.20	0.53	0.22	0.81							0/4	
S910	C15-1H	6.12	NDD						0.17	0.64	0.13	0.55							0/4	
S914	C16-2H	1.26	NDD						0.10	0.23	0.17	0.53							0/4	
S914	C17-1H	1.27	NDD						0.13	0.28	0.21	0.49							0/4	
S916	C16-2H	4.26	NDD						0.13	0.56	0.21	0.70							0/4	
S917	C16-2H	1.24	NDD						0.12	0.56	0.21	0.82							0/4	
S917	C17-1H	1.42	NDD						0.10	0.25	0.19	0.59							0/4	
S807	C45-2H	4.19	NDD						0.15	0.74	0.26	1.06							1/4	
S807	C25-1H	5.67	NDD						0.17	0.86	0.21	0.89							0/4	
S805	C12-1H		NDD-no DE						0.12	0.28	0.20	0.51								
							Average		0.13	0.42	0.20	0.61								
							Std. Dev.		0.04	0.18	0.04	0.23								
							Range		.09 -.20	.16 - .74	.13 - .26	.29 - 1.26								

Figure 1



Indication Voltage vs Crack Area
10
1
0.1
0.1
1
10
100
1000
Peak Indication Voltage (Volts)
Crack Area (%-in.)
POD Database
IP-2 2000 (400 kHz)
IP-2 1997 (400kHz)