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PG&E Letter DCL-04-158

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Docket No. 50-323, OL-DPR-82
Diablo Canyon Unit 2
Supplement to Relaxation Request for NRC Issuance of First Revised Order (EA-03-009) Establishing Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactors

Dear Commissioners and Staff:

On February 11, 2003, the NRC issued Order EA-03-009 for interim inspection requirements for reactor pressure vessel heads at pressurized water reactor facilities. On February 20, 2004, the NRC issued the First Revised Order EA-03-009, which superseded Order EA-03-009. Revision 1 of the Order modified the requirements regarding nondestructive examination of the penetration nozzles.

PG&E provided responses consenting to the Order and Revision 1 of the Order in PG&E Letter DCL-03-022, "Twenty-Day Response to NRC Order Modifying Licenses (EA-03-009)," dated February 28, 2003, and PG&E Letter DCL-04-021, "Twenty-Day Response to First Revision of NRC Order Modifying Licenses (EA-03-009)," dated March 11, 2004, respectively.

As discussed with the NRC staff on October 6, 2004, PG&E anticipated that it would need relaxation from the requirements for nondestructive examination of the penetration nozzles below the J-groove weld for which PG&E could not obtain coverage as specified in the Order. PG&E Letter DCL-04-146, "Relaxation Request for NRC Issuance of First Revised Order (EA-03-009) Establishing Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactors," dated October 26, 2004, transmitted PG&E's request for relaxation of the Order requirements for Unit 2 of the Diablo Canyon Power Plant. During subsequent discussions, the NRC staff requested that PG&E provide the completed inspection scope and the bases for why the growth rates for the five nozzle angles provided in PG&E Letter DCL-04-146 are bounding for the remaining nozzle angles.

Unit 2 refueling outage twelve (2R12) began on October 25, 2004. The reactor head penetration volumetric examination has been completed. Enclosure 1

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provides the results of the examination, defines the scope of the relaxation needed, provides the basis for why the growth rates for the five nozzle angles are bounding, and provides analytical results that justify the acceptability of continued operation of Unit 2 for an additional cycle. PG&E will provide additional data at a later date to support a relaxation request for subsequent Unit 2 operating cycles.

In order to support restart from 2R12, PG&E requests that the NRC review and approve the associated relaxation request by November 25, 2004.

If you have any questions or require additional information, please contact Stan Ketelsen at (805) 545-4720.

Sincerely,

James R. Becker
Vice President – Operations and Station Director

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Supplement to Relaxation Request from NRC Order EA-03-009, Section IV, Paragraph C.(5)(b)(i), Diablo Canyon Power Plant (DCPP) Unit 2

Enclosure 1 provides the results of the examination, defines the scope of the relaxation needed, provides the basis for why the growth rates for the five nozzle angles provided in PG&E Letter DCL-04-016, "Relaxation Request for NRC Issuance of First Revised Order (EA-03-009) Establishing Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactors," dated October 26, 2004, are bounding, and provides analysis results that justify the acceptability of continued operation of Unit 2 for an additional cycle with no leakage from the reactor vessel head.

Extent of Coverage:

Table 1 of this enclosure shows the extent of coverage achieved during the DCPP Unit 2 refueling outage twelve (2R12) volumetric inspections. The inspection coverage above the J-groove satisfies the Order requirements for all penetrations. The inspection coverage below the J-groove weld on the uphill side also satisfies the inspection requirements for all penetrations. The inspection coverage below the J-groove weld on the downhill side of the penetrations was achieved for several of the penetration tubes with the open housing tool; however, the coverage specified in the Order could not be achieved on a majority of the penetrations. The coverage required by the Order was not achievable for penetrations 2-9, 14-17, 22-23, 25-61, 64, 66-74, and 76-78.

The Alloy 600 tubing base metal immediately adjacent to the weld area was completely inspected in all penetration tubes. In addition, the area above the weld was inspected to determine if there were leakage paths present in the interference fit between the tube and the carbon steel head. In all cases, there were no indication of detectable discontinuities noted.

The tube area below the weld is not part of the pressure boundary; however, if any flaws are present, they could potentially propagate into the weld material, eventually causing a leakage path through the reactor coolant pressure boundary. The examination limitations herein described apply to the non-pressure retaining tube areas below the weld.

Coverage Acceptability Analyses:

To demonstrate the acceptability of the inspection coverage achieved, a flaw was postulated to exist immediately below the lowest extent covered on the downhill side of each penetration tube. A measurement tolerance of ± 0.04 inches was included in all flaw evaluations. For the downhill side of the welds, the 0.04-inch tolerance was conservatively subtracted from the measured lower inspection coverage.

The postulated flaws were then compared to flaw growth curves in WCAP-15429-P, previously provided in PG&E Letter DCL-04-146, "Relaxation Request for NRC Issuance of First Revised Order (EA-03-009) Establishing Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactors," dated October 26, 2004.

This postulated flaw at the lower extent of coverage (accounting conservatively for the measurement tolerance) was located on the flaw growth curve associated with the penetration angle. For those penetrations that did not have a curve specific to the tube angle, a conservative curve (nearest lower angle), as demonstrated below, was used. The time it would take for that the postulated flaws to grow to intersect the weld metal for the minimum coverage achieved was then determined. The result is provided in Table 1.

While the flaw growth rate for 82/182 weld metal is greater than the alloy 600 base materials, there is a finite time associated with flaw growth through the weld to create a through-wall leakage path. Conservatively, no credit is taken for this time in this evaluation.

Crack Growth Analyses:

With the exception of penetrations 35 and 55, the measured coverage was sufficient to provide at least 1.8 effective full power years (EFPY) until the postulated flaws would reach the weld metal. Penetrations 35 and 55 are evaluated separately below. Cycle 13 is designed for an 18-month cycle with a core design of 1.33 EFPY. Therefore the next inspection will be conducted prior to the time that a postulated flaw could grow to intersect the weld. This demonstrates that DCPP Unit 2 can safely operate until the next inspection is performed in Unit 2 refueling outage thirteen (2R13). If there were a flaw as postulated above, it would be detected during the next inspection and corrective actions would be taken.

For penetrations 35 and 55, the minimum time for a flaw in the uninspected area of the tube to grow to the weld material is less than 1.8 EFPY. Penetrations 35 and 55 are 30.2 and 38.6-degree penetrations, respectively. The measured coverage below the weld on both penetrations was 0.31 inches. Using the WCAP flaw growth curve associated with the 26.2-degree angle (nearest lower angle for which a conservative curve was calculated), the time for a postulated flaw, located 0.27 inches below the weld, to propagate to the weld was calculated to be approximately 1.2 EFPY. Westinghouse developed a conservative crack growth curve, assuming that the upper extremity of an axial through-wall flaw is located at 0.27 inches below the weld (conservatively accounting for the measurement uncertainty of ± 0.04 inches), for penetrations 35 and 55, using the stress distribution profile below the weld generated for penetrations with a nozzle angle of a 26.2-degree penetration tube. The resulting crack growth curve, as shown in Figure 1, indicates that it would take a minimum of 1.44 EFPY for any undetected flaw in the region not inspected to reach the bottom of the J-groove weld. This demonstrates that DCPP Unit 2 can safely operate until the next inspection is performed.

The reasons that the 26.2-degree curve is bounding are as follows:

The crack growth result shown in Figure 1 is conservative for both penetrations 35 and 55, as illustrated in Figure 2, by comparing the crack growth curves for axial through-wall flaws generated for penetrations with nozzle angles of 26.2, 44.3, 45.4 and 48.7 degrees. The Figure 2 crack growth curves for penetrations with nozzle angles of 44.3, 45.4 and 48.7 degrees are taken directly from Figures 6-14, 6-15 and 6-16 respectively in WCAP-15429-P, while that for penetrations with a nozzle angle of 26.2 degrees has been regenerated by assuming that the upper crack extremity is located at 0.3 inches below the weld, in order to allow a direct comparison with the other penetration nozzle angles.

The service time required for the upper crack extremity to reach the bottom of the weld is dependent on a combination of various parameters such as the actual hoop stress distribution below the weld (Appendix A of WCAP-15429-P), the location of the upper crack extremity, and the initial assumed flaw size. The methodology, used to generate the crack growth curves, is consistent with that used in the relaxation request submittals for other plants. Selected rows of penetrations were analyzed in order to establish a trend for the crack growth results as a function of radial locations of the penetration nozzles. As can be seen in Figure 2, using the stress distribution profile below the weld for penetrations with a nozzle angle of 26.2 degrees to generate a crack growth curve for penetrations 35 (30.2 degrees) and 55 (38.6 degrees) is conservative. The flaw growth curves show an increasing trend in the time for a postulated flaw to reach the J-groove weld. Thus, it is conservative to use the closest crack growth curve with a lower nozzle angle for the penetrations that do not have a specific angle crack growth curve.

PG&E recommends the relaxation be approved for one operating cycle, until the next scheduled volumetric head inspection is performed in 2R13. PG&E plans to provide penetration angle-specific flaw growth rate curves for penetrations 35 and 55 in support of operating cycles greater than that supported by the conservative 26.2-degree crack growth curves. Additional data will be provided at a later date to support a relaxation request for subsequent Unit 2 operating cycles.

Table 1

Extent of Coverage Achieved during DCPP Unit 2 Volumetric Examination									
Pen #	Tube Angle (degrees)	Probe Type	Penetration Type	Complies w/ Order Reqm'ts?	WCAP Figure # used (bold indicates specific to that angle)	Time for flaw growth to weld * (EFPY)	Lower exam extent (downhill side) @0°	Lower exam extent (uphill side) @180°	Upper exam extent @180°
1	0.0	Trinity	CRDM	Yes	**6-12**	> 5	1.11	1.07	3.52
2	11.4	Trinity	CRDM		6-12	> 5	0.79	1.59	3.28
3	11.4	Trinity	CRDM		6-12	> 5	0.75	1.55	3.64
4	11.4	Trinity	CRDM		6-12	> 5	0.91	1.47	3.56
5	11.4	Trinity	CRDM		6-12	> 5	0.87	1.72	3.72
6	16.2	Trinity	CRDM		6-12	> 5	0.87	2.2	3.4
7	16.2	Trinity	CRDM		6-12	> 5	0.87	2.23	3.28
8	16.2	Trinity	CRDM		6-12	> 5	0.71	2.07	3.16
9	16.2	Trinity	CRDM		6-12	> 5	0.67	1.95	3.48
10	18.2	OHS	Spare Penetration	Yes	6-12	> 5	1.16	2.84	3.64
11	18.2	OHS	Spare Penetration	Yes	6-12	> 5	1.48	2.96	3.84
12	18.2	OHS	Spare Penetration	Yes	6-12	> 5	1.28	3	3.24
13	18.2	OHS	Spare Penetration	Yes	6-12	> 5	1.36	2.88	3.4
14	23.3	Trinity	CRDM		6-12	1.8	0.39	2.59	3.68
15	23.3	Trinity	CRDM		6-12	> 5	0.67	2.63	3.44
16	23.3	Trinity	CRDM		6-12	> 5	0.63	2.47	3.48
17	23.3	Trinity	CRDM		6-12	> 5	0.59	2.51	3.68
18	24.8	OHS	Spare Penetration	Yes	6-12	> 5	1.12	3.44	3.72
19	24.8	OHS	Spare Penetration	Yes	6-12	> 5	1.24	3.56	3.52
20	24.8	OHS	Spare Penetration	Yes	6-12	> 5	1	3.44	3.24
21	24.8	OHS	Spare Penetration	Yes	6-12	> 5	1	3.4	3.6
22	26.2	Trinity	Part Length CRDM		**6-13**	> 5	0.63	2.87	2.8
23	26.2	Trinity	Part Length CRDM		**6-13**	> 5	0.55	2.75	2.44
24	26.2	OHS	Removed P/L CRDM	Yes	**6-13**	> 5	1.12	3.4	3.52
25	26.2	Trinity	Part Length CRDM		**6-13**	> 5	0.71	2.88	2.16
26	26.2	Trinity	Part Length CRDM		**6-13**	> 5	0.63	2.91	2.88
27	26.2	Trinity	Part Length CRDM		**6-13**	> 5	0.63	2.99	2.52
28	26.2	Trinity	Part Length CRDM		**6-13**	> 5	0.67	2.79	2.64
29	26.2	Trinity	Part Length CRDM		**6-13**	2.2	0.43	2.83	2.56
30	30.2	Trinity	CRDM		6-13	> 5	0.71	3.16	3.52
31	30.2	Trinity	CRDM		6-13	2.2	0.43	3.07	3.08
32	30.2	Trinity	CRDM		6-13	2.2	0.43	3.23	3.24

Extent of Coverage Achieved during DCPP Unit 2 Volumetric Examination									
Pen #	Tube Angle (degrees)	Probe Type	Penetration Type	Complies w/ Order Reqm'ts?	WCAP Figure # used (bold indicates specific to that angle)	Time for flaw growth to weld * (EFPY)	Lower exam extent (downhill side) @0°	Lower exam extent (uphill side) @180°	Upper exam extent @180°
33	30.2	Trinity	CRDM		6-13	> 5	0.67	3.35	2.72
34	30.2	Trinity	CRDM		6-13	4.5	0.51	3.27	2.96
35	30.2	Trinity	CRDM		**	1.44	0.31	2.91	3.6
36	30.2	Trinity	CRDM		6-13	3.5	0.47	2.95	3.68
37	30.2	Trinity	CRDM		6-13	> 5	0.55	3.07	3.28
38	33.9	Trinity	CRDM		6-13	2.2	0.43	3.63	3.04
39	33.9	Trinity	CRDM		6-13	4.5	0.51	3.83	2.68
40	33.9	Trinity	CRDM		6-13	4.5	0.51	3.51	3.32
41	33.9	Trinity	CRDM		6-13	> 5	0.59	3.63	3.24
42	35.1	Trinity	CRDM		6-13	2.2	0.43	3.83	2.84
43	35.1	Trinity	CRDM		6-13	> 5	0.55	3.83	2.88
44	35.1	Trinity	CRDM		6-13	> 5	0.75	3.71	3.04
45	35.1	Trinity	CRDM		6-13	> 5	0.67	3.91	2.56
46	35.1	Trinity	CRDM		6-13	> 5	0.75	3.55	3.52
47	35.1	Trinity	CRDM		6-13	2.2	0.43	3.59	3.36
48	35.1	Trinity	CRDM		6-13	3.5	0.47	3.47	2.88
49	35.1	Trinity	CRDM		6-13	> 5	0.55	3.75	2.84
50	36.3	Trinity	CRDM		6-13	> 5	0.63	3.71	2.68
51	36.3	Trinity	CRDM		6-13	4.5	0.51	3.47	3.8
52	36.3	Trinity	CRDM		6-13	3.5	0.47	3.79	3.84
53	36.3	Trinity	CRDM		6-13	2.2	0.43	3.63	3.44
54	38.6	Trinity	CRDM		6-13	4.5	0.51	3.58	3.4
55	38.6	Trinity	CRDM		**	1.44	0.31	3.99	3.72
56	38.6	Trinity	CRDM		6-13	> 5	0.67	3.87	3.88
57	38.6	Trinity	CRDM		6-13	> 5	0.67	4.07	3.44
58	38.6	Trinity	CRDM		6-13	> 5	0.59	4.03	3.52
59	38.6	Trinity	CRDM		6-13	2.0	0.4	3.79	3.48
60	38.6	Trinity	CRDM		6-13	2.2	0.43	3.91	3.32
61	38.6	Trinity	CRDM		6-13	4.5	0.51	4.23	3.32
62	44.3	OHS	Spare Penetration	Yes	**6-14**	> 3.2	1.2	5.4	3.56
63	44.3	OHS	Spare Penetration	Yes	**6-14**	> 3.2	1	5.6	3.44
64	44.3	OHS	Spare Penetration		**6-14**	> 3.2	0.68	5.12	3.72
65	44.3	OHS	Spare Penetration	Yes	**6-14**	> 3.2	1.12	5.6	3.68
66	45.4	Trinity	CRDM		**6-15**	> 3.5	0.59	4.67	3.88

Extent of Coverage Achieved during DCPP Unit 2 Volumetric Examination									
Pen #	Tube Angle (degrees)	Probe Type	Penetration Type	Complies w/ Order Reqm'ts?	WCAP Figure # used (bold indicates specific to that angle)	Time for flaw growth to weld * (EFPY)	Lower exam extent (downhill side) @0°	Lower exam extent (uphill side) @180°	Upper exam extent @180°
67	45.4	Trinity	CRDM		**6-15**	> 3.5	0.47	4.95	3.68
68	45.4	Trinity	CRDM		**6-15**	> 3.5	0.35	4.91	3.6
69	45.4	Trinity	CRDM		**6-15**	> 3.5	0.46	4.91	3.88
70	45.4	Trinity	CRDM		**6-15**	> 3.5	0.55	5.15	3.8
71	45.4	Trinity	CRDM		**6-15**	> 3.5	0.35	4.87	3.8
72	45.4	Trinity	CRDM		**6-15**	> 3.5	0.43	4.83	3.96
73	45.4	Trinity	CRDM		**6-15**	> 3.5	0.35	4.87	3.64
74	48.7	OHS	TC Location		**6-16**	> 4.5	0.76	5.92	3.64
75	48.7	OHS	TC Location	Yes	**6-16**	> 4.5	1.04	6.16	3.44
76	48.7	OHS	TC Location		**6-16**	> 4.5	0.92	6.04	3.4
77	48.7	OHS	TC Location		**6-16**	> 4.5	0.48	6	3.88
78	48.7	OHS	TC Location		**6-16**	> 4.5	0.76	6.16	3

Unit 2 cycle 13 is projected to achieve 1.33 EFPY

* 0.04" tolerance is subtracted from the lower exam extent (downhill side) column when using flaw growth charts

** Figure 1 is used for penetrations 35 and 55

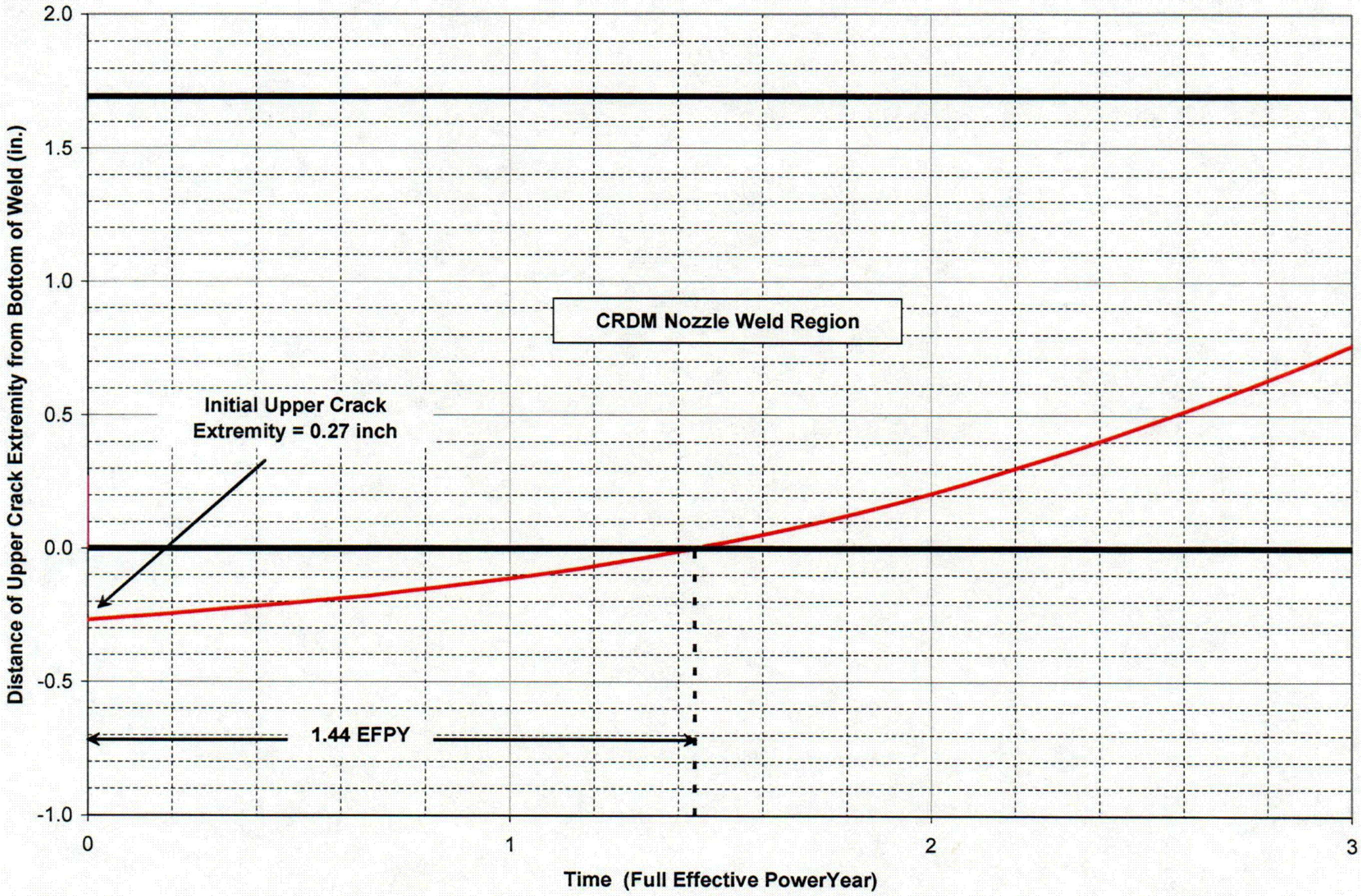

Figure 1 – Boundary Crack Growth Predictions for DCPP Unit 2 Penetrations 35 and 55 (Based on Through-Wall Axial Flaw Analyses for a 26.2 Degree Penetration)

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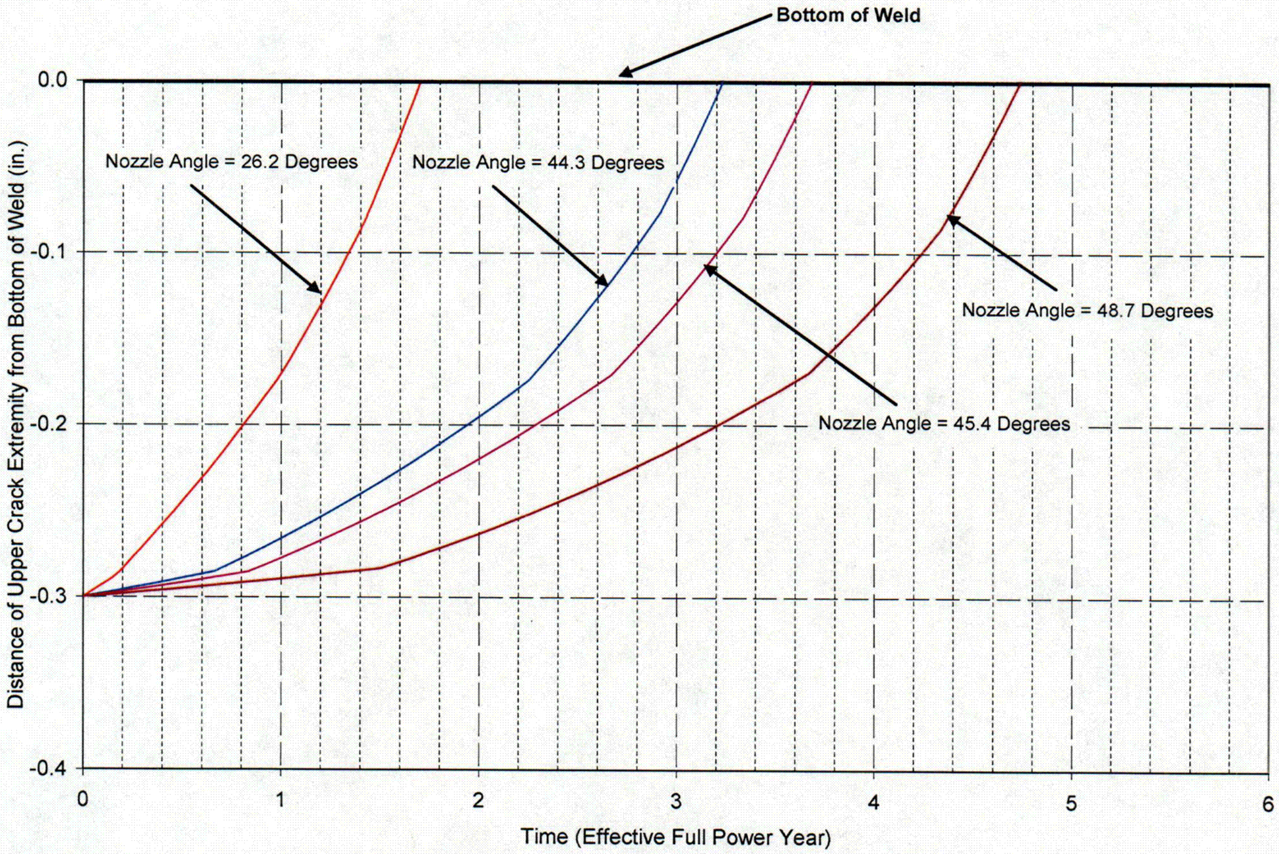

Figure 2 – Comparison of Crack Growth Curves for 26.2, 44.3, 45.4, and 48.7 Degrees (flaw located at 0.3 inches below the J-groove weld, downhill side)

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