WOLF CREEK
NUCLEAR OPERATING CORPORATION

John P. Broschak
Vice President Engineering

July 2, 2012

ET 12-0010

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

Subject: Docket 50-482: 10 CFR 50.55a Request Number I3R-07, Relief from ASME Code Case N-729-1 Requirements for Examination of Reactor Vessel Head Penetration Welds

Gentlemen:

Pursuant to 10 CFR 50.55a(a)(3)(ii), Wolf Creek Nuclear Operating Corporation (WCNOC) hereby requests Nuclear Regulatory Commission (NRC) approval of 10 CFR 50.55a Request Number I3R-07 (attached) for the Third Ten-Year Interval of WCNOC's Inservice Inspection (ISI) Program. The attached 10 CFR 50.55a Request (I3R-07) requests relief from certain ASME Code Case N-729-1 requirements for examination of reactor vessel head penetration welds.

The Code of Federal Regulations 10 CFR 50.55a(g)(6)(ii)(D)(1) requires that examinations of the reactor vessel head be performed in accordance with ASME Code Case N-729-1 subject to conditions specified in paragraphs 10 CFR 50.55a(g)(6)(ii)(D)(2) through (6). The vendor chosen by WCNOC to perform these examinations is unable to meet required examination coverage below the J-groove weld on two control rod drive mechanism (CRDM) penetrations. Both of these CRDM penetrations are configured such that the volumetric examination distance required by N-729-1 cannot be met. The attachment to this letter, 10 CFR 50.55a Request I3R-07, documents the ultrasonic coverage limitations.

An extended forced outage to effect repairs in conjunction with a longer than expected Refueling Outage 18 has resulted in a decision to move the scheduled start dates of Refueling Outages 19 and 20. Therefore, examination of reactor vessel head penetration welds has been moved from Refueling Outage 20 to Refueling Outage 19 to maintain compliance with the required examination frequency. WCNOC requests approval of the attached 10 CFR 50.55a Request I3R-07 by January 14, 2013, to support planning for Refueling Outage 19, which is now scheduled to begin February 4, 2013.

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NRR

There are no commitments contained within this letter. If you have any questions concerning this matter, please contact me at (620) 364-4085, or Mr. Gautam Sen at (620) 364-4175.

Sincerely,

John P. Broschak

JPB/rlt

Attachment: 10 CFR 50.55a Request Number I3R-07

cc: E. E. Collins (NRC), w/a
J. R. Hall (NRC), w/a
N. F. O'Keefe (NRC), w/a
Senior Resident Inspector (NRC), w/a

Wolf Creek Nuclear Operating Corporation
10 CFR 50.55a Request I3R-07
Request for Relief from the Requirements of ASME Code Case N-729-1

10 CFR 50.55a Request I3R-07

Request for Relief from the Requirements of ASME Code Case N-729-1

Proposed Alternative in Accordance with 10 CFR 50.55a(a)(3)(ii) Hardship or Unusual Difficulty Without Compensating Increase in Level of Quality or Safety

1. ASME Code Components Affected

Code Class:	1
Reference:	ASME Code Case N-729-1 / 10 CFR 50.55a(g)(6)(ii)(D)
Item No.:	B4.20
Description:	UNS N06600 Nozzles and UNS N06082 or UNS W86182 Partial-Penetration Welds in Head. Reactor vessel head control rod drive mechanism (CRDM) penetration nozzle base material and J-groove weld that attaches the nozzle base material to the underside of the head for penetration nozzles 77 and 78.

2. Applicable Code Edition and Addenda

ASME Code Section XI, 1998 Edition through 2000 Addenda, as augmented by ASME Code Case N-729-1 (Reference 1), "Alternative Examination Requirements for PWR Reactor Vessel Upper Heads with Nozzles Having Pressure-Retaining Partial-Penetration Welds Section XI, Division 1," as amended by 10 CFR 50.55a(g)(6)(ii)(D).

3. Applicable Code Requirement

10 CFR 50.55a(g)(6)(ii)(D)(1) requires that examinations of the reactor vessel head be performed in accordance with ASME Code Case N-729-1 subject to the conditions specified in paragraphs 10 CFR 50.55a(g)(6)(ii)(D)(2) through (6).

Paragraph -2500 of Code Case N-729-1 states, in part:

> If obstructions or limitations prevent examination of the volume or surface required by Figure 2 for one or more nozzles, the analysis procedure of Appendix I shall be used to demonstrate the adequacy of the examination volume or surface for each such nozzle. If Appendix I is used, the evaluation shall be submitted to the regulatory authority having jurisdiction at the plant site.

Figure 2 in ASME Code Case N-729-1, as referenced by paragraph -2500, requires that the volumetric or surface examination coverage distance below the toe of the J-groove weld (i.e. dimension "a") be 1.5 inches for incidence angle, θ, less than or equal to 30

degrees; 1 inch for incidence angle, θ, greater than 30 degrees; or to the end of the tube, whichever is less. These coverage requirements are applicable to Wolf Creek Generating Station (WCGS) reactor vessel head penetrations as shown in Table 1.

Table 1: WCGS Reactor Vessel Head Penetration Coverage Requirements

Penetration Numbers	Incidence Angle, θ (degrees)	Required Coverage, "a" (inches)
1 to 29	≤ 30	1.5
30 to 78	> 30	1.0

4. Reason for Request

Due to physical configuration of certain reactor vessel head penetration nozzles, full examination volume required by ASME Code Case N-729-1 Table 1 cannot be achieved for reactor vessel head penetration nozzles 77 and 78, therefore, use of Mandatory Appendix I is requested in accordance with 10 CFR 50.55a(g)(6)(ii)(D)(6).

Reactor vessel head CRDM penetrations at WCGS have two styles of ends, referred to as Type "X" and Type "Y" (Figure 1). Penetrations 1 through 73 are Type "Y" that are essentially a smooth wall cylinder with a radius at the outer diameter and inner diameter. Penetrations 74 through 78 have a threaded outside diameter and an internal taper.

The design of reactor vessel head penetration nozzles 74 through 78, referred to as Type "X", (Figure 1) includes a threaded section, approximately 1.19 inch in length at the bottom of the nozzles. These penetrations are located at the 48.7 degree location. The dimensional configuration at this location is such that the distance from the lowest point at the toe of the J-groove weld to the top of the threaded region could be less than the required coverage dimension "a" shown in Figure 2 of ASME Code Case N-729-1. Therefore, deviation from the required inspection coverage is sought for reactor vessel head penetrations 77 and 78, as the required coverage for these two penetrations cannot be obtained.

For the initial examinations of reactor vessel head penetration welds performed in accordance with Reference 6, a similar request was previously submitted for inability to examine the required examination volume (References 3 and 4). This previous request was approved by the NRC in Reference 5.

5. Proposed Alternative and Basis for Use

As an alternative to the volumetric and surface examination coverage requirements shown as dimension "a" in Figure 2 of ASME Code Case N-729-1, WCGS proposes the use of attainable ultrasonic examination distances shown in Table 2. The required examination coverage dimension for the other penetrations will be met or exceeded.

Table 2: WCGS Inspection Coverage Obtained for CRDM Penetrations Having Limited Coverage

Penetration No.	θ (degrees)	N-729-1 Required Exam Coverage (inches)	Inspection Coverage Obtained (inches)
77	48.7	1.0	0.6
78	48.7	1.0	0.88

Appendix I of ASME Code Case N-729-1 provides the analysis procedure for evaluation of an alternative examination area or volume to that specified in Figure 2 of Code Case N-729-1 if impediments prevent examination of the complete zone. Section I-1000 of ASME Code Case N-729-1 requires, for alternative examination zones below the J-groove weld, that analyses shall be performed using at least the stress analysis method (Section I-2000) or the deterministic fracture mechanics analysis method (Section I-3000) to demonstrate that the applicable criteria are satisfied. The techniques described in Section I-2000 were validated in WCAP-16589-P (Reference 2). Although not required, the deterministic fracture mechanics analysis described in Section I-3000 was also validated in Reference 2. This analysis does not fully meet the requirements stated in I-3200(a) Method 1 in that Reference 2 used the crack growth formula in the Electric Power Research Institute (EPRI) report, "Materials Reliability Program (MRP) Crack Growth Rates for Evaluating Primary Stress Corrosion Cracking (PWSCC) of Thick Wall Alloy 600Material (MRP-55), Revision 1."

5.1 Stress Analysis in Accordance with ASME Code Case N-729-1 Section I-2000

Section I-2000 of ASME Code Case N-729-1 requires that plant-specific analysis demonstrate that the hoop and axial stresses remain below 20 kips per square inch (ksi) (tensile) over the entire region outside the alternative examination zone but within the examination zone defined in Figure 2 of the Code Case.

The distance below the J-groove weld that requires examination, as determined by the point at which the CRDM penetration hoop stress distribution for the operating stress levels is less than 20 (ksi) tension, was obtained from Appendix A of Reference 2. Note that hoop stresses during steady state operation are much greater than the axial stresses.

The hoop stress distribution plots for penetrations 77 and 78 are provided in Figure 2 of this submittal. The hoop stress distribution plots in Figure 2 indicate that the minimum achievable inspection coverage below the bottom of the J-groove weld insures stresses remain below 20 ksi tensile over the entire region outside the alternative examination zone but within the examination zone defined in Figure 2 of ASME Code Case N-729-1. The hoop stress distribution plots display the downhill side as this is more limiting. Also, stress distribution plots shown are for the inside and outside surface. Table 3 summarizes the distance from below the toe of the downhill side J-groove weld to where both the inside and outside surface hoop stress drops below 20 ksi for penetrations 77 and 78.

Table 3: Distance Below Toe of Downhill Side J-Groove Weld Where Hoop Stress is Less Than 20 KSI

Penetration Nozzle No.	Source	Distance Below Toe of Downhill Side J-Groove Weld Where Hoop Stress < 20 ksi (inch)
77 and 78	Figure 2	0.30

5.2 Deterministic Fracture Mechanics Analysis in Accordance with ASME Code Case N-729-1 Section I-3200, Method 1

A fracture mechanics analysis was performed and documented in Reference 2. As previously stated, this analysis is not required and does not fully meet the requirements stated in I-3200(a) Method 1 because the analysis used the crack growth formula in EPRI MRP-55. The analysis does demonstrate that a potential axial crack in the unexamined zone will not grow to the toe of the J-groove weld prior to the examination frequency specified in Table 1 of ASME Code Case N-729-1.

The fracture mechanics analysis was performed using input from the previously discussed stress analysis. The results of the analysis are shown as flaw tolerance charts, which can be used to determine minimum required inspection coverage. This insures that any flaws initiated below the weld, in the region of the penetration nozzle not being inspected, would not reach the bottom of the weld before the next inspection. The flaw tolerance chart for penetrations 77 and 78 is presented in Figure 3.

The flaw tolerance chart in Figure 3 demonstrates that a postulated through-wall flaw at the bottom edge of the proposed alternative examination zone will not grow to the toe of the J-groove weld within an inspection interval of four refueling cycles. The crack growth prediction shows greater than six effective full power years (EFPY) of operation required to grow the postulated flaw to the toe of the weld. Additionally, the assumed initial upper extremity locations of axial through-wall flaws are conservative based on achievable inspection coverage, because the assumed upper crack extremities are located within the achievable inspection zone.

Examination of portions of the nozzle significantly below the J-groove weld is not pertinent to the phenomena of concern, which include leakage through the J-groove weld and circumferential cracking in the nozzle above the J-groove weld. In all cases, the measured coverage is adequate to allow WCGS to continue to operate prior to the hypothetical flaws reaching the J-groove weld. In accordance with 10 CFR 50.55a(g)(6)(ii)(D) requirements, the next required examination would be completed prior to potential flaw propagation into the J-groove welds.

5.3 Surface Examination

10 CFR 50.55a(g)(6)(ii)(D)(3) states in part that "if a surface examination is being substituted for a volumetric examination on a portion of a penetration nozzle that is below the toe of the J-groove weld, the surface examination shall be of the inside and outside wetted surface of the penetration nozzle not examined volumetrically."

To reduce personnel radiation exposure, the nozzles are typically inspected using remotely operated volumetric examination equipment. Although dye penetrant testing of threaded surfaces is possible, it is not practical. The threaded outside diameter (OD) makes a dye penetrant examination on the lower section of the penetration impractical because of excessive bleed out from the threads. Eddy current examination would similarly not be effective due to the threaded configuration. Additionally, the radiation levels under the reactor vessel head are estimated to be 10,000 millirem (mRem)/hr at the bottom of the CRDM nozzles resulting in an exposure of approximately 2500 mRem per nozzle. These dose rates are consistent with dose rates measured at The Seabrook Station during 2006, as reported in a Seabrook Station request for relief dated October 27, 2011 (Reference 7). The reactor vessel head configuration at Seabrook Station is similar that at WCGS. At Seabrook Station, radiation levels under the reactor vessel head were measured during their previous inspection in 2006 and ranged from 7000 mRem/hr to 10,000 mRem/hr at the bottom of the CRDM nozzles, resulting in an exposure of approximately 1750 to 2500 mRem per nozzle to perform surface examination. Therefore, no alternative is proposed for the two CRDM nozzles with limited examination coverage below the J-groove weld.

6. Duration of Proposed Alternative

The alternative requirements of this request will be applied for the remaining duration of the current 3rd 10-year Inservice Inspection (ISI) Interval.

7. Precedents

Similar relief requests have been granted to the following plants:

- NRC Safety Evaluation dated December 22, 2009, for San Onofre Nuclear Generating Station, Units 2 and 3, "Relief Request ISI-3-29, Request for Relief from Inspection Requirements of ASME Code Case N-729-1 for Control Element Drive Mechanism Penetrations (TAC Nos. ME0768 and ME0769)" (ML093441035)

- NRC Safety Evaluation dated March 3, 2011, for Braidwood Station Units 1 and 2, and Byron Station Units 1 and 2, "Relief Request from ASME Code Case N-729-1 Requirements for Examination of Reactor Vessel Head Penetration Welds (TAC Nos. ME3510, ME3511, ME3512 and ME3513)" (ML110590921)

8. References

1. ASME Code Case N-729-1, "Alternative Examination Requirements for PWR Reactor Vessel Upper Heads with Nozzles Having Pressure-Retaining Partial-Penetration Welds, Section XI, Division 1," March 28, 2006.

2. WCAP-16589-P, Revision 0, "Structural Integrity Evaluation of Reactor Vessel Upper Head Penetrations to Support Continued Operation: Wolf Creek," August 2006.

3. WCNOC letter ET 06-0035 from T. J. Garrett, WCNOC, to USNRC, "Relaxation Request from the First Revised NRC Order EA-03-009 Regarding Requirements for Nondestructive Examination of Nozzles Below the J-Groove," October 5, 2006.

4. WCNOC letter ET 06-0048 from T. J. Garrett, WCNOC, to USNRC, "Additional Information Related to the First Revised NRC Order EA-03-009 Regarding Requirements for Nondestructive Examination of Nozzles Below the J-Groove," November 1, 2006.

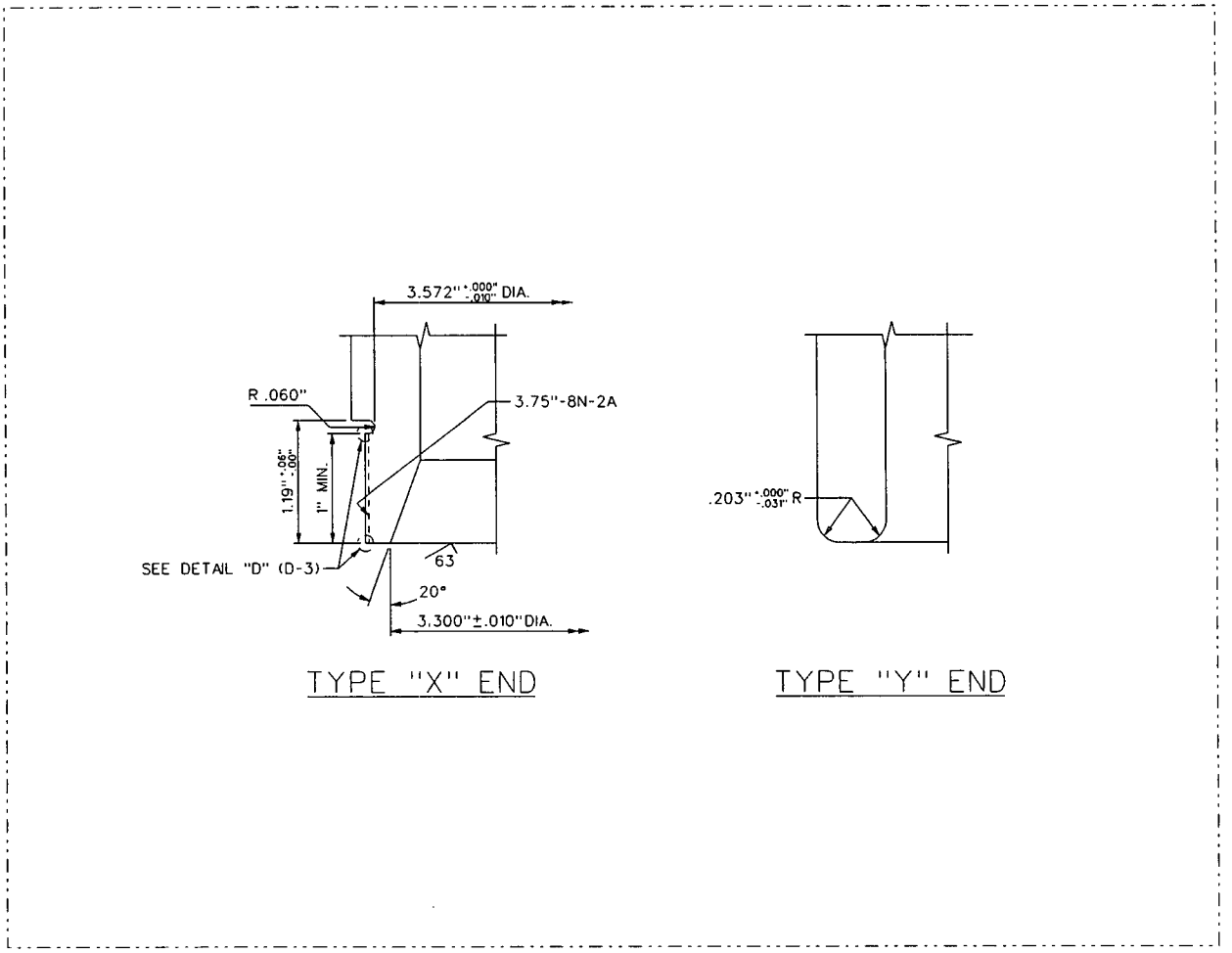
5. NRC letter from D. Terao, USNRC, to R. A. Muench, WCNOC, "Wolf Creek Generating Station – Request to Relax Nondestructive Examination of Reactor Pressure Vessel Head Penetration Nozzles in First Revised Order EA-03-009 (TAC NO. MD3210)," December 7, 2006.

6. NRC letter EA-03-009, "Issuance Of First Revised NRC Order (EA-03-009) Establishing Interim Inspection Requirements For Reactor Pressure Vessel Heads At Pressurized Water Reactors," February 20, 2004.

7. Nextera Energy letter SBK-L-11192, "Seabrook Station Request for Relief from ASME Code Case N-729-1 Requirements for Examination of Reactor Vessel Head Penetration Welds," October 27, 2011.

Figure 1

WCGS Reactor Vessel Head Penetration Ends



Details of the threaded and tapered portions of Penetrations 74, 75, 76, 77, and 78 referred to as "Type X" and the end of Penetrations 1 through 73, referred to as "Type Y."

Figure 2

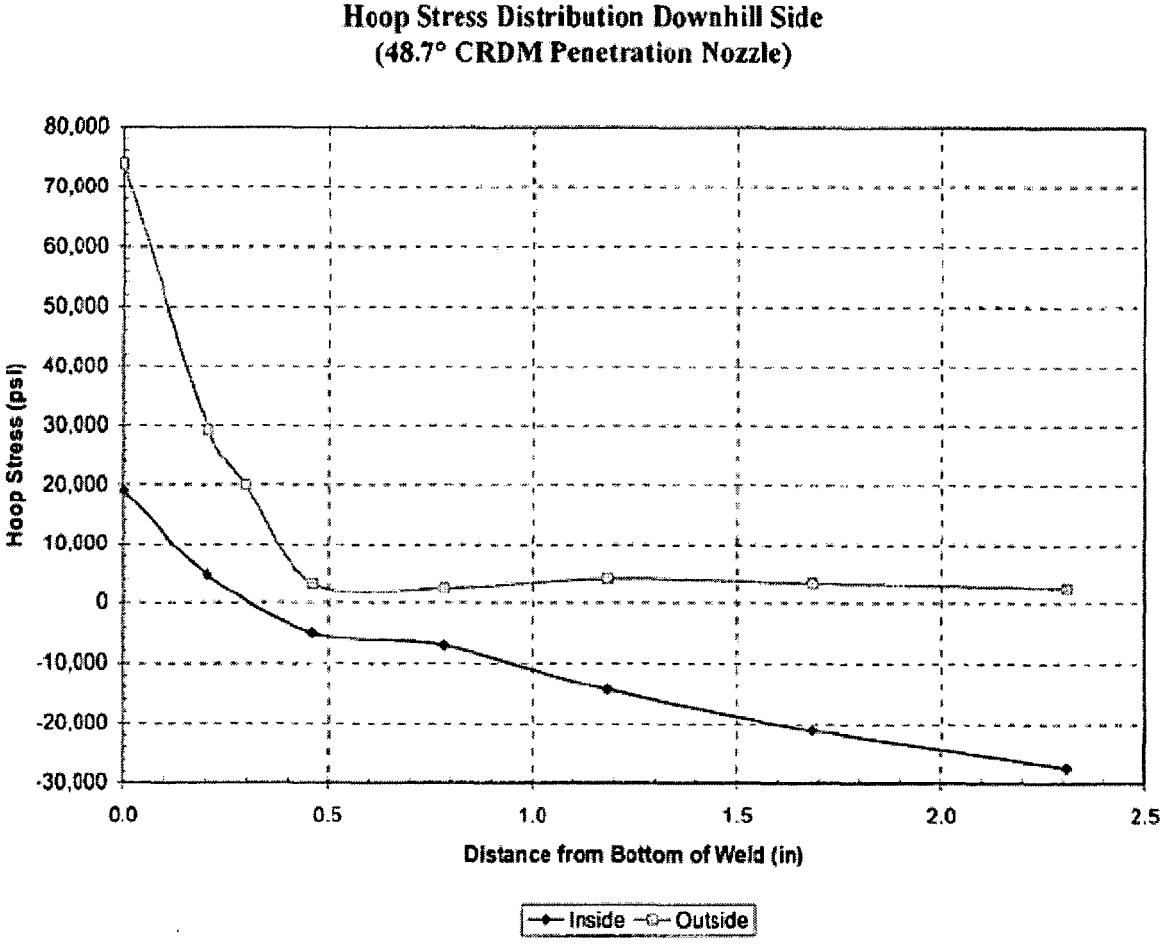

Hoop Stress Distribution Downhill Side
(48.7° CRDM Penetration Nozzle)
Hoop Stress (psi)
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
-10,000
-20,000
-30,000
0.0
0.5
1.0
1.5
2.0
2.5
Distance from Bottom of Weld (in)
Inside
Outside

Figure 3

Crack Growth Prediction for WCGS for Through-Wall Longitudinal Flaws Located in the 48.7° Row of CRDM Penetrations, Downhill Side

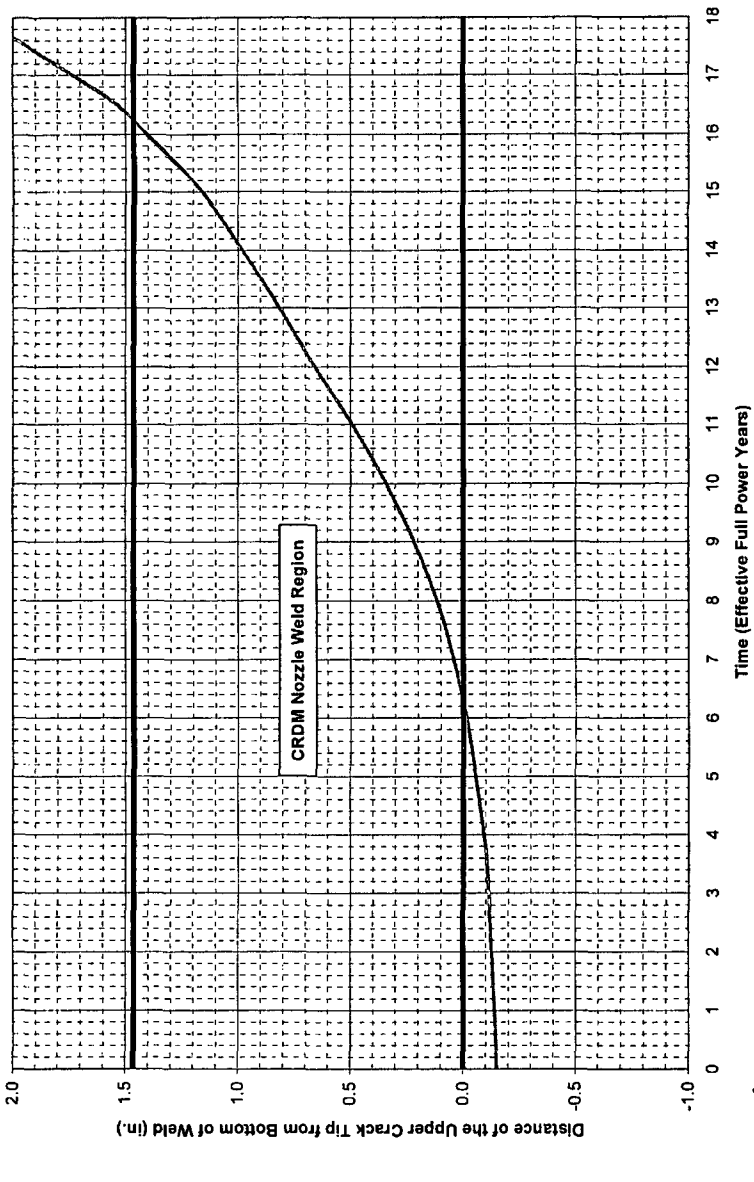


Figure 6-16 Through-Wall Longitudinal Flaws Located in the 48.7 Degrees CRDM Row of Penetrations, Downhill Side - Crack Growth Predictions for Wolf Creek