WOLF CREEK
NUCLEAR OPERATING CORPORATION

Terry J. Garrett
Vice President, Engineering

June 11, 2007

ET 07-0012

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

Reference: Letter ET 06-0029, dated September 1, 2006, from T. J. Garrett, WCNOC, to USNRC

Subject: Docket No. 50-482: Response to NRC Request for Additional Information on 10 CFR 50.55a Request to Use Alternative Ultrasonic Examination Method in Lieu of Radiography

Gentlemen:

The Reference provided a 10 CFR 50.55a Request for approval of alternatives to the requirements of American Society of Mechanical Engineers (ASME) Section III, NC-5222, which requires circumferential piping, pump, and valve butt welded joints be radiographed. Wolf Creek Nuclear Operating Corporation (WCNOC) requested the approval to use an alternative ultrasonic examination method in lieu of the radiography required by ASME Section III, NC-5222.

On November 22, 2006, the NRC provided a request for additional information by electronic mail requesting WCNOC to discuss the proposed NRC conditions published in the Federal Register for comment on October 27, 2006 (Vol. 71, No. 208, pages 62947-62949). On February 6, 2007, a teleconference was held between WCNOC and NRC personnel to discuss the conditions proposed for comment in the Federal Register. Attachment I provides WCNOC's response to the request for additional information and identifies certain areas where WCNOC disagrees with the proposed conditions. Attachment II provides a revised 10 CFR 50.55a Request based on WCNOC's review of the proposed conditions. Contained within Attachment II is Table 1, which was revised to expand the scope of the request to include additional feedwater system pipe welds that will be replaced in future refueling outages as part of the WCNOC Flow Accelerated Corrosion program. Attachment III provides an evaluation/comparison of the acceptance criteria of NB-2553(c) versus NC-5330.

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NRC/NRR

This letter contains no commitments. If you have any questions concerning this matter, please contact me at (620) 364-4084, or Mr. Kevin Moles at (620) 364-4126.

Sincerely,

Terry J. Garrett

TJG/rlt

Attachments

cc: J. N. Donohew (NRC), w/a
V. G. Gaddy (NRC), w/a
B. S. Mallett (NRC), w/a
Senior Resident Inspector (NRC), w/a

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

On November 22, 2006, the NRC provided a request for additional information by electronic mail requesting Wolf Creek Nuclear Operating Corporation (WCNOC) to discuss the proposed NRC conditions published in the Federal Register on October 27, 2006 (Vol. 71, No. 208, pages 62947-62949). Specifically, the NRC request for additional information is stated below:

> In the application dated September 1, 2006, Wolf Creek Nuclear Operating Corporation (the licensee) requested to use criteria similar to American Society of Mechanical Engineers (ASME) Code Case N-659, "Use of Ultrasonic Examination in Lieu of Radiography for Weld Examination Section III, Division 1". The Nuclear Regulatory Commission (NRC) staff has reviewed the ASME Code Case N-659 for endorsement as conditionally accepted in draft Regulatory Guide DG-1134 [1133], "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1." The NRC conditions on ASME Code Case N-659 are published in the Federal Register on October 27, 2006 (Volume 71 number 208, pages 62948-62949), and are applicable to relief requested for Wolf Creek Generating Station (WCGS). In order for the staff to continue its review, the licensee is requested to discuss how the proposed NRC conditions will be addressed at WCGS.
>
> Correction to RAI: Draft Regulatory Guide DG-1133, "Design, Fabrication, and Materials Code Case Acceptability, ASME Section III" is the correct regulatory guide to be referenced above, not DG-1134.

Each of the subject Federal Register proposed conditions (hereafter referred to as 71 FR 208) is listed below followed by WCNOC's response to each condition:

71 FR 208 Condition: In Paragraph (a) of Code Case N-659, the greater of ½ t or ½-inch from the widest portion of the weld shall be used, and any use of the second leg of the ultrasonic metal path shall be qualified by a performance based demonstration.

WCNOC Response: Expansion of the examination volume does not place an undue burden with regards to the welds covered by this relief request. The addition of the four Feedwater System welds, that are less than 1.0 inch nominal wall thickness, makes the wording of the proposed condition applicable to the WCNOC 10 CFR 50.55a request. Therefore, paragraph 5.0(3) of the 10 CFR 50.55a Request has been revised to reflect the wording of the proposed condition. Table 1, which has been revised, and Table 2 now identify that the nominal wall thicknesses of the welds covered by this request range between 0.938 inches through 1.5 inches.

71 FR 208 Condition: In lieu of Paragraph (b) and (d), the following shall be used: Procedures and personnel shall be qualified with blind performance demonstrations on representative mockups in terms of material, wall-thickness, diameter, surface roughness, and configuration of the weldment being examined.

WCNOC Response: It has always been WCNOC's intent to require the examination vendor to qualify the examination procedure and personnel with a procedure demonstration in accordance with WCNOC's originally submitted 10 CFR 50.55a Request which meets the provisions of Code Case N-659. However, paragraph 5.0(7) of the 10 CFR 50.55a Request has been revised to incorporate the additional revised requirements/wording of this part of the proposed condition.

71 FR 208 Condition: A minimum of 10 construction type flaws are required for a personnel qualification and the equivalent of three personnel qualifications required for a procedure qualification.

WCNOC Response: Paragraph 5.0(7)(b) of the 10 CFR 50.55a Request has been revised to incorporate the part of the proposed condition for a procedure that has not been previously qualified in accordance with ASME Section XI, Appendix VIII. However, Paragraph 5.0(7)(a) has been revised to include requirements for the use of a previously qualified ASME Section XI, Appendix VIII procedure with an additional procedure demonstration on at least 5 construction type flaws located in the outer 2/3 of the examination volume. Table 3 has been added to the 10 CFR 50.55a Request (Attachment II) and shows the detection criteria and maximum number of false calls allowed. There will be three procedure demonstration samples, one sample for the 14 inch, Sch 100, Feedwater System piping, one sample for the 14 inch, Sch 120, Feedwater System piping, and one sample for the 1.5 inch thick 28 inch diameter Main Steam System piping. Each sample will contain 6 to 8 weld fabrication flaws for a total of 18 to 24 flaws available for the procedure demonstration.

This part of the proposed condition includes the equivalent of three personnel qualifications required for procedure qualification. While this might be a reasonable expectation for an industry generic procedure approach similar to PDI, this should not be an expectation for site-specific weld procedure qualification. This part of the proposed condition, as written, is not applicable or technically justified, and is unnecessary to provide reasonable assurance of adequate protection to public health and safety, and would be an unwarranted burden on the licensee.

71 FR 208 Condition: At least 70% of the flaws shall be located along the base metal-to-weld fusion zone on both sides of the weld.

WCNOC Response: Experience in the nuclear industry and other industries does not support the position that side-wall lack of fusion is the most prevalent type of welding flaw. The type of flaws one might expect to encounter is based on the weld preparation, welding process, skill of the welder, cleanliness, etc. Requiring 70% of the fabrication flaws to be lack of fusion does not leave much room for other types of welding flaws in the demonstration samples. Paragraph 5.0(7)(a) and (b) of the 10 CFR 50.55a Request have been revised to require 50% of the flaws in a demonstration sample to be side-wall lack of fusion. This part of the proposed condition, as written, is not technically justified, and therefore is unnecessary to provide reasonable assurance of adequate protection to public health and safety.

71 FR 208 Condition: The flaws shall be randomly distributed throughout the weld thickness.

WCNOC Response: This part of the proposed condition is appropriate for a full weld volume inspection procedure qualification. Paragraphs 5.0(7)(a) and (b) of the 10 CFR 50.55a Request have been revised to incorporate this part of the proposed condition.

71 FR 208 Condition: Each flawed and unflawed volume shall be defined in independent grading units.

WCNOC Response: Each grading unit shall include at least 2 inches of weld length. At least ½ inch of unflawed material shall exist on either side of grading units designed to be unflawed. This is consistent with ASME Section XI, Appendix VIII requirements, except that the size of the

grading units and the required length of unflawed material on either side of unflawed grading units has been revised from that contained in ASME Section XI, Appendix VIII, due to the relatively short lengths of maximum allowable flaw lengths in the demonstration samples. Paragraph 5.0(7)(d) of the 10 CFR 50.55a Request has been added to incorporate this part of the proposed condition.

71 FR 208 Condition: The flaws shall be representative of the variety of construction flaws common to the welding process and material being examined.

WCNOC Response: This part of the proposed condition is appropriate for an ASME Section III weld inspection procedure qualification. Paragraphs 5.0(7)(a) and (b) of the 10 CFR 50.55a Request have been added to incorporate this part of the proposed condition.

71 FR 208 Condition: The demonstration must show the capability to detect flaws having a minimum 2% through-wall depth and within the flaw length acceptance of NB-2553(c). The demonstration detection acceptance criteria shall be:

Detection Test Acceptance Criteria		False Call Test Acceptance Criteria	
Number of Flawed Grading Units	Minimum Detection Criteria	Number of Unflawed Grading Units	Maximum Number of False Calls
10	8	15	2
11	9	17	3
12	9	18	3
13	10	20	3
14	10	21	3
15	11	23	3
16	12	24	4
17	12	26	4

WCNOC Response: Paragraph 5.0(7)(c) of the 10 CFR 50.55a Request has been revised and contains provisions for the through-wall size of demonstration sample flaws which meets the requirements contained in Code Case N-659. The responses from flaws that are detected during ultrasonic examinations are compared with the responses from either side-drilled holes of a given size (dictated by pipe nominal wall thickness) or notches that are 10% of the nominal through-wall thickness of the pipe. The minimum through-wall size of flaws in piping for PDI samples is 5% of the nominal pipe wall thickness (ref. ASME Section XI, Appendix VIII, Supplement 2, Paragraph 1.2 (c) (1)).

Making the detection of a flaw that is 2% of through-wall depth a condition of successful procedure demonstration creates a new weld quality level that has never been required. It is doubtful that a radiograph made with an isotope (Ir-192 or Co-60) within the Code acceptable density range and displaying the appropriate image quality indicator (IQI) for the nominal pipe wall thickness (plus maximum allowable reinforcement), would show the image of a 2% through-wall depth (TWD) flaw.

For example, a 2% TWD flaw in the 14 inch, Sch 120, Feedwater piping (1.094" tnom) is 0.022 inches. The required hole (plaque) type IQI for this thickness (not taking into account the maximum allowable reinforcement) is an ASTM 25 penetrameter displaying the outline (at least 3 sides) and a 2T hole. IQI thickness is 25mils with a hole diameter of 50mils. Requiring a UT procedure to detect a 2% TWD flaw is equivalent to requiring a radiograph to display less than

2-1T sensitivity. ASME Section III does not require this level of quality and sensitivity for radiography and it should not be required for ultrasonic testing.

Also, there is no flaw manufacturing capability to meet this requirement. The range of error in the making/sizing (determining "truth") of the flaw may be greater than 2%.

WCNOC disagrees with the use of the radiographic acceptance criteria of NB-2553(c) for the ultrasonic examinations to be performed under this 10 CFR 50.55a Request. Since ultrasonic testing methods are to be used, it does not make sense, and in fact it would be inappropriate to utilize the radiographic acceptance standards criteria of NB-2553(c). The appropriate acceptance criteria for the welds under consideration in this 10 CFR 50.55a Request is the Class 2 acceptance criteria for ultrasonic examination. Therefore, acceptance for the Class 2 welds addressed in this 10 CFR 50.55a Request will be in accordance with ASME Section III, NC-5330, "Ultrasonic Acceptance Standards," 1992 Edition through the 2003 Addenda. Reference Attachment III, which provides WCNOC's evaluation/comparison of the acceptance criteria of NB-2553(c) versus NC-5330. As stated above, the technical basis for this part of the proposed condition is incorrect and not feasible, and therefore is unnecessary to provide reasonable assurance of adequate protection to public health and safety, and would impose an unwarranted burden on the licensee. WCNOC's response will provide reasonable assurance of adequate protection to public health and safety and the quality of the welds.

71 FR 208 Condition: Flaws shall be detected and located within 1.0-inch of true length and width location and within 10% of true through-wall depth location or within 10% of the sound beam metal path, whichever is greater. All other reported flaws within false call grading units shall be false calls.

WCNOC Response: While this is not a requirement of the Class 2 acceptance criteria, this positional information can be critical when characterizing flaws and is useful as part of the repair process. Paragraph 5.0(7)(e) of the 10 CFR 50.55a Request has been added to incorporate the part of the proposed condition that would require that flaws detected in the qualification sample be located within 1 inch of true position with respect to the sample "zero" location and be located within 1 inch of true position with respect to the qualification sample weld centerline, respectively. The wording has been modified to use the correct technical terminology.

However, regarding the part of the proposed condition that would require detecting and locating flaws within 10% of true through-wall depth location or within 10% of the sound beam metal path, WCNOC contends that this part of the proposed condition is not necessary due to length and flaw type acceptance criteria of ASME Section III, NC-5330. Volumetric flaws are dispositioned on length measurement only. Planar flaws such as cracks, lack of fusion, or lack of penetration are rejected upon characterization as such. While knowing where a flaw is located within the volume of the weld is helpful in characterizing a flaw and aids the craft in the removal of unacceptable flaws, the location of a flaw within the weld volume is not a requirement of either the radiography or ultrasonic acceptance criteria contained in ASME Section III. The technical basis for this part of the proposed condition is incorrect, therefore, unnecessary to provide reasonable assurance of adequate protection to public health and safety and would impose an unwarranted burden on the licensee. WCNOC's response will provide reasonable assurance of adequate protection to public health and safety and the quality of the welds.

71 FR 208 Condition: A minimum of 10 flaws shall be used for sizing with a random distribution of lengths greater than and less than the applicable NB-2553(c) acceptance standard.

WCNOC Response: While 10 flaws may be appropriate for the qualification of a non-PDI qualified procedure, Code Case N-659 has a provision for qualifying a PDI qualified procedure for full weld required volume examination using fewer flaws. Table 3 of the 10 CFR 50.55a Request expands the table contained in the proposed rules to allow the use of less than 10 flaws to qualify a previously qualified PDI procedure for examining the full weld required volume.

71 FR 208 Condition: The maximum flaw length shall not exceed 200% of the acceptance standard.

WCNOC Response: Paragraph 5.0(7)(c) of the 10 CFR 50.55a Request has been revised to incorporate this part of the proposed condition.

71 FR 208 Condition: For qualification, all flaws shall be correctly identified as acceptable or unacceptable.

WCNOC Response: Due to the potential ultrasonic technique performance error when length sizing, flaws that are of an acceptable length, and are near but less than rejectable length, may be rejected. WCNOC would chose to err on the side of conservatism. A similar RT length sizing error exists depending on how far the flaw is from the film. The image of flaws that are close to the film are closer to "true" flaw size. Flaws that are of an acceptable length, and are near but less than rejectable length, may be rejected due to the size of the image on the film when they are farther away from the film, e.g., the image of a ¼ inch flaw on the ID of a pipe appears larger than the image of the same ¼ inch flaw on the OD of a pipe when the film is placed on the OD with the source on the ID. Therefore, this part of the proposed condition is not legitimate and has not been incorporated into the 10 CFR 50.55a Request.

In referring to ASME Section XI, Appendix VIII, Supplement 2, Paragraph 3.2(a), we see that the RMS error of the flaw lengths estimated by ultrasonics, as compared to the true lengths, shall not exceed 0.75 inches. The RMS error for PDI qualification is greater than any of the allowable flaws for the pipe thicknesses covered by this 10 CFR 50.55a Request.

71 FR 208 Condition: Procedures shall identify the equipment and essential variable settings used for the qualification. An essential variable is any variable that has an effect on the results of an examination. The procedure shall be requalified when an essential variable is changed outside the demonstrated range.

WCNOC Response: This is typical industry practice and is required by ASME Section V and ASME Section XI, Appendix VIII. However, Paragraph 5.0(5) of the 10 CFR 50.55a Request has been revised to specifically state the requirements of this part of the proposed condition, although it was already included by use of the applicable Code requirements.

DG-1133 Condition: Chemical ranges of the calibration blocks *(and demonstration samples)* may vary from the materials specification if:

(1) it is within the chemical range of the component specification to be inspected, and

(2) the phase and grain shape are maintained in the same ranges produced by the thermal process required by the material specification.

WCNOC Response: Paragraph 5.0(6) of the 10 CFR 50.55a Request has been revised to be consistent with the EPRI PDI program to satisfy ASME Section XI, Appendix VIII requirements for material used for mockups and demonstration samples when material of the same product form and specification is not available. WCNOC can find no methodology that could be employed to verify the second portion of the condition without destroying the demonstration sample and/or the production weld we wish to examine and ultimately place in service. Therefore, this part of the proposed condition is not legitimate and has not been incorporated into the 10 CFR 50.55a Request.

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Proposed Alternative
In Accordance with 10 CFR 50.55a(a)(3)(i)

Alternative Provides Acceptable Level of Quality and Safety

1.0 ASME CODE COMPONENTS AFFECTED

Description: Alternative ultrasonic examination is requested for Class 2 Feedwater System welds listed in Table 1 and Class 2 Main Steam System welds listed in Table 2. The tables provide the weld identification (ID) number, description, nominal pipe size (NPS), pipe nominal thickness (T), and base material for each weld.

Table 1: Feedwater System Welds

Loop	Weld ID No. Note (1)	Description	NPS	"T" (inches)	Base Material Note (2)
A	MW7069	Pipe-FV39 Upstream	14	1.094	SA106, Gr. B to SA216, Gr. WCB
A	MW7070	FV39-Pipe Downstream	14	1.094	SA216, Gr. WCB to SA333, Gr. 6
B	MW7071	Pipe-FV40 Upstream	14	1.094	SA106, Gr. B to SA216, Gr. WCB
B	MW7072	FV40-Pipe Downstream	14	1.094	SA216, Gr. WCB to SA333, Gr. 6
C	MW7073	Pipe-FV41 Upstream	14	1.094	SA106, Gr. B to SA216, Gr. WCB
C	MW7074	FV41-Pipe Downstream	14	1.094	SA216, Gr. WCB to SA333, Gr. 6
D	MW7075	Pipe-FV42 Upstream	14	1.094	SA106, Gr. B to SA216, Gr. WCB
D	MW7076	FV42-Pipe Downstream	14	1.094	SA216, Gr. WCB to SA333, Gr. 6
A	F001-A	Torsional Restraint-to-Fitting	14	0.938	SA508 Cl. 1-to-A234, WPBW, Gr. 70 or WPC
B	F016-A	Torsional Restraint-to-Fitting	14	0.938	SA508 Cl. 1-to-A234, WPBW, Gr. 70 or WPC
C	F016-A	Torsional Restraint-to-Fitting	14	0.938	SA508 Cl. 1-to-A234, WPBW, Gr. 70 or WPC
D	F001-B	Torsional Restraint-to-Fitting	14	0.938	SA508 Cl. 1-to-A234, WPBW, Gr. 70 or WPC

Notes: (1) Weld ID Numbers replace those currently identified in the Wolf Creek Nuclear Operating Corporation (WCNOC) Inservice Inspection (ISI) Program Plan.
(2) Chemical composition specification of SA333, Gr. 6 and SA106, Gr. B are identical.

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Table 2: Main Steam System Welds

Loop	Weld ID No. Note (1)	Description	NPS	"T" (inches)	Base Material
1	MW7079	Pipe-to-Valve HV14 Upstream	28.38" OD	1.5	SA-106, Gr. C to SA216, Gr. WCB
1	MW7080	Valve HV14-to-Pipe Downstream	28.38" OD	1.5	SA216, Gr. WCB to SA-671 CC70 Cl 32
1	F009-A	Pipe-to-Torsional Restraint	28.38" OD	1.5	SA-671 CC70 Cl 32 to SA-508, Cl 1
2	MW7081	Pipe-to-Valve HV17 Upstream	28.38" OD	1.5	SA-106, Gr.. C to SA216, Gr. WCB
2	MW7082	Valve HV17-to-Pipe Downstream	28.38" OD	1.5	SA216, Gr. WCB to SA-671 CC70 Cl 32
2	F028-A	Pipe-to-Torsional Restraint	28.38" OD	1.5	SA-671 CC70 Cl 32 to SA-508, Cl 1
3	MW7083	Pipe-to-Valve HV20 Upstream	28.38" OD	1.5	SA-106, Gr. C to SA216, Gr. WCB
3	MW7084	Valve HV20-to-Pipe Downstream	28.38" OD	1.5	SA216, Gr. WCB to SA-671 CC70 Cl 32
3	F052-A	Pipe-to-Torsional Restraint	28.38" OD	1.5	SA-671 CC70 Cl 32 to-SA 508, Cl 1
4	MW7077	Pipe-to-Valve HV11 Upstream	28.38" OD	1.5	SA-106, Gr. C to SA216, Gr. WCB
4	MW7078	Valve HV11-to-Pipe Downstream	28.38" OD	1.5	SA216, Gr. WCB to SA-671 CC70 Cl 32
4	F076-A	Pipe-to-Torsional Restraint	28.38" OD	1.5	SA-671 CC70 Cl 32 to SA-508, Cl 1

Notes: (1) Weld ID Numbers replace those currently identified in the WCNOC ISI Program Plan.

2.0 APPLICABLE CODE EDITION AND ADDENDA

The following editions and addenda of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Sections III and XI, are used at Wolf Creek Generating Station (WCGS):

- ASME Section XI, 1998 Edition through the 2000 Addenda for the 3rd Interval Inservice Inspection (ISI) Program
- ASME Section III, 1974 Edition through Summer 1975 Addenda [Original Code of Construction]

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3.0 APPLICABLE CODE REQUIREMENTS

a) IWA-4520(a) of ASME Section XI requires welded joints made for installation of items to be examined in accordance with the Construction Code, which is Section III for the identified welds.

b) NC-5222 of ASME Section III requires circumferential piping, pump, and valve butt welded joints to be radiographed.

4.0 REASON FOR REQUEST

Background:

WCNOC is currently in its third 10-year inservice inspection (ISI) interval, which began on September 3, 2005. The 1998 Edition through the 2000 Addenda of ASME Section XI governs repair/replacement activities for WCNOC's third 10-year ISI interval. IWA-4520(a) of ASME Section XI requires welded joints made for installation of items to be examined in accordance with the Construction Code, which is Section III for the identified welds. ASME Class 2 welds installed under the WCNOC Repair/Replacement Program are installed in accordance with the 1974 Edition with Summer 1975 Addenda of ASME Section III. Pursuant to the provisions of 10CFR 50.55a(a)(3)(i), WCNOC requests permission to use an alternative ultrasonic examination method in accordance with the justification, requirements, and provisions detailed below in lieu of the radiography required by ASME Section III, NC-5222.

Justification for Alternative Ultrasonic Examination in Lieu of Radiography:

The proposed alternative ultrasonic examination will ensure an adequate level of safety and quality and will provide adequate verification that the Class 2 welds are free of significant flaws that could affect structural integrity. The examination will cover 100% of the weld volume and include base material for a distance of one-half the nominal through-wall pipe thickness (0.5T) on each side of the widest part of the weld. A demonstration of the ultrasonic examination system capability to detect both subsurface and surface workmanship type flaws (i.e., slag, porosity, lack of fusion, and incomplete penetration) will be performed on a qualification block. All flaws and indications will be evaluated in accordance with the standard acceptance criteria of NC-5330. In addition, an automated scan and data acquisition system will be used to improve examination repeatability and provide permanent storage of the raw data. Finally, the proposed alternative ultrasonic examination will be limited to base material and weld material that is conducive to ultrasonic examination.

Depending on flaw type (i.e., volumetric or planar) and orientation, ultrasonic examination may be superior to radiography or vice versa. Radiography is most effective in detection of volumetric type flaws (i.e., slag and porosity) and detection of planar type flaws (i.e., lack of fusion and cracks) that are oriented in a plane parallel to the x-ray beam. However, radiography is limited in detection of planar flaws not oriented parallel to the beam. In contrast, ultrasonic examination is very effective in detection of planar type flaws that are not oriented in a plane parallel to the sound beam and less effective in detecting flaws in a plane parallel to the sound beam. Finally, ultrasonic examination is capable of detecting volumetric type flaws such as slag or porosity.

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The proposed alternative ultrasonic examination requirements and provisions address the known limitations of the ultrasonic method to ensure both planar and volumetric flaws in all orientations are detected and properly evaluated. First, examination using two angle beams (i.e., 45 and 60 degree nominally) or a procedure qualified on 100% of the weld volume in accordance with the performance demonstration methodology of ASME Section XI, Appendix VIII is required. Second, scans in two directions perpendicular to the weld axis and two directions parallel to the weld axis are required. Third, to ensure laminar type flaws are detected, a supplemental examination using straight beam is also required. Finally, if an indication, such as slag or porosity, is not characterized as volumetric, the indication will be characterized as a planar type flaw and evaluated in accordance with the acceptance criteria of NC-5330. The acceptance criteria of NC-5330 specifies acceptable length of an indication only and does not differentiate between planar and volumetric type flaws. Most importantly, planar type flaws such as cracks, incomplete penetration, and lack of fusion, which are rejectable by NC-5330 for any size, are more readily and properly characterized by ultrasonic examination.

In addition to the effectiveness of the proposed alternative, with the use of ultrasonic examination in lieu of radiography, the personnel safety risk of inadvertent or accidental exposure and also the normal anticipated exposure associated with transportation, positioning and exposing a source for radiography is eliminated. Also, outage duration and costs will be reduced by allowing parallel path work to progress uninterrupted during examination of welds.

5.0 PROPOSED ALTERNATIVE AND BASIS FOR USE

For ASME Class 2 welds installed under the WCNOC Repair/Replacement Program where ultrasonic examination will be performed in lieu of radiography the following requirements shall apply:

(1) The nominal weld thickness shall be 1/2 inch or greater.

(2) The ultrasonic examination shall not be applied to welds that include austenitic cast product forms or austenitic corrosion-resistant-clad piping butt welds.

(3) The ultrasonic examination area shall include 100% of the volume of the entire weld plus the greater of ½*t* or ½ inch from the widest portion of the weld, where *t* is the thickness of the weld. The ultrasonic examination area shall be accessible for angle beam examination in four directions, two directions perpendicular to the weld axis and two directions parallel to the weld axis. Where perpendicular scanning is limited on one side of the weld, a technique using the second leg of the V-path may be credited as access for the second perpendicular examination direction provided that the detection capability of that technique is included in the procedure demonstration described in (5) and (6) below.

(4) The ultrasonic examination shall be in accordance with (a) or (b) below:

(a) Examination shall be performed in accordance with ASME Section V, Article 5, 1992 Edition through the 2003 Addenda. Two angle beams having nominal angles of 45 and 60 degrees should generally be used; however, other pairs of angle beams may be used provided the measured difference between the angles is at least 10 degrees. A supplemental straight beam shall also be used.

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(b) Examination shall be performed by a procedure qualified in accordance with the performance demonstration methodology of ASME Section XI, Appendix VIII provided the entire volume of the weld examination is included in the demonstration. A supplemental straight beam shall also be used.

(5) A written procedure shall be followed. The procedure shall identify the equipment and essential variables and shall be re-qualified when equipment or essential variables change. The procedure shall be demonstrated to perform acceptably on a qualification block or specimen that includes a weld with both surface and subsurface flaws as described in (7) below.

(6) Calibration blocks and procedure qualification samples shall be fabricated in accordance with (a) through (d) below:

(a) Calibration blocks and demonstration samples shall be fabricated from material of the same material specification, product form, and heat treatment condition as one of the materials joined. If material of the same product form and specification is not available, material of similar chemical analysis, tensile properties, and metallurgical structure may be used. For the purpose of demonstration sample fabrication, typical grades of ferritic material are acceptable. Wrought product forms, (i.e., plate, pipe, fittings, and forgings), are acceptable representations of piping and forgings of that material.

(b) The welding method and position used to fabricate the procedure qualification samples shall simulate that which is used to fabricate the in-service component to be ultrasonically examined.

(c) Where two or more base material thicknesses are involved, the calibration block and procedure qualification sample thickness shall be of a size sufficient to contain the entire examination path. Samples shall be within thickness tolerances in ASME Section XI, Appendix VIII, Supplement 3, which states: the set shall include pipe specimens not thicker than 0.1" more than the minimum thickness, nor thinner than 1.0" less than the maximum thickness for which the examination procedure is applicable.

(d) The surface condition of the procedure qualification sample shall be consistent with condition of the production welds

(7) A blind procedure and personnel performance demonstration shall be conducted with representative mock-ups in terms of material, wall thickness, diameter, surface roughness, and configuration of the weldments to be examined. Each procedure qualification sample shall contain the minimum number of flaws in accordance with (a) or (b) and meet the additional requirements of (c) through (e) below:

(a) Where an ASME Section XI, Appendix VIII, performance demonstration methodology is used, supplemental qualification to a previously approved procedure may be demonstrated through the use of a blind test with appropriate specimens that contain a minimum of five (5) different construction-type and fabrication-type flaws, such as those described in (b) below. The flaws for a five (5) through nine (9) flaw sample set

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(see Table 3) shall be located in the outer 2/3 of the weld examination volume. At least two (2) of the flaws in a five flaw sample set shall be side-wall lack of fusion.

(b) When the examination is performed in accordance with a procedure not previously approved in accordance with ASME Section XI, Appendix VIII, the test shall be conducted utilizing a minimum of 10 flaws. At least 50% of the flaws shall be side-wall lack of fusion. One (1) side-wall lack of fusion flaw shall be oriented parallel to the fusion line on the upstream weld bevel and one (1) side-wall lack of fusion flaw shall be oriented parallel to the downstream weld bevel. At least one (1) side-wall lack of fusion flaw shall be surface and at least one (1) side-wall lack of fusion flaw shall be subsurface. The remainder of the demonstration sample flaws may be side-wall lack of fusion, transverse flaws, or welding flaws that are volumetric in nature (i.e., slag and porosity). The flaws shall be distributed throughout the thickness of the specimen(s).

(c) The flaws shall be no larger in the through-wall direction than the diameter of the applicable side-drilled hole in the calibration block shown in Figure T-542.2.1 of ASME Section V, Article 5, and no longer than two (2) times the shortest unacceptable elongated discontinuity length listed in NC-5330 for the thickness of the weld that will be examined.

(d) Each flawed and unflawed volume shall be defined in independent grading units. Each grading unit shall include at least 2 inches of weld length. At least ½ inch of unflawed material shall exist on either side of grading units designed to be unflawed. The procedure qualification detection test acceptance criteria shall be in accordance with Table 3, below.

(e) Flaws detected in the qualification sample shall be located within 1 inch of true position with respect to the sample "zero" location. Flaws detected in the qualification sample shall be located within 1 inch of true position with respect to the sample weld centerline.

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Table 3
PROCEDURE QUALIFICATION DETECTION TEST ACCEPTANCE CRITERIA

	Detection Test Acceptance Criteria		False Call Test Acceptance Criteria	
	Number of Flawed Grading Units	Minimum Detection Criteria	Number of Unflawed Grading Units	Maximum Number of False Calls
Procedure Qualification for a Previously Qualified ASME Section XI, Appendix VIII Procedure	5	5	10	0
	6	6	12	1
	7	6	14	1
	8	7	16	2
	9	7	18	2
Procedure Qualification for a Procedure Not Previously Qualified in accordance with ASME Section XI, Appendix VIII	10	8	15	2
	11	9	17	3
	12	9	18	3
	13	10	20	3
	14	10	21	3
	15	11	23	3
	16	12	24	4
	17	12	26	4
	18	13	27	5
	19	13	28	5
	20	14	30	6

(8) A documented examination plan shall be provided showing the transducer placement, movement and component coverage that provides a standardized and repeatable methodology for weld acceptance. The examination plan shall also include the ultrasonic beam angle used, beam directions with respect to weld centerline, and volume examined for each weld.

(9) The ultrasonic examination shall be performed using a device with an automated computer data acquisition system.

(10) Data shall be recorded in unprocessed form. A complete data set with no gating, filtering, or thresholding for response from the examination volume in paragraph (3) above shall be included in the data record.

(11) Personnel who acquire and analyze ultrasonic data shall be qualified and trained using the same type of equipment as in (9) above, and demonstrate their capability to detect and characterize the flaws using the procedure as described in (5) above.

(12) The evaluation and acceptance criteria shall be in accordance with ASME Section III, NC-5330, 1992 Edition through the 2003 Addenda.

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(13) Flaws exceeding the applicable acceptance criteria referenced in (12) above shall be repaired, and the weld subsequently reexamined using the same ultrasonic examination procedure that detected the flaw.

(14) Review and acceptance of the ultrasonic examination procedure by the Authorized Nuclear Inservice Inspector is required.

(15) All other related requirements of the Wolf Creek Repair/Replacement Program shall be met.

(16) Use of ultrasonic examination in lieu of radiography shall be documented in accordance with the Wolf Creek Repair/Replacement Program on a Form NIS-2A and/or ASME Section XI Repair/Replacement Plan, as applicable.

6.0 DURATION OF THE PROPOSED ALTERNATIVE

The alternatives in this 10 CFR 50.55a Request are requested for the Third Ten-Year Interval of WCNOC's Inservice Inspection (ISI) Program.

7.0 PRECEDENTS

A similar Relief (10 CFR 50.55a) Request was approved by the NRC in a letter from Robert A. Gramm, NRC, to Charles D. Naslund, Union Electric Company, "Callaway Plant, Unit 1 – Request for Relief from Certain ASME Code Examinations for the Second and Third Inservice Inspection Intervals (TAC No. MC5379)," dated May 19, 2005.

Evaluation of Acceptance Criteria NB-2553(c) vs. NC-5330

During the February 6, 2007 phone call with the NRC, Wolf Creek asked about using the acceptance requirements for UT (NC-5330) from the 1975 Addenda of ASME Section III in lieu of the acceptance requirements in the proposed NRC condition to Code Case N-659 which is NB-2553(c) (RT acceptance standards). Although the NRC reference to paragraph NB-2553(c) was silent on a specific edition and addenda, the latest referenced ASME Section III (2001 Edition through 2003 Addenda) in 10 CFR 50.55(a)(b) was used.

WCNOC Response: Edition and Addenda are not the point here. NB-2553 (c) is the acceptance criteria for the examination and repair of seamless and welded (without filler metal) tubular products and fittings when radiographic examination is performed as an alternative to the required ultrasonic examination. If a radiographic acceptance criteria is going to be used for the evaluation of ultrasonic examination data, NC-5320 is the appropriate criteria for the full penetration butt welds covered in the WCNOC relief request. However, it is more appropriate to use an ultrasonic acceptance criteria for evaluation of ultrasonic examination data. The UT examination acceptance criteria for Class 2 welds contained in NC-5330 has served the industry well since it first appeared in ASME Section III over 30 years ago. The UT acceptance criteria of other codes and standards, such as ASME/ANSI B31.1, parallels ASME Section III.

An additional NRC comment was that Paragraph NB-5330 (UT acceptance standards) in the 1975 ASME Section III requirements was reviewed. Paragraph NB-5330 has, among other things, a requirement that responses greater than 20% (distance amplitude correction) of the reference level shall be investigated. The 20% amplitude value is associated with prescriptive UT examination techniques. Amplitude restrictions are not appropriate for performance-based examination and performance demonstration testing. Most modern UT techniques use sound coming out of the metal's background noise for detection and sizing.

WCNOC Response: WCNOC will concede that the technique of using the sound coming out of the background noise (looking for indications breaking out of "roll" from the inner surface of the pipe) is the PDI-UT-1 (Generic Procedure for the Ultrasonic Examination of Piping Welds) technique for detection of cracks during PDI qualifications.

From PDI-UT-1:
8.6 Examination Sensitivity
8.6.1 Shear Wave Search Units
8.6.1.1 The examination sensitivity (scan gain) shall be established on the component to be examined. To accomplish this, position the search unit on the base metal adjacent to the weld to be examined and adjust the gain level until the signal response from the inside surface (ID roll) is between 5 and 20% FSH.

The PDI qualification process measures the ability of a candidate to not only detect flaws but to discriminate between service-induced flaw indications and weld inside surface (ID) geometry. The candidate knows from the beginning of the test that all of the flaws in the demonstration sample population that he/she is expected to detect are cracks. [Ref. ASME Section XI, Appendix VIII, Supplement 2, Para. 1.1 (d)] All of the cracks are associated to a greater or lesser degree with pipe ID geometry (ie. weld root, counterbore, etc.).

While we are dealing with the detection of some flaws that are connected to the ID, we are also concerned with those weld fabrication flaws that are located throughout the remainder of the

Evaluation of Acceptance Criteria NB-2553(c) vs. NC-5330

weld volume. Turning up the gain to obtain a 5% to 20% ID roll will, in most cases, give a false sense of size and severity of the indications detected throughout the remainder of the weld volume.

Paragraph 5.0 (10) of the 10 CFR 50.55a Request requires that the data be recorded in unprocessed form. A complete data set with no gating, filtering, or thresholding for response from the examination volume shall be included in the data record. All of the UT responses from the weld volume are recorded. This requirement far exceeds turning up the gain to obtain a 5% to 20% ID roll. Applying a threshold to the data is part of the indication characterization, length sizing, and evaluation process. Using the ASME Section III, 20% of reference threshold is reasonable when length sizing and positioning indications within the weld examination volume. The detection, sizing, and evaluation of indications are three separate processes, especially when automated data acquisition is used. And we must still keep in mind that the data evaluator has the ability to reject indications characterized as cracks, lack of fusion, or incomplete penetration.

It should also be noted that a separate preservice ultrasonic examination will be performed following acceptance of the welds to the criteria of ASME Section III.

Contrary to the information conveyed during the phone call of February 6, 2007, the NRC staff is still standing by the NB-2553(c) (from the 2001 Edition through 2003 Addenda of ASME Section III) criteria referenced in the proposed conditions to Code Case N-659. If Wolf Creek wishes to take exception, they will have to explain why NB-2553(c) (from the 2001 Edition through 2003 Addenda of ASME Section III) is inappropriate for acceptance, or why specific parts of NB-2553(c) are inappropriate for UT acceptance. If an alternative is being proposed, Wolf Creek should state the specific acceptance criteria that is being proposed and provide the supporting basis.

WCNOC Response:
WCNOC disagrees with the use of the radiographic acceptance criteria of NB-2553(c) for the ultrasonic examinations to be performed under this 10 CFR 50.55a Request. Since ultrasonic testing methods are to be used, it does not make sense, and in fact it would be inappropriate to utilize the radiographic examination acceptance standards criteria of NB-2553(c). The appropriate acceptance criteria for the welds under consideration in this 10 CFR 50.55a Request is the Class 2 acceptance criteria for ultrasonic examination. Therefore, acceptance for the Class 2 welds addressed in this 10 CFR 50.55a Request will be in accordance with ASME Section III, NC-5330, "Ultrasonic Acceptance Standards," 1992 Edition through the 2003 Addenda.

The following justification is provided for the use of NC-5330 acceptance criteria:

The acceptance criteria for radiography (RT) and ultrasonic examination (UT) have two attributes in common:

1) The RT and UT for acceptable and rejectable flaw lengths for elongated (linear) indications are identical.

2) Any indication characterized as a crack or zone of incomplete fusion or penetration is rejectable for both RT and UT.

Evaluation of Acceptance Criteria NB-2553(c) vs. NC-5330

The UT criteria does not address porosity (rounded indications) or the aggregate length of aligned indications. However, the justification for these two omissions is provided below:

1) The maximum acceptable random rounded indication for the pipe wall thicknesses that we are considering for this 10 CFR 50.55a Request is 0.156 inches or 0.250 inches for isolated indications (Reference ASME Section III, Appendix VI, Table VI-1132-1). The length for isolated indications is approximately 80% of the maximum allowable flaw length for the 14 inch, Sch 100, Feedwater welds, approximately 69% of the maximum allowable flaw length for the 14 inch, Sch 120, Feedwater welds, 50% of the maximum allowable flaw length for the 28 inch Main Steam welds. Due to the globular nature of these types of flaws, porosity presents a reflecting face perpendicular to the sound beam regardless of the angle of propagation or the direction that the sound beam approaches it from. Since a minimum of two sound angles will be directed from at least three directions, there is a high probability of detection of rejectable rounded indications that might occur during the welding process. Cluster porosity exhibits a recognizable signal characteristic. The length and width of acceptable porosity will normally be rejected by UT due to the length of the signal along the weld axis when compared to the NC-5330 criteria.

2) Since all of the UT responses from the weld volume are recorded, all indications can be evaluated. Indications on a radiograph which appear to be aligned have to be assumed to be aligned in the same plane due to the 2-dimensional presentation of a radiograph. With UT we can "see" the alignment in 3 dimensions, horizontally along the weld axis and vertically within the weld volume. For example, six ¼ inch indications, spaced 5L apart, would be interpreted as aligned on a radiograph of a 1.5" thick weld. When viewed with UT we find that they alternate in depth with adjacent indications being ¼ inch from the ID and OD respectively. On the radiograph these indications appear to be 1.25 inches apart (less than 6L). But due to the vertical separation that we see with UT the physical end to end measurement is 1.6 inches (greater than 6L).

In conclusion, we believe that the ultrasonic examination methodology and the performance demonstration rigor required by WCNOC's 10 CFR 50.55a Request, coupled with a conservative approach to ultrasonic indication evaluation, will result in high quality welds and provide reasonable assurance of adequate protection to public health and safety. The ASME Section III consensus process has excluded rounded indications and the aggregate length of aligned indications from the ultrasonic acceptance criteria. This exclusion has existed in ASME Section III and other codes and standards (ASME Section I, ASME Section VIII, ANSI B31.1, etc.) for several years. Finally, the ultrasonic examination method is more likely to detect and characterize those weld defects that are most likely to propagate (cracks, lack of penetration, lack of fusion) if allowed to remain in welds that are placed inservice.

The next page contains the ASME Section III Class 2 piping weld acceptance criteria (NC-5330) from the 1974 Edition with all Addenda through Summer 1975 for UT, the ASME Section III Class 2 piping weld acceptance criteria (NC-5330) from the 2001 Edition with all Addenda through 2003 for UT, and the acceptance criteria for RT (NB-2553c) from the 2001 Edition with all Addenda through 2003 in a side-by-side format so that the similarities and differences can be seen more readily.

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Ultrasonic Acceptance Criteria for Class 2 piping welds ASME Section III, 1974 Edition with all Addenda through Summer 1975	Ultrasonic Acceptance Criteria for Class 2 piping welds ASME Section III, 2001 Edition with all Addenda through 2003	Radiographic Acceptance Criteria for Examination and Repair of Seamless and Welded (Without Filler Metal) Tubular Fittings and Products ASME Section III, 2001 Edition with all Addenda through 2003
NC-5330 ULTRASONIC ACCEPTANCE STANDARDS	NC-5330 ULTRASONIC ACCEPTANCE STANDARDS	NB-2553 RADIOGRAPHIC EXAMINATION
All indications which produce a response greater than 20% of the reference level shall be investigated to the extent that the operator can determine the shape, identity and location of all such reflectors and evaluate them in terms of the acceptance rejection standards as given in (a) and (b) below. *(a)* Discontinuities are unacceptable, if the amplitude exceeds the reference level and discontinuities have lengths which exceed: *(1)* ¼ in. for t up to ¾ in., inclusive; *(2)* $^1/_3t$ for t from ¾ in. to 2¼ in., inclusive; *(3)* ¾ in. for t over 2¼ in. where t is the thickness of the weld being examined; if a weld joins two members having different thicknesses at the weld, t is the thinner of these two thicknesses; (b) Where discontinuities are interpreted to be cracks or incomplete penetration, they are unacceptable regardless of discontinuity or signal amplitude.	All imperfections which produce a response greater than 20% of the reference level shall be investigated to the extent that the operator can determine the shape, identity, and location of all such imperfections and evaluate them in terms of the acceptance rejection standards as given in (a) and (b) below. *(a)* Imperfections are unacceptable if the indications exceed the reference level amplitude and have lengths exceeding: *(1)* ¼ in. (6mm) for t up to ¾ in. (19mm), inclusive *(2)* $^1/_3t$ for t from ¾ in. to 2¼ in. (19mm to 57mm), inclusive *(3)* ¾ in. (19mm) for t over 2¼ in. (57mm) where t is the thickness of the weld being examined; if a weld joins two members having different thicknesses at the weld, t is the thinner of these two thicknesses; (b) Indications characterized as cracks, lack of fusion, or incomplete penetration, are unacceptable regardless of length.	*(c) Accptance Standard.* Welds that are shown by radiography to have any of the following types of discontinuities are unacceptable: *(1)* any type of crack or zone of incomplete fusion or penetration; *(2)* any other elongated indication which has a length greater than: *(a)* ¼ in. (6mm) for t up to ¾ in. (19mm), inclusive *(b)* $^1/_3t$ for t from ¾ (19mm) in. to 2¼ in. (57mm), inclusive *(c)* ¾ in. (19mm) for t over 2¼ in. (57mm) where t is the thickness of the thinner portion of the weld; (3) any group of aligned indications having an aggregate length greater than t in a length of $12t$, unless the minimum distance between successive indications exceeds $6L$, in which case the aggregate length is unlimited, L being the length of the largest indication; (4) rounded indications in excess of those shown as acceptable in Appendix VI.