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U.S. Nuclear Regulatory Commission
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Subject: Oconee Nuclear Station, Unit 1
Docket Nos. 50-269
Supplemental Information - Request To Use An Alternative to ASME Boiler and Pressure Vessel Code, Section XI, Request for Alternate No. 00-04 and No. 00-05

On December 28, 2000, Duke Energy Corporation (Duke) submitted Request for Alternate No. 00-04 pursuant to 10CFR50.55(a) (3) (i). This request was for use of an alternative to the volumetric examination requirements of IWA 4533 following repairs of Class A Reactor Vessel (RV) head components (thermocouple nozzles #2 and #5). Additional information was provided to the NRC in a supplement dated January 2, 2001. In addition, on January 2, 2001, Duke also submitted a similar Request for Alternate No. 00-05 regarding repair of Control Rod Drive Mechanism #21.

Telephone discussions with the NRC staff on January 3, 2001, revealed the need for additional information concerning the proposed examination techniques with both Requests. The requested information is attached.

If there are any further questions, please contact Bob Douglas at (864) 885-3073.

Very truly yours,

W.R. McCollum, Jr.
Site Vice President

Attachment:

Request for Alternates Nos. 00-04 and 00-05, Supplemental Information

A047

xc w/attach:

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Duke Energy Corporation
Oconee Nuclear Station, Unit 1

Background

The purpose of Duke Energy Corporation's Request for Alternate No. 00-04 and No. 00-05 is, in part, to obtain relief from certain examination requirements of ASME Boiler and Pressure Vessel Code (ASME), Section XI, Subsection IWA, 1992, IWA - 4533 requirements for post-repair examination by radiographic methods. The requests proposed, in part, ultrasonic testing in lieu of radiographic examination. This substitution is necessary since the thickness of the reactor vessel head combined with the geometry of the head and the thermocouple (T/C) and Control Rod Drive Mechanisms (CRDM) penetrations limits the capability of radiographic methods to detect indications of unacceptable defects. In a conference call on January 3, 2001, the NRC requested the below additional information.

Request #1
Describe any additional non-destructive examinations (NDE), such as eddy current (ECT) and liquid penetrant (PT), that will be performed following the weld overlay on CRDM #21 and T/C #2 and #5.

Response #1
Following the completion of the temper bead weld process for the repair at CRDM #21, ultrasonic (UT) and PT examinations were completed on the weld repair areas. Subsequent UT and PT examinations were completed on the 5" band around the repair area as required by code. Following the completion of these inspections, a fillet weld and a weld overlay at CRDM #21 were completed. Following this final weld process on CRDM #21, a PT was completed on all weld repair areas, including a minimum of ½ inch outside the weld repair area.

Following the completion of all welding on CRDM #21, an ECT Analysis was completed on the ID bore of the nozzle surface. The inspection area included the ID surface of the nozzle two inches above and below the weld. This inspection was completed as an action above and beyond code requirements.

For the repairs completed at T/C locations #2 and #5, the NDE completed was a UT and PT of the weld pad and a subsequent UT and PT of the 5" band around the weld pad as required by code.

All NDE work on the repaired areas of CRDM #21 and T/C locations #2 and #5 was completed and is clear of any indications.

Request #2
Provide a comparison of the attributes between radiographic testing (RT) and ultrasonic testing (UT) for both CRDM #21 and T/C #2 and T/C #5. Include a discussion of the problems that would be encountered when using RT. This discussion should include configuration interference, film/source placement, etc.

Response #2
NB 5320 Radiographic Acceptance Standards stated in the ASME Section III 5300 includes criteria based upon the characterization of the defects. Similar reference is found in code section NB 5330 Ultrasonic Acceptance Standards. These acceptance standards are the basis for the potential evaluation of defects discovered in the CRDM #21 and thermocouple #2 and #5. Paragraphs NB5320 and NB5330 both have identical wording regarding the evaluation of elongated indications. Both state that indications characterized as cracks, lack of fusion, or zones of incomplete penetration are rejected regardless of the size, location or orientation.

NB 5330 Ultrasonic Acceptance Standards does not include criteria for volumetric defects as described in paragraph (d) and (e) under NB 5320 Radiographic Acceptance Standards. Ultrasonic techniques are capable of detecting some volumetric defects although they are not generally utilized for this type inspection. The ultrasonic detection of volumetric defects is a function of the characteristics of the defect and wavelength of the sound energy.

Paragraph NB 5330 states that the ultrasonic evaluation criterion is 20% distance amplitude correction (DAC). It has been proven that amplitude is a poor indicator of crack like indications. Therefore utilizing advanced ultrasonic techniques such as tip diffraction, the acceptance criteria stated in NB 5330 was enhanced in the UT procedure to eliminate the amplitude qualifier.

The radiographic (RT) and ultrasonic (UT) examination methods provide full volumetric examination of the area to be examined. In the case of the CRDM and T/C nozzle repairs the RT method is considered impractical for use based upon the specific geometry constraints for each of the nozzles. The CRDM nozzle itself limits the placement of the RT film and source, which limits full coverage of the required area. The plug of the T/C nozzles will limit the RT capabilities of achieving full volumetric coverage of the weld buildup. The thickness of the vessel head in relation to the weld repair thickness also reduces the effective sensitivity of the RT method.

The UT examination method and techniques used for CRDM and T/C nozzle repairs have been specifically developed for the examination of weld repairs. The UT techniques used for the

examinations of the weld and adjacent base material volumes provides enhanced detection capabilities for indications characterized as cracks, lack of fusion, or zones of incomplete penetration regardless of the size, location, or orientation. For this application, it is concluded that RT is not practical to be performed and the UT method as described will provide results that assure no flaws will go undetected.

Request #3

Discuss the scan direction and transducers to be used for the UT of both CRDM #21 and T/C #2 and #5.

Response #3

The UT examination procedures and techniques are based upon industry standards for the examination of large volumes of weld materials developed for the Boiling Water Reactor weld overlay examinations. The UT examinations consist of a combination of 0 degree longitudinal wave, creeping wave (ODCR) and 60 degree longitudinal wave search units. The 0 degree longitudinal wave is performed to detect any lack of bond areas between the weld materials and original parent materials, interbead lack of fusion, and any laminar type cracking within the base material of the examination volume. The ODCR search unit is used to detect welding defects within the weld deposit such as cracks or lack of fusion between weld beads. The 60 degree longitudinal unit will detect cracking in the parent base material beneath the weld deposit and welding defects within the weld deposit.

For the ultrasonic examinations of both the CRDM and thermocouple T/C nozzle repairs, scanning will be performed in at least four directions to the extent possible to maximize the examination coverage. For the examination of CRDM nozzle No. 21 the examination from the inside surface of the vessel head is limited due to the CRDM nozzle. However, additional scanning is performed from the OD surface of the portion of the nozzle that extends through the head using the 60° and ODCR angle beam search units with the sound beams directed to interrogate the weld to nozzle interface region. Additionally, a 0° longitudinal wave search unit scan from the nozzle ID will be performed. The examination technique of a 0° longitudinal wave, 60° longitudinal wave, and creeping wave (ODCR) search unit combination was applied to the weld repair and the 5.0" band of base material surrounding the weld repair.

Coverage of the examination volume has been calculated for CRDM nozzle # 21 and thermocouple T/C nozzles #2 and #5 as follows:

Nozzle	% Of weld examined	% Of 5.0" band examined
CRDM 21	100%	87%
T/C 2	100%	75%
T/C 5	100%	80%

The maximum size transducer used in the UT examination was 0.4" x 0.7".

Request #4
Describe how tip diffraction is being used to locate cracks below the weld overlay. Discuss how tip diffraction has been integrated into the acceptance criteria. This discussion applies to both CRDM #21 and T/C #2 and #5.

Response #4
For crack type indications located below the weld deposit, tip diffraction is used for the detection and evaluation of crack indications. The examination of the region below the weld deposit is performed with the 60° longitudinal wave (L-wave) search unit. Scanning with the 60° L-wave search unit is based on material noise level, which produces a more sensitive examination than those based upon DAC levels normally used for ASME Section III and Section V examination procedures. The procedures used for these examinations require *any* indications characterized as cracks to be recorded and evaluated. The UT procedures did not rely on an amplitude threshold to characterize an indication as a potential crack

Request #5
Provide a comparison between the Performance Demonstration Initiative (PDI) weld overlay qualification technique and procedures with the technique and procedures used for the CRDM #21 and T/C #2 and #5 repair. Will the individuals conducting the examinations also be qualified to PDI? Include a discussion relative to the demonstrated effectiveness of the procedures and personnel (as discussed in 10CFR50.55a(a)(3)).

Response #5
The ultrasonic examination procedures used for the thermocouple and CRDM nozzle repair examinations were developed based on the qualified techniques of the PDI weld overlay procedure. Essential variables of the PDI qualified weld overlay examination procedure such as; search unit selection (size, angle, and frequency), scanning parameters (speed, index, and sensitivity), and application of each search unit are contained within the examination procedures used for the Oconee repair examinations. The PDI qualified

procedure was modified for the specific geometry and configuration associated with the weld buildup repair of the thermocouple nozzles and the weld repair of the CRDM nozzle. Additional changes were incorporated to include the ASME Section III, NB-5330 Acceptance Standards. Examination personnel that performed these examinations were qualified in accordance with the ASME Section XI, Appendix VII and Section III, NB-5520 requirements. Examination personnel that performed these inspections were also qualified to other industry programs such as Section XI, Appendix VIII and to the above discussed procedure.

The initial calibration of the examination system provides a demonstration of the procedure, equipment, and examiner capabilities to detect and resolve the 3/32" diameter calibration reflectors located within and below the weld material deposited on the calibration block. This provides adequate demonstration that the sound beams are adequately penetrating to the intended depth for the examination.

Request #6
Is the weld pad for the T/C repair considered the pressure boundary?

Response #6
The exterior weld pad on the OD of the RV Head at T/C locations #2 and #5 will act as the pressure boundary for the repairs completed at those locations. This specific repair design used the repair by analysis option of NB 3200 with the technical analysis completed by Framatome to support the repair configuration.

Request #7
Discuss the possibility of foreign material to enter in any remaining gaps in the T/C repair that could contribute to local corrosion.

Response #7
The OD of the plug used during the repair is 1.020 +/- .005 inches. The ID of the RV Head Penetration for T/C location #2 and #5 is 1.035 inches, so there is a slight gap or annulus that exists. Since this gap is exposed to the primary water environment (Reactor Coolant System), there is a potential that a minimal amount of corrosion will occur on the exposed low alloy steel penetration surface. An analysis of this corrosion potential concluded that there would not be an adverse impact on the integrity of the RV head for the remaining life of the unit. The risk of foreign material entering the annulus area at the repair location is insignificant.

Request #8
Describe methods to be employed to detect future flaws in the new welds.

Response #8
Several methods will be used to identify leaks in the Reactor Coolant System. These methods include Generic Letter 88-05 walk downs, unidentified leakage calculations, sump level

monitoring and others. The flaws detected during this outage were a result of a routine visual inspection of the RV head.

Additionally, the welds associated with this repair will be evaluated for inclusion into the Owner's Inservice Inspection Program.

Request #9
Discuss the operational consequences of a failure of a T/C weld.

Response #9
The thermocouple plug design used at T/C locations #2 and #5 has an inherent safety feature built into the plug. By designing a notched or expanded end of the plug that extended down to the counterbore region on the ID surface of the RV Head, the plug will be captured at the counterbore region. This inherent safety design will prevent significant leakage should a failure of the T/C weld occur. The consequences of any future leakage would be similar in nature to the minor leakage noted during this outage.