



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST FROM ASME CODE, SECTION XI REQUIREMENT

DUKE ENERGY CORPORATION

CATAWBA NUCLEAR STATION, UNITS 1 AND 2

OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3

MCGUIRE NUCLEAR STATION, UNITS 1 AND 2

1.0 INTRODUCTION

The Technical Specifications (TSs) for the Catawba Nuclear Station (Catawba), Units 1 and 2, the Oconee Nuclear Station (Oconee), Units 1, 2, and 3, and the McGuire Nuclear Station (McGuire), Units 1 and 2, state that the inservice inspection (ISI) of the American Society of Mechanical Engineers (ASME) Code Class 1, 2, and 3, components shall be performed in accordance with Section XI of the ASME Boiler and Pressure Vessel Code (ASME Code) and applicable addenda as required by Title 10 of the Code of Federal Regulations (10 CFR) Section 50.55a(g), except where specific written relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i). Section 50.55a(a)(3) states that alternatives to the requirements of paragraph (g) may be used, when authorized by the NRC, if (i) the proposed alternatives would provide an acceptable level of quality and safety or (ii) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

In Federal Register Notice No. 154, Volume 61, dated August 8, 1996, the Nuclear Regulatory Commission (NRC) announced the amendment of its regulation, 10 CFR 50.55a (rule). The rule incorporated, by reference, the 1992 Edition with 1992 Addenda of Subsections IWE and IWL of Section XI of the Code. Subsections IWL and IWE, respectively, provide the "Requirements for Class CC Concrete Components of Light-Water Cooled Plants," and "Requirements for Class MC and Metallic Liners of Class CC Components of Light-Water Cooled Plants." The effective date for the amended rule was September 9, 1996, and it required licensees to incorporate the new requirements in their ISI plans and to complete the first containment inspection by September 9, 2001. However, Duke Energy Corporation (DEC or the licensee) can submit a request for relief from one or more requirements of the regulation (or the endorsed Code requirements) with proper justification. The provision for granting relief is incorporated in the regulation.

By its letter of April 6, 1998, the licensee requested the staff's approval to use an alternative to the requirements of the Code for its Oconee Units 1, 2 and 3, McGuire Units 1 and 2, and Catawba Units 1 and 2 (Ref. 1). This evaluation addresses the acceptability of the licensee's request for relief from the Code.

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## 2.0 EVALUATION

### A. Code Requirements:

The ASME Code Section XI, Division 1, 1992 Edition with the 1992 Addenda, Paragraph IWE-2500(c) "Examination and Pressure Test Requirements" reads as follows:

- (c) Examination methods for surface areas for augmented examination in IWE-1242 shall comply with the following criteria.
  - (1) Surface areas accessible from both sides shall be visually examined using a VT-1 visual examination method.
  - (2) Surface areas accessible from one side only shall be examined for wall thinning using an ultrasonic thickness measurement method in accordance with Section V, T-544.
  - (3) When ultrasonic thickness measurements are performed, one foot square grids shall be used. The number and location of the grids shall be determined by the Owner.
  - (4) Ultrasonic measurements shall be used to determine the minimum wall thickness within each grid. The location of the minimum wall thickness shall be marked such that periodic reexamination of that location can be performed in accordance with the requirements of Table IWE-2500-1, Examination Category E-C.

Table IWE-2500-1, Examination Category E-C, Item E4.12, requires ultrasonic thickness measurement of 100 percent of minimum wall thickness locations during each inspection period, established in accordance with IWE-2500(c)(3) and IWE-2500(c)(4). The extent of examination shall be 100 percent for each inspection period until the areas remain essentially unchanged for three consecutive inspection periods. Such areas no longer require augmented examination in accordance with IWE-2420(c).

### B. Requirement from which Alternative is Requested:

DEC requests an alternative to the visual, VT-1 examination requirements and the ultrasonic thickness measurement requirements of IWE-2500(c)(1), IWE-2500(c)(2), IWE-2500(c)(3), IWE-2500(c)(4), and Table IWE-2500-1, Examination Category E-C, Containment Surfaces Requiring Augmented Examination.

### C. Systems/Components for which Alternative is Requested:

Class MC pressure retaining components and metallic shell and penetration liners of Class CC pressure retaining components.

D. Licensee's Basis for Requesting Alternative:

Compliance with IWE-2500(c)(1):

DEC states that compliance with IWE-2500(c)(1) will require a VT-1 visual examination on some surfaces that do not warrant augmented examination, and that these examinations will result in a hardship without a compensating increase in quality or safety. DEC further states that for a component, which is accessible from both sides, it is unnecessary to require a VT-1 visual examination on both sides when only one side of the component is subject to conditions that warrant augmented examination, and that VT-1 visual examination of the side subject to augmented examination is sufficient to comply with the intent of IWE-2500(c)(1).

Compliance with IWE-2500(c)(2):

DEC states that compliance with IWE-2500(c)(2) will require ultrasonic thickness measurements to be performed on some surfaces that do not warrant volumetric examination, and that these examinations will result in a hardship without a compensating increase in quality or safety, since it is unnecessary to require an ultrasonic thickness measurement for a component, which is accessible from one side only, if only the accessible side of the component is subject to conditions that warrant augmented examination. Such surfaces, DEC claims, can be effectively examined using a visual VT-1 examination method.

Compliance with IWE-2500(c)(3) and (c)(4):

Because IWE-1241 does not indicate whether an owner can select a sample for examination from within an area subject to ultrasonic thickness measurement, DEC has interpreted the Code to require that 100 percent of such areas be examined. Furthermore, IWE-1241 is applicable to areas that not only have experienced accelerated degradation and aging, but also to areas that could potentially experience such degradation and aging. It can be interpreted that all areas with conditions similar to those where degradation is found shall require augmented examination. As a result, it is possible that large areas of containment surfaces shall be subject to ultrasonic thickness measurement in accordance with the augmented examination requirements of IWE-2500(c)(2). DEC considers that the requirement to perform examinations on 100 percent of these areas is excessive and that it may expose personnel to increased radiological exposure, with no compensating increase in quality or safety. 100 percent examination is unwarranted if an appropriate examination plan is established that provides an equivalent level of assurance that potential degradation can be detected. An alternative sampling plan for selecting areas to be examined using an ultrasonic thickness measurement method is provided in Table 1 in Reference 1.

Table 1 in Reference 1 permits the use of a sampling plan that complies with the Normal Sampling Plan specified in Table 2-1 of EPRI NP-7218, "Guideline for the Utilization of Sampling Plans for Commercial-Grade Item Acceptance (NCIG-19)," Project Q101-07, Final Report, June 1992. The reasons for DEC's use of the Normal Sampling Plan are given below: (as stated)

1. Lot homogeneity.

Table 1 requires that the lot size be limited to areas which are subject to similar service conditions. This helps to ensure lot homogeneity within the areas subject to augmented examination.

2. Lot attributes.

The critical characteristic of the lot (wall thickness) can be easily verified using the required examination method. Another critical characteristic of the lot (leak-tightness) is verified through periodic leak-testing in accordance with 10 CFR 50, Appendix J.

3. Component safety significance.

The Reactor containment provides an essentially leak-tight barrier against the uncontrolled release of radioactivity to the environment. Although the containment serves an important safety function, its function is less critical than that of safety class 1 systems such as reactor coolant systems which are subject to examination under ASME Code, Section XI, Subsection IWB.

4. Performance history.

Although licensees have identified degradation to containment pressure boundary materials, there have been no documented cases where the leak-tight integrity of the containment pressure boundary has resulted from wall thickness loss. As a result, it is unlikely that ultrasonic thickness measurements will reveal areas where degradation is unacceptable, even if 100% examination is performed.

5. Designation of areas subject to ultrasonic thickness measurement.

IWE-1241 requires that areas likely to experience accelerated aging and degradation require augmented examination. However, IWE does not specifically address areas where the risk of potential degradation is low or where expected service conditions have an undetermined effect on containment surface areas. An advantage to allowing an appropriate sampling plan is that areas with marginal degradation risk can now be examined in accordance with IWE without excessive hardship or unusual difficulty. IWE does not contain risk-based provisions which would allow an owner the flexibility to establish appropriate examination requirements, commensurate with the anticipated risk of degradation.

6. Additional verifications of containment integrity.

10 CFR 50, Appendix J, Type A, leakage tests provide assurance of containment leak-tight integrity. Option B to Appendix J was approved in 1996 primarily

because the performance history of these tests justified reducing the required test frequency.

Also, 10 CFR 50.55a (b) (2) (x) (A) requires that a licensee evaluate the acceptability of inaccessible areas when conditions exist in accessible areas that could indicate the presence of or result in degradation to such inaccessible areas. When such degradation is detected by visual examination, the inaccessible surface areas would be evaluated. If these areas can be examined using an ultrasonic thickness measurement method, such areas would be subject to augmented examination in accordance with IWE-2420(b). This provision will help to ensure that the sampling plan would be modified to include these additional areas.

DEC claims that the proposed alternative will provide an equivalent level of quality and safety in lieu of the augmented examination requirements of IWE-2500(c) and Table IWE-2500-1, Examination Category E-C for all containment surfaces subject to augmented examination and will minimize personnel radiological exposure associated with performing these examinations.

E. Alternative Examination(s) proposed by the licensee:

The licensee states that, for areas subject to augmented examination in accordance with IWE-1240, the following alternative provides more appropriate examination requirements. (as stated)

In lieu of the requirements of IWE-2500(c)(1) and IWE-2500(c)(2), the following alternative is proposed:

- (1) Surface areas accessible for visual examination shall be visually examined using a VT-1 visual examination method.
- (2) Surface areas accessible only from the opposite side [to that requiring augmented examination] shall be examined for wall thinning using an ultrasonic thickness measurement method in accordance with [ASME] Section V, T-544.

The licensee states that both sides of a component part need not be subject to augmented examination if conditions, which warrant the augmented examination, occur on one side only. The "surface areas" listed above are those subject to augmented examination. (as stated by the licensee)

In lieu of the requirements of IWE-2500(c)(3) and IWE-2500(c)(4), the following alternative[s] are proposed:

- (3) When ultrasonic thickness measurements are performed, grids not exceeding one foot square shall be used. The size and location of examination areas shall be determined by the Owner.

- (4) Ultrasonic thickness measurements shall be used to determine the minimum wall thickness within each grid. The location of the minimum wall thickness shall be recorded or marked so that periodic reexamination of that location can be performed in accordance with Table 1, Examination Category E-C.

In lieu of the requirements of Table IWE-2500-1, Examination Category E-C, Containment Surfaces Requiring Augmented Examination, [given in the ASME Code Subsection IWE, the licensee provided an alternative table (Table 1 in Ref. 1)].

#### F. Justification for Proposed Alternative:

The purpose of IWE-2500(c) and Table IWE-2500-1, Examination Category E-C, is to require either visual or ultrasonic thickness measurement of areas subject to augmented examination to ensure containment leak-tight or structural integrity. The licensee claims that (i) the proposed alternative satisfies this requirement, but eliminates examinations that are not necessary to provide this assurance; (ii) it also provides a sampling plan for areas subject to ultrasonic thickness measurements that provides an equivalent level of quality and safety without imposing a hardship or unusual difficulty; and that (iii) augmented examinations performed in accordance with this alternative will also eliminate unnecessary radiological exposure to examination personnel.

#### G. Staff Evaluation

In response to a staff question as to how the licensee can be certain that a particular side of a component will not permanently need augmented examination, and how it can justify the omission of a VT-1 examination of that side, the licensee indicated that some surfaces requiring augmented visual examination may need permanent augmented examination (Ref. 2). However, the Code allows VT-1 visual examinations of these surfaces to be discontinued if the areas remain essentially unchanged for three consecutive periods, as stated in Table IWE-2500-1, Examination Category E-C, footnote (2). The licensee believes that the intent of the Code is to permit these examinations to be discontinued after three consecutive periods because the service conditions in that area have been demonstrated not to cause accelerated aging and degradation. If any area subject to augmented visual examination does not remain essentially unchanged after three consecutive periods, that area shall continue to be examined in accordance with Category E-C.

The licensee's alternative would exempt the opposite side of a component from augmented visual examination (VT-1) if the conditions on that side are different from those on the examined side, and if the conditions on the opposite side are such that accelerated aging and degradation is not likely. The licensee has indicated that all accessible surfaces (including surfaces on both sides of a component) are required to be examined once each inspection period using a general visual examination in accordance with Table IWE-2500-1, Examination Category E-A, Item E1.11, as modified by 10 CFR 50.55a(b)(2)(x)(E). Further, although Table IWE-2500-1, Category E-A, footnote (1) permits these examinations to be performed from either the inside or the outside surface, the licensee intends to use these examinations to satisfy both 10 CFR Part 50, Appendix J and IWE. Since 10 CFR Part 50, Appendix J requires both sides to be examined, the general visual examinations shall be performed on both sides. These surfaces

are also required to be examined once each interval using a VT-3 visual examination in accordance with Table IWE-2500-1, Examination Category E-A, Item E1.12. If conditions on the opposite side of a component are causing accelerated aging and degradation, or may be capable of causing accelerated aging and degradation, then that side shall also be subject to augmented examination in accordance with Category E-C. In view of the above clarification, the staff finds the licensee's request for relief from compliance with IWE-2500(c)(1), which will require a VT-1 visual examination on some surfaces that do not warrant augmented examination, reasonable and acceptable and that the alternative provides an acceptable level of quality and safety by providing assurance of structural integrity.

In response to a staff inquiry about the appropriateness of performing a VT-1 visual examination in lieu of ultrasonic testing (UT) when only the accessible side is subject to conditions, which warrant augmented examination, the licensee explained its rationale as follows:

IWE-1241 requires that surface areas subject to conditions which are likely to cause accelerated aging and degradation require augmented examination. These areas may, or may not, be experiencing any degradation. For areas where accelerated aging and degradation could occur, it is possible to determine this solely by performing a visual, VT-1 examination. For areas that are subject to conditions causing accelerated aging and degradation, UT examination may be appropriate, depending on the type and extent of degradation. In either case, if visual examinations detect conditions, which require engineering evaluation in accordance with IWE-3200, supplemental examinations are required by the Code. In most cases, UT would be the nondestructive examination (NDE) method chosen to evaluate the acceptability of any metal loss. Furthermore, if a coated area has experienced accelerated aging and degradation, and the coating has been repaired, there is no benefit to performing UT examinations when a VT-1 examination can confirm that the area is no longer experiencing accelerated aging and degradation. In other words, DEC proposes using a VT-1 examination method if the augmented examination surface is accessible, and a UT examination if it is inaccessible for visual examination. If a surface is accessible, and is experiencing degradation which warrants evaluation, the licensee has proposed performing an NDE on the accessible surface, as required by IWE-3200.

In response to a related question as to which surface areas have been identified where a visual VT-1 examination is proposed in lieu of UT measurements required by IWE-2500(c)(2), the licensee stated that, because the Containment ISI Programs are under development and have not been completed, a detailed list of these areas cannot be provided at this time. However, based on operating experience at its plants, the licensee does not anticipate initially performing any VT-1 examinations in lieu of UT. The licensee further states that the request to use VT-1 in lieu of UT was made primarily to address component surfaces which, during the course of implementing examinations required by the Code, are found to warrant augmented examination. Suspect areas detected by visual examination, which require evaluation in accordance with IWE-3200, shall be added to the augmented examination program in accordance with IWE-2420(b). The staff finds this proposal reasonable and acceptable since the alternative provides an acceptable level of quality and safety by providing assurance of structural integrity.

IWE-2500(c)(3) specifies that 1 foot square grids shall be used for ultrasonic measurements, and further states that the number and location of the grids shall be determined by the owner, while IWE-2500(c)(4) specifies that the extent of examination shall be 100 percent for each inspection period until the areas examined remain essentially unchanged for three consecutive inspection periods. The alternative proposal separates the question of the number of grids from IWE-2500(c)(3), and incorporates it in its alternative proposal for IWE-2500(c)(4). The staff considers the proposed alternative for IWE-2500(c)(3) acceptable.

In response to a staff question regarding the nominal plate thickness and under tolerance limit, which may determine the extent of additional examinations required for McGuire, Units 1 and 2, and Catawba, Units 1 and 2, the licensee has stated that areas identified at Catawba and McGuire, which should be examined under Category E-C, have a nominal plate thickness of 3/4 inch and 1 inch. For this plate thickness, the material specifications allow an under thickness tolerance of 0.01 inch (0.99 inch minimum plate thickness). This limit is obtained from Table A1.1 of ASTM A20/A20M, which specifies a "permissible variation under specified thickness, 0.01 in." For areas where the nominal plate thickness is equal to 3/4 inch, the licensee's alternative program shall require additional examinations if the measured plate thickness is less than  $0.95 \times (3/4 \text{ inch} - 0.01 \text{ inch}) = 0.70 \text{ inch}$ . For areas where the nominal plate thickness is equal to 1 inch, the alternative program shall require additional examinations if the measured plate thickness is less than  $0.95 \times (1 \text{ inch} - 0.01 \text{ inch}) = 0.94 \text{ inch}$ . The licensee stated that the 95 percent limit (i.e., the 0.95 factor) proposed above is intended to provide reasonable assurance that the thickness measurements obtained are due to metal loss, and not the result of measuring locally thin areas of plate which otherwise meets the material specification thickness requirements. In this connection, it is worth noting that the acceptance standards for IWE 3512.3 "Ultrasonic Examination" allow the material loss of up to 10 percent of the nominal containment wall thickness; therefore, the staff does not accept the licensee's proposed 95 percent limit on top of the 10 percent allowance given in IWE-3512.3.

Table 1 of Reference 1 gives the details of the sampling plan for surface areas requiring ultrasonic thickness measurement. DEC proposes to use a sample size of 32 from a lot size greater than 210 grids as per the guidelines given in EPRI NP-7218, "Guideline for the Utilization of Sampling Plans for Commercial-Grade Item Acceptance (NCIG-19)." The staff's evaluation indicates that the sampling size given by DEC (using EPRI NP-7218) does not meet the NRC criterion of 5 percent defects with 95 percent confidence. To assure meeting such a criterion, a sample size varying between 54 and 58 is required for lot sizes between 210 and 1000, provided that the lot is accepted only if there are no defectives in the sample, as given in Table 1 of the NRC draft Regulatory Guide DG-1070 (September 1997). Therefore, DEC's proposed sampling plan described in Table 1 of Reference 1 for ultrasonic thickness measurements is not acceptable.

### 3.0 CONCLUSION

Based on the information provided by the licensee in the request for relief (Ref. 1) and the presentation made by DEC on July 8, 1998, at NRC headquarters, the staff concludes that, in lieu of the requirements of IWE-2500(c)(1), IWE-2500(c)(2), and IWE-2500(c)(3) the following alternative examinations proposed by DEC provide an acceptable level of quality and safety and are, therefore, authorized pursuant to 10 CFR 50.55a(a)(3)(i):

- (1) Surface areas accessible for visual examination shall be visually examined using a VT-1 visual examination method.
- (2) Surface areas accessible only from the side opposite to that requiring augmented examination shall be examined for wall thinning using an ultrasonic thickness measurement method in accordance with ASME Section V, T-544.
- (3) When ultrasonic thickness measurements are performed, grids not exceeding one foot square shall be used. The size and location of examination areas shall be determined by the licensee.

However, DEC's proposed sampling plan described in Table 1 of Reference 1 for ultrasonic thickness measurements (in lieu of the requirement of IWE-2500(c)(4)) is not acceptable as it does not meet the NRC criterion of 5 percent defects with 95 percent confidence as recommended in the NRC draft Regulatory Guide DG-1070 (September 1997).

#### References

1. Letter dated April 6, 1998, from M. S. Tuckman, Duke Energy Corporation, to U.S. Nuclear Regulatory Commission, Subject: "Request to Use an Alternative to the ASME Boiler and Pressure Vessel Code, Section XI in accordance with 10 CFR 50.55a(a)(3)(i) Duke Energy Corporation Serial Number 98-GO-003."
2. Memorandum dated July 9, 1998, from David E. LaBarge, U.S. Nuclear Regulatory Commission, Subject: Summary of the July 8, 1998, Meeting on Relief Request 98-GO-003 (for Oconee, Catawba, and McGuire) enclosing Duke Energy Corporation (DEC)'s Handout of DEC's Responses to NRC's questions.

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