Duke Energy®

T. PRESTON GILLESPIE, JR.
Vice President
Oconee Nuclear Station

Duke Energy
ON01VP / 7800 Rochester Hwy.
Seneca, SC 29672

864-873-4478
864-873-4208 fax
T.Gillespie@duke-energy.com

October 13, 2011 10 CFR 21.21

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

Subject: Duke Energy Carolinas, LLC

Oconee Nuclear Station (ONS)
ONS Docket Nos. 50-269, 50-270, and 50 -287

McGuire Nuclear Station (MNS)
MNS Docket Nos. 50-369 and 50-370

Catawba Nuclear Station (CNS)
CNS Docket Nos. 50-413 and 50-414
Amended 10CFR21 Notification - Identification of Defect
Mackson Inc. - Defective Tube Steel - NRC Event Number 46375

On November 22, 2010, Duke Energy Carolinas, LLC (Duke Energy) submitted a written report of the identification of a defect in a basic component, as required by 10CFR21.21(d)(3)(ii). The defect identified was a longitudinal crack in a section of 4 inch X 4 inch X 1/2 inch ASTM A500 tube steel that was to be used in the Oconee Protected Service Water (PSW) duct bank elevated cable raceway. This information was initially reported to the Nuclear Regulatory Commission (NRC) Operations Center on October 29, 2010 (Event Number 46375, ADAMS Accession Number ML103060087). Investigations to determine the cause and extent of the problem are complete. This letter amends the report, addressing the results of the subsequent evaluation and corrective actions that have been and will be taken with respect to installed and purchased tube steel.

The attachment to this letter provides the information to close the report for this concern. There are no commitments contained in this letter or its attachment. Should you have any questions or require additional information, please contact Sandra N. Severance, Regulatory Compliance, at (864) 873-3466.

Sincerely,

T Gillespie

T. Preston Gillespie, Jr., Vice President
Oconee Nuclear Site

Attachment

IE19
NRR

cc: Mr. Victor McCree
Administrator, Region II
U.S. Nuclear Regulatory Commission
Marquis One Tower
245 Peachtree Center Ave., NE, Suite 1200
Atlanta, GA 30303-1257

Mr. John Stang, Jr.
Project Manager (ONS)
U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Mail Stop 08-G9A
Washington, DC 20555-0001

Mr. Jon H. Thompson
Project Manager (CNS & MNS)
U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Mail Stop 08-G9A
Washington, DC 20555-0001

Mr. Andrew Sabisch
NRC Senior Resident Inspector
Oconee Nuclear Station

Mr. John Zeiler
NRC Senior Resident Inspector
McGuire Nuclear Station

Mr. Andy Hutto, III
NRC Senior Resident Inspector
Catawba Nuclear Station

Mr. Tom Sharp, Director of Quality
Mackson Inc.
PO Box 12067
2346 Southway Drive
Rock Hill, SC 29730

Attachment
Oconee, McGuire, and Catawba Nuclear Stations
Amended Notification per 10CFR21.21(d)(3)(ii)

This notification follows the format of and addresses the considerations contained in 10 CFR 21.21(d)(4)(i) - (viii).

(i) Name and address of the individual or individuals informing the Commission.

T. Preston Gillespie
Vice President
Oconee Nuclear Station
7800 Rochester Highway
Seneca, SC 29672

(ii) Identification of the facility, the activity, or the basic component supplied for such facility or such activity within the United States which fails to comply or contains a defect.

Basic component which fails to comply or contains a defect:

ASTM A500 Tube Steel, four inch by four inch by one half inch wall thickness (4 inch x 4 inch x 1/2 inch) supplied by Mackson, Inc., under Duke Energy Purchase Order number: 124917, Heat No. A010493

(iii) Identification of the firm constructing the facility or supplying the basic component which fails to comply or contains a defect.

Supplied by (dedicating entity):

Mackson Incorporated
PO Box 12067
2346 Southway Drive
Rock Hill, SC 29731

Manufactured by:

Hanna Steel Corporation
Tuscaloosa Division
1701 Boone Blvd
PO Box 428
Northport, AL 35476

(iv) Nature of the defect or failure to comply and the safety hazard which is created or could be created by such defect or failure to comply.

The affected material is 4 inch x 4 inch x 1/2 inch tube steel. The material was manufactured by Hanna Steel under ASTM A500 as commercial grade. It was then dedicated as defined by Part 21 by the supplier (Mackson, Inc.). Duke Energy procured the tube steel as safety-related from Mackson, Inc.

During construction of the Protected Service Water (PSW) ductbank elevated cable raceway, craft reported a longitudinal crack in the tube steel, approximately four feet in length, adjacent to a raceway fabrication weld. The crack was located in the manufacturer's longitudinal seam weld in the tube steel. Follow-up investigation and laboratory evaluation revealed that the structural steel tubing in question contains surface breaking flaws located along the centerline of the seam weld which are attributable to lack of fusion that occurred during tubing manufacture. Additional testing of samples from the same heat of material indicated that the seam weld flaw depth varied with some localized areas reaching depths of at least 40 percent through the wall thickness prior to raceway fabrication welding.

According to documents received from the supplier, during dedication, the supplier performed chemical, physical and 100 percent visual exam in accordance with their accepted dedication procedures for ASTM A500 for Grade B material. However, the supplied product did not conform to the requirements of ASTM A500 in that the longitudinal butt joint was not welded across its thickness (Reference ASTM A500, Section 6.2).

Samples of the 4 inch x 4 inch x 1/2 inch A500 tube steel were sent to Duke Energy's metallurgical laboratory (Metlab). The Metlab report concluded that "the structural steel tubing in question contains OD surface breaking flaws located along the centerline of the seam weld which are attributed to lack of fusion that occurred during tubing manufacture. ... weld flaw depth [varied but reached] depths of at least 40% throughwall."

A defective longitudinal seam weld of the hollow structural section (HSS) 4 inch x 4 inch x 1/2 inch structural members may significantly impair the structural properties of the HSS section of the tube steel. The generic implications associated with the potential use of these structural members in various nuclear safety-related applications at Oconee and other stations could result in a substantial safety hazard.

(v) The date on which the information of such defect or failure to comply was obtained.

Duke Energy concluded its evaluation of the deviation under 10CFR21.21(a)(1) on October 28, 2010.

(vi) In the case of a basic component which contains a defect or fails to comply, the number and location of all such components in use at, supplied for, or being supplied for one or more facilities or activities subject to the regulations in this part.

Mackson, Inc. states that Duke Energy is the only known nuclear utility which has purchased this type of tube steel from them. Four (4) additional samples of seam welded tube steel procured from Mackson, Inc., representing different sizes, manufacturers and heat numbers, were submitted for metallurgical analysis. Those results indicated the problem to be isolated to 4 inch x 4 inch x 1/2 inch tube steel, heat A010493. On October 29, 2010, Duke Energy reported an initial conclusion that the subject defect was confined to this heat of tubing in use at Oconee.

Update: Upon discovery of the problem during welding at Oconee, all stock quantities of tube steel were quarantined at Catawba, McGuire, and Oconee Nuclear Sites. The supplier was notified, and future supplies were only accepted from the supplier based on the successful performance of surface examination. The quarantined tube steel was then examined via liquid penetrant or magnetic particle testing to support an extent of condition review. A total of 1862 linear feet of tube steel was pulled from plant stock and examined at the three sites. Surface examinations of the seam welds were performed and approximately 212 inches of linear indications were identified over the length of steel. These indications were detected in tube steel produced by five different manufacturers and in a variety of tube steel sizes and wall thicknesses.

The extensive testing of tube steel performed at all three nuclear sites determined the extent of condition associated with non-conforming tube steel. These surface examinations concluded that less than one percent (in terms of length) of tube steel within the scope of testing had relevant surface Indications. A smaller subset of this quantity had significant through wall extent.

The use of ASTM A500 tube steel in plant components is widespread. The most common application has been in piping supports. Other structures containing tube steel are cable tray supports, instrument and tubing supports, platforms, and equipment base supports.

Duke Energy performed a qualitative review of the structural effects related to the identified fabrication problem to evaluate the potential impact of this issue to the qualification of nuclear safety related components. The structural behavior of a tube steel section with an indication similar to those identified by supplemental testing was evaluated considering effects on section properties. Typical structural applications of tube steel use in the plant and load transfer between components and their supports were also reviewed. And finally, experience data in terms of component qualification was considered to recognize margins in existing component support designs. The combination of factors related to indication frequency, tube steel use, effects, and margins were used to qualitatively accept the existing tube steel. It was concluded, based on the review, that the design function of structures using ASTM A500 tube steel members would not be adversely affected.

(vii) *The corrective action which has been, is being, or will be taken; the name of the individual or organization responsible for the action; and the length of time that has been or will be taken to complete the action.*

1. The defective tube steel utilized in the PSW structure was not placed into service without evaluation. Tube steel sections of the same heat of material not used in pre-fabrication efforts were scrapped. Those installed were cut out or evaluated for acceptability by Engineering. All tube steel of this heat has been disposed of, removed, or verified to be acceptable.

2. After initial identification of the problem, all other stock quantities of tube steel were quarantined at Catawba, McGuire, and Oconee Nuclear Sites. The

quarantined tube steel was then examined via liquid penetrant or magnetic particle testing to support the extent of condition review.

3. All quarantined tube steel with rejectable indications has been identified to be scrapped.

4. Additional required testing for safety-related A500 tube steel has been developed. All QA-1 tube steel purchased since this issue was first identified was tested prior to issuance. All future QA-1 tube steel will be procured requiring non-destructive examination (NDE) of the weld.

(viii) *Any advice related to the defect or failure to comply about the facility, activity, or basic component that has been, is being, or will be given to purchasers or licensees.*

Testing required by ASTM A500 for rectangular tube steel is not sufficient to verify the quality of the weld. Some manufacturer's weld process control is not sufficient to ensure uniform weld quality that meets ASTM A500 along the entire length of the weld.

Discussions between the manufacturer and the supplier concluded that a specific root cause for the weld seam flaws could not be determined. The manufacturer identified three factors most likely contributing to the root cause, listed in the order of importance to be:

1. The weld seam was located too close to the corner which could cause some stretching of the weld during the final forming of the tube.
2. The possibility of "rounded" or "beveled" edges resulting from the tooling design for the tube mill rolls for this size.
3. Less than optimal heating during the ERW (Electric Resistance Welding) Process.

The tube steel in question was procured to ASTM A500, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes. The ASTM A500 specification covers cold-formed welded and seamless structural tubing produced in a variety of shapes. The specification contains requirements for chemical analysis and tensile testing. A flattening test is required for round structural tubing, but not shaped structural tubing. In Section 6, Manufacture, the specification requires the "longitudinal butt joint of welded tubing be welded across its thickness in such a manner that the structural design strength of the tubing section is assured." In Section 11, Permissible Variations in Dimensions, the specification requires the "minimum wall thickness at any point of measurement on the tubing shall not be more than 10% less than the specified wall thickness." However, this requirement is qualified for square and rectangular tubing such that the wall thickness requirements "apply only to the center of the flats." Section 16 of the specification states "surface imperfections shall be classed as defects when their depth reduces the remaining wall thickness to less than 90% of the specified wall thickness."

The concern noted during this evaluation is that there is no specific requirement in ASTM A500 addressing the specific dimensional thickness of the weld. Reliance on the requirements in the ASTM A500 specification that could be measured by dimensional

inspection, chemical and mechanical testing to ensure the quality of the tube steel was not sufficient. The quality of the longitudinal weld which forms the closed tube section was not evaluated. This is considered a weakness in application of the selection of critical characteristics applicable to tube steel. Critical characteristics are those characteristics that have a direct effect on the item's ability to accomplish its intended safety function that, once verified, will provide reasonable assurance the item will perform its intended safety function. The supplier's dedication of commercial-grade structural material provides requirements for assuring lot homogeneity and traceability. Their procedure states material purchased as commercial-grade to be used in nuclear safety related applications will be inspected, tested, and accepted based on either the Test and Inspection Method or by Commercial-Grade Survey. The procedure requires the Test and Inspection Method be followed when material is purchased from a manufacturer whose quality program has not been audited. Their procedure states that for the purposes of testing, the critical characteristics of the material shall be defined by the chemical, mechanical, and dimensional requirements of the applicable material specification. Weld quality of structural steel was not addressed.

Additionally, in the procurement of tube steel, Duke Energy provided no oversight of identification of critical characteristics. Instead, Duke Energy relied solely on the requirements within ASTM A500. Going forward, Duke Energy will define the integrity of the weld as a critical characteristic of QA-1 tube steel, will require a Duke Energy approved dedication plan for QA-1 tube steel, and will provide oversight of the sampling methodology any time it is revised. These revisions to the procurement process are necessary to prevent questions related to the structural integrity of the tube steel material.