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March 16, 2020

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U.S. Nuclear Regulatory Commission Attn: Document Control Desk Washington, DC 20555-0001

Subject: 10CFR21 Reportable Issue

THE REPORT OF AND

Holtec International has identified an issue with stainless steel tubes supplied by Sandvik Materials Technology that has been determined to be reportable under 10CFR21. The issue was identified as an arc strike on the tubes which reduced wall thickness and caused cracking. The actual defect was caused by Sandvik's vendor Atlas Industrial Manufacturing Company. Specific details of the evaluation are provided on the attached 10CFR21 Reportability Evaluation.

Please feel free to contact me with any questions you may have on this matter.

Mark Soler Distant Soler, o, ou, email=m.soler@holtec.co Date: 2020.03.16 12:44:21 -04'00

Mark Soler Vice President-Quality

Attachment: 10CFR21 Reportability Evaluation (5 pages)

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Re: 10CFR21 Report # 2020-1

This material in this evaluation document follows the format set down in HSP-101501.

BRIEFLY SUMMARIZE THE DEVIATION OR NONCONFORMING ITEM*:

The non-conforming item is ASME Section III Class 1 tubing supplied by Sandvik for use in heat exchangers manufactured or in the process of being manufactured by Holtec for deployment in nuclear power plants.

Stainless steel tubes were procured by Holtec from Sandvik (Clarks Summit, Pa.) for subsequent use in an ASME Section III heat exchanger project. Certain tubes exhibited uncharacteristic corrosion on their inside surfaces which led Holtec to perform a detailed investigation. Testing of several tubes by Holtec's vendor, (International Testing Laboratory Services (ITLS)) were performed in order to examine the tubing for the anomalous oxidation, discoloration and rusting that had been observed at the Holtec Manufacturing Division, Pittsburgh, PA. The source of the corrosion has been attributed to inadequate inert gas cover in the interior of the tubes employed by Sandvik's vendor (Atlas) during the heat treatment of the U-bends. However, during this investigation, an unrelated questionable surface condition on the heat-treated region of the tubes was identified. When analyzed, this condition appeared to be an arc strike/burn from the electrodes which were attached for the annealing process performed by a Sandvik vendor (Atlas) after forming of the "U" bends. Further investigation showed wall thinning and cracking in the areas of the arc strikes. The nonconforming condition, therefore, pertains to two types of damage to the pressure boundary of the tubes, namely:

- (i) Generation of oxidation products in the inside of the tubes and evidence of possibility of increased susceptibility to future corrosion.
- (ii) Creation of locations of stress concentration on the outside of the tube walls that lead to future breach of the tube's pressure boundary.

DATE OF DISCOVERY: January 21, 2020 [This filing had to wait until the investigation by Holtec's experts was completed and definitive conclusions were drawn. Because the non-compliant condition did not pose an imminent danger to society, the Company decided to make an in-depth inquiry in consultation with its customer (Curtiss Wright) and supplier (Sandvik)].

SOURCE DOCUMENT FOR DEVIATION OR NONCOMPLIANCE (E.G., AUDIT REPORT, QI, NCR, ETC.): NCR 16238-7

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^{*} Include part make/model or similar identifier, as applicable.

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Re: 10CFR21 Report # 2020-1

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NAME AND ADDRESS OF ENTITY RESPONSIBLE FOR THE DEVIATION OR NONCOMPLIANCE:

The party directly responsible to Holtec for providing the defective tubing is Sandvik Materials Technology 982 Griffin Pond Road Clarks Summit, Pa. 18411 Contact: Keith Hottle-Director of Quality

The party where the defect was introduced, to the best of our knowledge, is Sandvik's vendor, Atlas Industrial Mfg. Co.

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I. Determination of 10CFR21 Applicability

Is the affected component hardware or the design, analysis, inspection, testing, fabrication, replacement of parts, or consulting services associated with the component hardware a basic component.

YES X NO *

BASIS: The noncomplying items are stainless steel tubes that are used in the tube bundles for an ASME Section III Reactor Coolant Pump External Heat Exchanger used in Nuclear Power Plants.

*If the response is "NO", then 10 CFR 21 is not applicable to this deviation or noncompliance. The preparer and reviewer must sign this evaluation and obtain a Corporate QA Manager concurrence signature. No further action is required.

II. Description of Deviation or Noncompliance

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Provide a detailed description of the deviation or noncompliance as it relates to the basic component's ability to perform its safety function.

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Stainless steel tubes were procured by Holtec from Sandvik (Clarks Summit, Pa.) for subsequent use in an ASME Section III pressure vessel project. Recent testing of several tubes by Holtec's vendor (International Testing Laboratory Services (ITLS)) was performed in order to examine tubing for oxidation, discoloration and rusting issues. During this testing an unrelated questionable surface condition was identified.

Areas on two (2) tubing sample pieces were closely examined. The tubing pieces were pickled with a Nitric/Hydrofluoric mix then rinsed. The area with the arc burn was split open, sectioned and mounted for microscopic examination. First, an unaffected/not burned area was examined. This unaffected area on test piece #1 showed a normal equi-axed grain structure with correct nominal wall thickness. On sections of areas under the arc burn on test piece #1, melting, solidification, and a thinning of the wall to .011" from the .035" nominal was found. Further investigation of the arc burn on test piece # 2 showed cracks are that were formed in the base metal under the arc burns. Additional tubes were subsequently found to have the same condition though the actual arc burn is not easily recognizable as it will visually blend with the background oxide.

Per SA-688 (Standard Specification for Seamless and Welded Austenitic Stainless Steel Feedwater Heater Tubes) which is invoked on the purchase order, "If the heat treatment is accomplished by resistance-heating methods wherein electrodes are clamped to the tubes, the clamped areas shall be visually examined for arc burns. Burn indications shall be cause for rejection unless they can be removed by local polishing without encroaching upon minimum wall thickness." Under the deviated condition, the tubing is in violation of this specification and is thus deviating from ASME Section III Class 1 pressure vessel Code which requires use of ASME material.

III. Determination of 10CFR21 Reportability

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Is the deviation or noncompliance described in Item II above a defect or failure to comply potentially involving a substantial safety hazard per 10 CFR 21? Pay particular attention to the definition for substantial safety hazard.

NOTE: For those occasions where it is indeterminate whether a defect or noncompliance constituting a substantial safety hazard exists, consult with the Corporate QA Manager; Licensing Manager, Vice President; or other senior management. If, after discussion with Company management, the issue is still indeterminate and no further evaluation can be performed in a timely manner, check "YES" and report the issue to the NRC. Describe the issue as a "potential" defect or failure to comply potentially involving a substantial safety hazard in the basis below.

Re: 10CFR21 Report # 2020-1

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YES X NO

BASIS:

The tubes under this purchase order are installed in the heat exchangers and are currently being stored at Curtiss Wright (Holtec's customer). The heat exchangers are not installed or being used at this time. Therefore, there is no immediate substantial safety hazard for this particular order of tubes. However, the equipment in which the tubes with hidden defects were installed is known as the "Reactor Coolant Pump External Heat Exchanger". Each heat exchanger features 720 U- tubes made of seamless stainless steel (SA213-304) material bent into u-shapes in compliance with SA688. The tube side of the heat Management of the nuclear Code-ASME Section III and the highest pedigree of the nuclear Code-ASME Section III and the section of the section of the nuclear Code-ASME Section III and the section of the section of the nuclear Code-ASME Section III and the section of the section of the nuclear Code-ASME Section III and the section of the section of the nuclear Code-ASME Section III and the section of the section of the nuclear Code-ASME Section III and the section of the section of the nuclear Code-ASME Section of the section of Subsection NB by the system designer. The Code designation given to tube side of the heat exchanger is in line with the severe design conditions (2500 psi @300 Deg. F.) applicable to it. The heat exchanger is also postulated to withstand a number of severe thermal and pressure transients during its service life. So, if the heat exchanger had been installed, under the transients, the localized flaw introduced in the tubes during their heat treatment may propagate causing a thru-wall leak. Because of the very large pressure difference between the tube and shell sides of the heat exchanger, a breach in the tube wall may lead to substantial leakage of the reactor coolant water into the plant's circulating cooling water which is highly undesirable.

A second purchase order to Sandvik during the same time period also shows similar conditions. These tubes are at Holtec and are for 16 heat exchangers which are in varying stages of production at Holtec for Harbin (a Chinese company). Therefore, there is no current substantial safety hazard for this particular order of tubes.

The Holtec evaluation identified one additional older Holtec order to Sandvik for supply of pressure vessel tubes for a similar project. While these tubes are installed in heat exchangers and these heat exchangers are installed in nuclear plants in China, it was determined that these tubes were processed by a different Sandvik vendor and also did not exhibit any signs of oxidation/discoloration, which was the initiating condition that lead to the subsequent finding. As such, there is no reason to believe the tubes in these heat exchangers exhibit a similar condition identified in this evaluation.

Despite the above evaluation that indicates there is no current substantial safety hazard, it is unknown what other customers Sandvik may have supplied tubes to that were formed and heat treated at Atlas and may have been used in safety related applications. As such, it is determined that this condition is reportable under 10 CFR 21.

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IV. Conclusions

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- (i) The defect seems to have been introduced in the tubes by a faulty process for heat treating employed by Sandvik"s (the tubing manufacturer's) vendor subsequent to their manufacturing by Sandvik.
- The defects introduced in the tubes renders them unsuitable for reliable long term service (ii) in a nuclear plant.
- (iii) The ASME Code's specification of heat treatment of the tubing have been determined by Holtec's experts to be adequate to prevent such defects.
- (iv) In so far as the arc strikes are difficult to detect, the nuclear industry should be cautioned against faulty heat treatment processes employed by any vendor. Among the preventive measures introduced by Holtec's QA department in the wake of this discovery is to require one or more random tubes from the lot to be independently tested by our company before their final acceptance in our manufacturing program. Holtec considers this measure to be essential to uphold our commitment to protect public health and safety.
 - (v) This Deviation/noncompliance IS reportable under 10CFR21
 - Digitally signed by Mark Sole DN: cn=Mark Soler. o. ou. Mark m.soler@holtec.com email c=US Soler Date: 2020.03.16 12:39:07 -04'00

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Digitally signed by Rob Tindal Date: 2020.03.16 12:48:15 -04'00'

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Reviewer Signature/Date

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Corporate QA Manager Concurrence Signature/Date