GE Oil & Gas

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U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001
ATTN: Document Control Desk
Subject; Reply to NRC letter on feedback to GE Response to Notice of Nonconformance - NON 99901468/2016-201-01

Document Control Desk:

Thank you for your feedback and opportunity to clarify our response regarding the subject NON 99901468/2016-201-01. The following is provided in response to your request for clarification of actions regarding the 2 specific points below.

1. **NRC Feedback** – "Verify the tensile strength property as it related to the spindle material ASTM B637 Type 2 (Inconel) cited as specific example in NON"

   Response: Per our commercial grade dedication process, hardness is defined as the acceptance criteria (Section 2.0, GE Dresser Document, EG-504). The conversion formula to correlate hardness and tensile strength is used in this document (EG-504) to convert published tensile strength (ASME Sec IID) to an equivalent hardness (Section 6.1, EG-504). This formula is not used to convert the measured hardness to tensile strength to qualify the commercial grade part for nuclear service. The tensile strength is not used as the acceptance criterion for commercial grade dedication; and therefore it is not checked during our commercial dedication process. We failed to communicate this clearly during the audit and in the follow up discussions.

   As noted in the audit, the correlation formula shall not be used to convert tensile strength to hardness for non-steel materials. EG-504 was revised (both revisions were provided for clarity) to restrict the use of the conversion formula to steel materials only. For ASTM B637 Inconel Type 2 and non-steels, the hardness value is directly used from the published material specification.

   Additional Information: The material (ASTM B637 Type 2 Inconel) was purchased and processed through the ASME audited commercial supplier quality assurance program and GE Dresser site Quality Assurance program. For commercial parts, the commercial Supplier Quality Assurance program and internal quality program (including supplier qualification and audits, incoming material inspection, internal audits etc.) provide satisfactory assurance on the mechanical properties, chemical composition, and dimensional characteristics of the valve/valve parts. However, when these commercial parts/materials are used for nuclear

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service, the commercial grade dedication process is used to reasonably assure that the commercial parts are acceptable. The commercial grade dedication checks various critical to quality properties like dimensions, chemistry and mechanical properties. The commercial grade dedication process does not completely qualify the material, but provides reasonable assurance that the ASTM B637 Type 2 Inconel material sourced commercially meets the required dimensional/chemical/mechanical properties. Additional dimensional checks are performed to provide reasonable assurance of dimensional properties. PMI testing is performed for reasonable assurance of the chemical composition of the material. The hardness check provides reasonable assurance that the mechanical property of the ASTM B637 Type 2 Inconel as qualified and procured through the commercial sourcing process was met. For nuclear products, the commercial grade dedication process acts as an additional check to provide reasonable assurance of the mechanical, chemical and physical properties of the material.

The hardness is used as the acceptance criterion to provide reasonable assurance for the mechanical properties of the metallic material. There is a direct correlation of hardness and tensile strength for metals (including ASTM B637 Type 2 Inconel) as confirmed by the following references. However, empirical correlation formulas that convert hardness value to tensile strength and vice versa are available only for steels and cast irons.

a. EPRI NP-5652 Revision 1, Plant Engineering: Guideline for the Acceptance of Commercial-Grade Items in Nuclear Safety Related Applications, Section 5 – Commercial-Grade Dedication Process, Subsection 5.7, Page 5-13, Excerpt below:

   "Relationships between characteristics may be considered. In certain situations, verification of one characteristic may provide some assurance of another characteristic. For example, verification of hardness may provide some assurance of a related property, such as tensile strength."

b. ISO 18265-2013, Metallic Materials – Conversion of Hardness Values, Section 2 – Principles of conversion, Excerpt below:

   "In practice, it is often desirable to use hardness results to draw conclusions on the tensile strength of the same material if tensile testing is too involved or the piece to be examined is not to be destroyed.
   Since the means of loading in hardness testing is considerably different from that in tensile testing, it is not possible to derive a reliable functional relationship between these two characteristic values on the basis of a model. Nevertheless, hardness values and tensile strength values are positively correlated, and so it is possible to draw up empirical relationships for limited applications."

c. Mechanical Engineering Design, Shigley & Mischke, 5th Edition, 1989, McGraw-Hill Inc., Chapter 5 – Materials, Section 5-4 – Hardness, Excerpt below:

"The primary advantage of the method (both –Rockwell hardness measurement and Brinell hardness measurement – are nondestructive in most cases) is that the Brinell hardness is directly related to the ultimate strength of the material tested. This means that the strength of the parts could, if desired, be tested part by part during manufacture."

2. **NRC Feedback** – "Justify the lack of verification of the tensile strength property as it related to the other non-stainless steel products previously manufactured and shipped."

   Response: All ASTM B637 Inconel Type 2 parts that were dedicated using EG-504 Revision 4 (potential escaping defects), were validated by ensuring that the material property met the ASTM/ASME material specifications. No safety issues were identified during the FMEA performed on installed base. Apart from ASTM B637 Inconel Type 2, no other non-steel parts were qualified using the commercial grade dedication.

We presume that this additional clarification and information provides sufficient response to your questions.

Please let us know if we should discuss further or if this information will now close this NON.

Thank you for your attention and consideration in this matter.

Sincerely,

Anne Sullivan
Global Quality Manager

CC: Chief, Mechanical Vendor Inspection Branch
Division of Construction and Operational Programs
Office of New Reactors