May 3, 2000

COMMITTEE CORRESPONDENCE

ORGANIZATION: ASME, Boiler & Pressure Vessel Code

COMMITTEE: Working Group Pressure Testing (WGPT)
Subcommittee Inservice Inspection, Section XI

SUBJECT: Code Case N-616, "Alternative to Insulation Removal"

TO:

Mr. Frank J. Schaaf, Jr., Chairman
Working Group Pressure Testing
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ADDRESS WRITER CARE OF:

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Frank,

The purpose of this letter is to document technical concerns regarding Code Case N-616, "Alternative to Insulation Removal." Code Case N-616 would allow licensees to perform the VT-2 visual examination without insulation removal for bolting material that is resistant to boric acid corrosion. I was not aware of the following technical concerns when I voted affirmatively for Code Case N-616, however, after discussions with James A. Davis of the NRC staff, I have an explanation of concerns related to three particular materials that have been identified as corrosion resistant. Specifically, the three materials are: AISI Type 17-4 PH stainless steel (SA-564 Grade 630), AISI Type 410 stainless steel (SA-194 Grade 6), and A-286 stainless steel (SA-453 Grade 660) bolted connections. The 17-4 PH stainless steel and the 410 stainless steel are suitable for use in contact with primary water if they are aged at a temperature of 1100 °F or higher. If they are aged at a lower temperature, they become susceptible to primary water stress corrosion cracking. The hardness of these alloys should be below R_c 30 if they are properly heat treated. A-286 stainless steel is susceptible to stress corrosion cracking in primary water, particularly if preloaded above 100 ksi. NUREG/CR-3604, "Bolting Applications," states that A-286 stainless steel is not suitable for use as a reactor structural material because much safer materials are available. However, there are a large number of A-286 currently in nuclear service, both in BWRs and PWRs.

Bengtsson and Korhonen of ASEA-ATOM, Vasteras, Sweden, examined the behavior of A-286 in a BWR environment as reported in the Proceedings of the International Symposium on Environmental Degradation of Materials in Nuclear Power Systems-Water Reactors, August 22-25, 1983, Myrtle Beach, South Carolina sponsored by National Association of Corrosion Engineers, the Metallurgical Society of AIME, and the American Nuclear Society. They found the A-286 in comparison to other tested materials, was the most susceptible material they tested to intergranular stress corrosion cracking in BWR water. They also found that A-286 is less likely to crack as the applied stress is reduced. Piascik and Moore from Babcock & Wilcox reported a number of vessel internals bolt failures of A-286 bolts in Nuclear Technology, Vol.

75, December, 1986 in PWR water. They correlated the failures with bolt fillet peak stress and found that bolts preloaded below 100 ksi showed no failures.

The staff has concluded that any 17-4 PH stainless steel or 410 stainless steel stud, bolt, or nut aged at a temperature below 1100 °F or with hardness above R_c 30 must have the thermal insulation removed for VT-2 examination during the system pressure test. For A-286 stainless steel studs or bolts, the preload must be verified to be below 100 ksi or the thermal insulation must be removed and the joint visually inspected. For A-286 nuts, experience indicates it would not be necessary to remove the thermal insulation for visual inspection.

Code Case N-616 does not address the possibility that 17-4 PH stainless steel, 410 stainless steel, or A-286 bolted connections could fail in service under insulation and the failure could go unnoticed. In addition, all valve bodies, pump casings, and piping must contain at least 10 percent chromium and be in the proper heat treatment condition because the insulation could create an autoclave, and materials with less than 10 percent chromium could experience high corrosion rates that could go unnoticed. The code case does not specifically require the four hour hold time at operating temperature and pressure prior to conducting the VT-2, and has eliminated the requirement to remove the insulation at any time.

Due to the technical concerns outlined in this letter, the working pressure testing should reconsider Code Case N-616 to address these concerns.

Sincerely,

Andrea D. Lee
Component Integrity Section
Materials and Chemical Engineering Branch
Division of Engineering

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Sincerely,

Andrea D. Lee
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