UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS
WASHINGTON, DC 20555

October 17, 1996

NRC INFORMATION NOTICE 96-54: VULNERABILITY OF STAINLESS STEEL TO CORROSION WHEN SENSITIZED

Addressees

All materials licensees.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to make licensees aware of the vulnerability of stainless steel to corrosion when sensitized. This issue is of particular concern to the NRC when it involves sources or devices constructed of stainless steels. Although the corrosion in the incident described below involved only 316L stainless steel, the inherent concerns extend to other types of stainless steel that may be subjected to temperatures that sensitize the material. It is expected that recipients will review the information for applicability to their programs. However, suggestions contained in this information notice are not NRC requirements; therefore, no specific action nor written response is required.

Description of Circumstances

Recently, the NRC was informed of the discovery of corrosion found on a particular manufacturer's 316L stainless steel irradiator source used in Category IV irradiator facilities. These sources were similar in design and construction to other manufacturers' sources; however, their sources showed signs of intergranular corrosion, whereas other manufacturer's sources located in the same irradiator pool did not.

Analysis of test data and reports provided by the manufacturer revealed that the 316L stainless steel sources were heat sensitized as a result of improper loading of the sources in the shipping container. The heat generated by these high activity sources resulted in higher than normal temperatures inside the container. The sensitized stainless steel was then vulnerable to intergranular corrosion. The intergranular corrosion was initiated due to the sensitized material being in an environment favorable for corrosion (i.e., poor pool water quality).

Discussion

Although stainless steels are considered as having excellent corrosion resistance, they can be susceptible to corrosion when exposed to certain conditions. Stainless steels are protected against corrosion by alloying them with protective elements such as chromium. For

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example, 316L stainless steel, which is considered to have high corrosion resistance, contains 17 percent chromium. However, if the level of these protective elements is reduced below the minimum percentage necessary, the protective properties are reduced and the material becomes vulnerable to corrosion.

One of the ways that these protective properties can be compromised occurs when the stainless steel is subjected to temperatures within a certain critical temperature range. The critical temperature range for this to occur varies for different stainless steels, and is typically higher than the normal operating temperatures that the material would be subjected to. Stainless steels subjected to temperatures within this critical range for a sufficient length of time will become heat sensitized. Heat sensitization refers to a condition where the protective elements in the material structure of the stainless steel are reduced to levels below the minimum necessary for corrosion protection. The amount of time before heat sensitization occurs is temperature and time dependent, and is typically longer for temperatures at the lower end of the temperature range. For example, a material may need to be exposed to temperatures at the low end of the range for a year or longer before heat sensitization would occur, while at the upper end of the scale, heat sensitization may occur within seconds. These higher than normal temperatures may occur in a number of ways, including, but not limited to, loading too many sources in a shipping or storage container, loading the sources in an improper configuration within the shipping or storage container, and use or accident conditions which result in the material experiencing high temperatures. If these sensitized materials are placed in an environment favorable to corrosion, such as an electrolyte or conducting liquid medium, then intergranular corrosion, which is a type of corrosion that occurs along the boundaries between the grains of the stainless steel, can occur. The rate of intergranular corrosion is hard to predict and is based on a complex relationship involving time, temperature, and environment.

All licensees should be aware of the potential for sensitization and resulting corrosion in stainless steel, and should consider their own circumstances and take action appropriately. Licensees should be particularly sensitive to past and potential situations involving transportation, and to situations involving accident conditions and incident response. Licensees should avoid subjecting their sources and devices to conditions that could cause sensitization. Licensees who suspect that a source or device may have been subjected to conditions that could cause sensitization, should monitor the source or device for signs of corrosion. Sources or devices showing signs of corrosion should be isolated and placed in an environment not favorable to corrosion. They should be evaluated before continued use. Licensees may contact the manufacturer or a knowledgeable consultant to obtain assistance in evaluating whether sensitization and corrosion is a concern for their particular circumstances.

This information notice requires no specific action nor written response. If you have any questions about the information in this notice, please contact the technical contacts listed below or the appropriate regional office.

Donald A. Cool, Director
Division of Industrial and
Medical Nuclear Safety
Office of Nuclear Material Safety
and Safeguards

Technical contacts: Michele Burgess, IMAB
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Attachments:
1. List of Recently Issued NMSS Information Notices
2. List of Recently Issued NRC Information Notices

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LIST OF RECENTLY ISSUED NMSS INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
96-53	Retrofit to Amersham 660 Posilock Radiography Camera to Correct Inconsistency in 10 CFR Part 34 Compatibility	10/15/96	All industrial radiography licensees
96-52	Cracked Insertion Rods on Troxler Model 3400 Series Portable Moisture Density Gauges	09/26/96	All U.S. Nuclear Regulatory Commission portable gauge licensees and vendors
96-51	Residual Contamination Remaining in Krypton-85 Handling System After Venting	09/11/96	All material licensees
96-47	Recordkeeping, Decommissioning Notifications for Disposals of Radioactive Waste by Land Burial Authorized Under Former 10 CFR 20.304, 20.302, and Current 20.2002	08/19/96	All U.S. Nuclear Regulatory Commission licensees
96-35	Failure of Safety Systems on Self-Shielded Irradiators Because of Inadequate Maintenance and Training	06/11/96	All U.S. Nuclear Regulatory Commission irradiator licensees and vendors
96-33	Erroneous Data from Defective Thermocouple Results in a Fire	05/224/96	All material and fuel cycle licensees that monitor temperature with thermocouples
96-28	Suggested Guidance Relating to Development and Implementation of Corrective Action	05/01/96	All material and fuel cycle licensees

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95-04, Supp. 1	Excessive Cooldown and Depressurization of the Reactor Coolant System Following Loss of Offsite Power	10/11/96	All holders of OLs or CPs and vendors for nuclear power reactors
96-40, Supp. 1	Deficiencies in Material Dedication and Procurement Practices and in Audits of Vendors	10/07/96	All holders of OLs or CPs for nuclear power reactors
96-52	Cracked Insertion Rods on Troxler Model 3400 Series Portable Moisture Density Gauges	09/26/96	All U.S. Nuclear Regulatory Commission portable gauge licensees and vendors
92-68, Supp. 1	Potentially Substandard Slip-On, Welding Neck, and Blind Flanges	09/16/96	All holders of OLs or CPs for nuclear power reactors
96-51	Residual Contamination Remaining in Krypton-85 Handling System After Venting	09/11/96	All material licensees

OL = Operating License
CP = Construction Permit

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WASHINGTON, D.C. 20555-0001

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