

UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
OFFICE OF NUCLEAR REACTOR REGULATION  
WASHINGTON, DC 20555-0001

June 19, 2003

NRC INFORMATION NOTICE 2003-06: FAILURE OF SAFETY-RELATED LINESTARTER  
RELAYS AT SAN ONOFRE NUCLEAR  
GENERATING STATION

Addressees

All holders of operating licenses or construction permits for nuclear power reactors, except those that have permanently ceased operations and have certified that fuel has been permanently removed from the reactor.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to inform addressees of recent failures of safety-related valves due to linestarter relay degradation. The degradation was caused by past use of excessive amounts of trichloroethane-based cleaners during preventive maintenance. It is expected that recipients will review the information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions in this information notice are not NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances

San Onofre Nuclear Generating Station utilizes reversing linestarters manufactured by Square D to operate the motors on safety-related motor-operated valves. The linestarter consists of two relays that provide 480 volt power to the motor and contain auxiliary contacts associated with interlock and seal-in functions. The interlock function provides a means to avoid energizing both open and closed relays at the same time. The seal-in function keeps the relay energized until the valve has completed its stroke. All reversing linestarters have interlock auxiliary contacts. San Onofre has 172 Square D linestarters associated with safety-related motor-operated valves, 86 in each unit.

On August 30, 2002, a Unit 3 low-pressure safety injection (LPSI) pump mini-recirculation valve failed to open during surveillance testing. Subsequent analysis determined that the plastic housing on an auxiliary contact in the associated linestarter was degraded. The licensee determined that the auxiliary contact housing degradation was caused by the past use of excessive amounts of Inhibisol, a cleaning solvent based on trichloroethane (TCE). The cleaning solvent caused the plastic to break down. Over time, small amounts of the plastic came loose and interfered with the electrical contacts, resulting in the valve failure.

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In response to the LPSI pump mini-recirculation valve failure, San Onofre developed a plan to inspect a sample of other safety-related linestarters installed in Units 2 and 3. In October 2002, San Onofre completed the inspection of 19 additional linestarters. This sample inspection identified two auxiliary contacts that showed signs of chemical attack (i.e., cloudy plastic contact housing); however, both were found to be functional. Subsequently, the licensee developed a risk-informed plan to inspect all safety-related linestarters and replace all auxiliary contacts showing signs of chemical attack. The linestarter inspections were scheduled into online and outage maintenance windows, and will be completed by the end of the Unit 2 outage in 2004.

On January 18, 2003, during a Unit 3 refueling outage, the quench tank sample containment isolation valve failed to open during surveillance testing. Examination of the contact revealed that a similar chemical attack had occurred and caused the valve failure.

On February 10, 2003, during an inspection of Unit 3 LPSI header stop valve linestarters, an auxiliary contact failed on the 20<sup>th</sup> cycle of the auxiliary contact test. The linestarter inspections included a test to cycle each auxiliary contact 20 times. This auxiliary contact cycle test was performed to determine the functionality of the auxiliary contacts in the linestarter.

On Unit 3, all 86 linestarters have been inspected with two surveillance test failures noted and one maintenance test failure. The licensee replaced 42 auxiliary contacts from the linestarters due to evidence of chemical attack on the plastic auxiliary contact housing. On Unit 2, 33 linestarters have been inspected as of May 2, 2003, with no failures noted; however, four auxiliary contacts showed signs of chemical attack on the plastic contact case.

### Discussion

As a result of the valve stroke failure on August 30, 2002, the licensee initiated a laboratory analysis of the suspect auxiliary contact from the linestarter. The contact was coated with a plastic residue from the deterioration of the plastic switch bodies. The licensee concluded that excessive use of cleaning solvents during previous preventive maintenance activities had caused the failure of the contacts.

The licensee believes that all damage to the auxiliary contact housings occurred prior to 1989 and is showing up in the recent safety-related valve failures. The original linestarter preventive maintenance procedure was issued in April 1984, and required the use of cleaning solvents on linestarters, but had no caution regarding the potential for damage to plastic components within the linestarter. Also, the procedure did not require visual inspection of internally mounted auxiliary contact assemblies. As a result, Inhibisol was used liberally, which allowed the cleaner to come in contact with plastics that were susceptible to chemical degradation. In April 1989, the licensee recognized that TCE-based cleaners were being used improperly and that controls needed to be implemented to prevent future damage to equipment containing plastics. The licensee revised the consumables controls manual to restrict the use of TCE-based cleaners on plastics, and provided guidance on the approved method for use of the cleaner (i.e., spray on cloth, then wipe component). Additionally, the linestarter preventive maintenance procedure was revised to caution that cleaning solvents should be used sparingly to avoid damage to plastic components. In response to the recent valve failures, the licensee took action on March 7, 2003, to prohibit the use of all TCE-based cleaners for electrical maintenance applications.

The licensee missed several opportunities from plant and industry experience to recognize the need for an extent-of-condition review. An extent-of-condition review could have identified any equipment degradation that occurred throughout the plant due to improper use of cleaning solvents. One of these prior opportunities was the review of Information Notice 93-76, "Inadequate Control of Paint and Cleaners for Safety Related Equipment," which the licensee performed in February 1994. The review determined that the programs in place were sufficient to avoid problems similar to those discussed in the notice. The licensee focused on the TCE-based cleaner controls in place at the time of the information notice review, but overlooked the fact that safety-related equipment could have been damaged prior to the implementation of the controls in April 1989. This oversight was a missed opportunity to correct the equipment deficiency that has been revealed by the recent linestarter failures and the discovery of degraded contacts.

The San Onofre linestarter experience emphasizes the need to perform an extent-of-condition review to determine equipment impact when an improper maintenance practice is recognized and corrected. Further, the root cause analysis revealed that past improper use of corrosive cleaners could result in degraded plant equipment that could remain undetected for a considerable length of time before showing up in equipment failures.

This information notice requires no specific action or written response. If you have any questions about the information in this notice, please contact one of the technical contacts listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

**/RA/**

William D. Beckner, Program Director  
Operating Reactor Improvements Program  
Division of Regulatory Improvement Programs  
Office of Nuclear Reactor Regulation

Technical Contacts: Gregory G. Warnick  
623-386-3638  
Email: [gxw2@nrc.gov](mailto:gxw2@nrc.gov)

Vern Hodge  
301-415-1861  
Email: [cvh@nrc.gov](mailto:cvh@nrc.gov)

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Technical Contacts: Gregory G. Warnick  
623-386-3638  
Email: [gxw2@nrc.gov](mailto:gxw2@nrc.gov)

Vern Hodge  
301-415-1861  
Email: [cvh@nrc.gov](mailto:cvh@nrc.gov)

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2003-05	Failure to Detect Freespan Cracks in PWR Steam Generator Tubes	06/05/2003	All holders of operating licenses or construction permits for pressurized-water reactors (PWRs).
2002-15, Sup 1	Potential Hydrogen Combustion Events in BWR Piping	05/06/2003	All holders of operating licenses for light water reactors, except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor.
2002-21, Sup 1	Axial Outside-diameter Cracking Affecting Thermally Treated Alloy 600 Steam Generator Tubing	04/01/2003	All holders of operating licenses for nuclear power reactors, except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel.
2003-04	Summary of Fitness-For-Duty Program Performance Reports for Calendar Year 2000	02/06/2003	All holders of operating licenses for nuclear power reactors, except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel.
2003-03	Part 21 - Inadequately Staked Capscrew Renders Residual Heat Removal Pump Inoperable	01/27/2003	All holders of operating licenses or construction permits for nuclear power reactors.

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