UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D.C. 20555

March 15, 1989

NRC INFORMATION NOTICE NO. 89-30: HIGH TEMPERATURE ENVIRONMENTS AT NUCLEAR POWER PLANTS

Addressees:

All holders of operating licenses or construction permits for nuclear power reactors.

Purpose:

This information notice is being provided to alert addressees to potential problems resulting from high temperature environments in areas that contain safety-related equipment or electrical cables. 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 contained in this information notice do not constitute NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances:

In November 1988, while Duane Arnold Energy Center (DAEC) was shut down for refueling, the licensee for DAEC discovered 1 pinhole leak, 2 through-wall cracks, and 30 flaw indications on the control rod drive (CRD) insert lines inside the drywell. The defects were caused by externally induced chloride stress corrosion cracking. The area near the defects contained Rockbestos Firewall III radiation, cross-linked, polyethylene-insulated, electrical cable with a Hypalon (Neoprene Chloroprene) jacket. The cable had previously been degraded by exposure to local drywell temperatures in excess of 270°F. When the damaged electrical cable was replaced, loose degraded insulation lodged in the conduit and the field junction box. Moisture from steam leaks condensed in and dripped through the conduit onto the CRD piping. The condensate contained chlorides that were leached from the insulation lodged in the conduit and the junction box. There are several areas at a reactor facility where degradation of cables and leaching of chloride may occur because of high temperature and humidity. In addition to the drywell, the licensee for DAEC also found indications of chlorides leaching on the steam tunnel.

During a refueling outage in November 1988, the licensee for Dresden Unit 2 discovered evidence that paint inside the upper region of the drywell had been exposed to elevated temperatures. Further investigation revealed that the Limitorque operators on the steam supply valves to the high-pressure

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coolant injection system and the isolation condenser (located in the same area) had indications of exceeding their environmental qualification (EQ) design temperature. Grease samples taken from these valves showed significant degradation, and the lower main bearing of one valve operator was damaged. Other equipment affected by the high temperature included two vessel head vent valves and a standby liquid control valve. Also, the electrical insulation on about 50 cables was cracked. The root cause for the elevated temperature at Dresden was attributed to a deficiency in procedures that resulted in the ventilation ducts in the upper region of the drywell being left closed for about 18 months while the plant was in operation.

In August 1987, the NRC became aware that Arkansas Nuclear One, Unit 1 (ANO-1), had probably operated since it was licensed in 1974 with containment temperatures ranging from 90°F to 180°F. The bulk average temperature was roughly 140°F. Safety-related electrical equipment is environmentally qualified to operate at temperatures up to 120°F. Also, design basis accident scenarios had been analyzed assuming an initial containment temperature of 110°F. Over the years, the licensee for ANO-1 attempted to reduce the high containment temperature by installing improved insulation on the reactor coolant system and by acid cleaning of the chillers used for the containment cooling units. These efforts resulted in a very limited temperature reduction.

Discussion:

In the boiling-water reactor events described above, elevated drywell temperature was responsible for degradation of safety-related equipment. Electrical cables are vulnerable to degradation when exposed to high temperatures that exceed their design EQ temperature even for a short period. Regarding the DAEC event, the elevated temperature along with high humidity led to the degradation of safety-related components.

In the ANO-1 event, the higher local temperatures exceeded some of the EQ temperatures for some of the safety and non-safety equipment and components. Also, the higher bulk temperature exceeded the ambient temperature assumed in some of the accident analyses. Three of the analyses that were affected were:

1. The reactor building peak pressure analysis.
2. The inadvertent initiation of the containment spray system analysis.
3. The internal containment subcompartment differential pressure analysis.

There has been a history of reports since 1982 of boiling-water reactors (BWRs) and pressurized-water reactors (PWRs) experiencing excessive heat load problems within the drywell and localized high temperature areas within containment. On June 30, 1988, the NRC issued Temporary Instruction (TI) 2515/98, "Information of High Temperature Inside Containment/Drywell in PWR and BWR Plants." The objective of this TI was to determine whether or not high containment or drywell

temperatures were a plant-specific problem or generic to all PWRs and BWRs. Preliminary findings from the TI showed that:

1. BWRs, especially Mark I and II containments, routinely operate very close to their EQ temperature limit.

2. In the drywells of BWRs there may be substantial temperature gradients (i.e., 100°F or more) that may or may not be detected depending on the location of instrumentation and circulation of the drywell air.

3. The BWR drywell head region seems most susceptible to high temperature.

4. Some PWRs experienced high containment temperatures but the licensees failed to recognize the safety significance and take corrective actions.

It is important for licensees to be aware that there are areas within the plant where the local temperature may exceed equipment qualification specifications even when the bulk temperature, as measured by a limited number of sensors, is indicating that it is lower than the qualification temperature.

No specific action or written response is required by this information notice. If you have any questions about this matter, please contact one of the technical contacts listed below or the Regional Administrator of the appropriate regional office.

Charles E. Rossi

Charles E. Rossi, Director
Division of Operational Events Assessment
Office of Nuclear Reactor Regulation

Technical Contacts: R. Anand, NRR
(301) 492-0805

T. Greene, NRR
(301) 492-1176

Attachment: List of Recently Issued NRC Information Notices

LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
89-29	Potential Failure of ASEA Brown Boveri Circuit Breakers During Seismic Event	3/15/89	All holders of OLs or CPs for nuclear power reactors.
89-28	Weight and Center of Gravity Discrepancies for Copes-Vulcan Air-Operated Valves	3/14/89	All holders of OLs or CPs for nuclear power reactors.
89-27	Limitations on the Use of Waste Forms and High Integrity Containers for the Disposal of Low-Level Radioactive Waste	3/8/89	All holders of OLs or CPs for nuclear power reactors, fuel cycle licenses and certain by-product materials licenses.
89-26	Instrument Air Supply to Safety-Related Equipment	3/7/89	All holders of OLs or CPs for nuclear power reactors.
89-25	Unauthorized Transfer of Ownership or Control of Licensed Activities	3/7/89	All U.S. NRC source, byproduct, and special nuclear material licensees.
89-24	Nuclear Criticality Safety	3/6/89	All fuel cycle licensees and other licensees possessing more than critical mass quantities of special nuclear material.
89-23	Environmental Qualification of Litton-Veam CIR Series Electrical Connectors	3/3/89	All holders of OLs or CPs for nuclear power reactors.
89-22	Questionable Certification of Fasteners	3/3/89	All holders of OLs or CPs for nuclear power reactors.

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TGreene:db	PBaranowsky		LShao	WDLanning	CHBerlinger
2/15/89	2/15/89	2/15/89	3/1/89	3/8/89	3/8/89

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2. In the drywells of BWRs there may be substantial temperature gradients (i.e., ~ 100°F) that may or may not be detected depending on the location of instrumentation and circulation of the drywell air.

3. The BWR drywell head region seems most susceptible to high temperature.

4. PWRs experience high temperatures mainly because of licensee inattention rather than limited instrumentation.

Therefore, licensees should be aware that there are areas within the plant where the local temperature may exceed equipment qualification specifications even when the bulk temperature, as measured by a limited number of sensors, is indicating that it is lower than the qualification temperature.

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Please see the comments as marked.
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2/16/89

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