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

March 7, 1995

NRC INFORMATION NOTICE 95-15: INADEQUATE LOGIC TESTING OF SAFETY-RELATED CIRCUITS

Addressees

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

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to logic testing methods that may not completely test the functionality of a safety-related control circuit. 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 are not NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances

The following logic system functional testing deficiencies have been reported recently and serve as examples of inadequate surveillance testing.

Cooper Nuclear Station

On May 23, 1994, during review of test procedures for automatic load shedding, the licensee determined that load shedding of nonsafety loads from safety-related electrical buses was not being verified. In addition to five nonsafety-related motor control centers, the load shed capability of the service water booster pumps, the station air compressors, and the control rod drive pumps was not verified. As a result, both emergency diesel generators were declared inoperable, the licensee declared an Unusual Event, and the reactor was shut down.

Fermi 2

On July 15, 1994, the licensee discovered that the permissive interlocks for the 4160-Vac emergency bus undervoltage relays were not being adequately tested. While the reviewing engineer was verifying that proper test overlap existed between an electrical logic functional test procedure and a related instrumentation and control (I&C) logic functional test procedure for the residual heat removal system, he determined that neither the electrical procedure nor the I&C procedure fully tested the pump logic.

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Neither procedure included testing of the conductors that connected the electrical and the I&C portions of the circuit. Additionally, verification that a switchgear circuit breaker would not close following initiation of an undervoltage relay was not included in the procedure.

Waterford 3

On September 7, 1994, the licensee discovered that surveillance test procedures did not adequately verify that safety-related 4160-Vac and 480-Vac electrical buses designed to swap from one power source to another ("swing" buses) would properly deenergize and subsequently automatically realign to the proper source. Before performing the integrated emergency diesel generator testing, the swing buses were routinely aligned to the electrical division not under test.

A licensee investigative team concluded that the swing buses may have been deleted from the preoperational test procedure because of a misunderstanding of what constituted a "permanently connected load" in their technical specifications. Although the swing buses can be aligned to more than one power source, the transfer from one source to another requires that the buses be momentarily deenergized (a "dead bus" transfer) and therefore should be considered permanently connected loads. The licensee subsequently revised the definition of a permanently connected load in the technical specification bases.

Grand Gulf Nuclear Station

On September 29, 1994, during a review of logic system functional testing overlap, the licensee discovered that one of four sets of contacts in the "B" containment spray train high drywell pressure initiation logic was not being verified to function during testing. Because of a difference in logic between the "A" and "B" trains, the manual initiation pushbutton had to be held in while the trip signal was introduced in the "B" train logic. Holding the pushbutton in created a current path that bypassed one set of contacts, and these contacts were not tested elsewhere in the procedure.

Arkansas Nuclear One, Unit 2 (ANO-2)

On October 7, 1994, in response to a query about logic system functional testing from the NRC senior resident inspector, the licensee discovered that the swing high-pressure safety injection pump actuation logic was not being fully tested under the engineered safety features surveillance test procedure. The swing pump safety injection actuation signal was not being verified when the pump was being powered from either emergency diesel generator. Further review of the service water pump surveillance methodology found that individual contacts in the engineered safety feature starting circuitry also were not being tested. These contacts prevent redundant service water pumps from automatically starting and loading onto a 4160-Vac bus being powered by a diesel generator to ensure that the diesel is not overloaded.

Arkansas Nuclear One, Unit 1 (ANO-1)

On October 8, 1994, the licensee performed a review of engineered safety feature testing methodology as a result of concerns raised during operation of ANO-2 and discovered two discrepancies. The licensee found that integrated testing of the high-pressure injection pumps did not include complete verification of the circuit breaker position interlocks used in the pump auto-start circuitry. Also, integrated testing did not verify that the swing high pressure injection pump would start if the logic path containing the normal feeder breaker contact was used. Review of the service water system showed that the automatic restart logic for the service water pumps is not verified for the condition when power is supplied from the offsite feeder breaker.

Discussion

Because testing of the engineered safety feature logic is performed during reactor operation when actuation of the system under test would be undesirable, the logic test must be broken up into parts so that the system does not actuate. To ensure that no part of the logic is overlooked, the procedures for these partial functional tests must assure an overlap between where one section of testing ends and the next section begins.

Inadequate logic system functional testing of safety-related circuits has been the topic of numerous information notices issued by the NRC, but licensees continue to report instances in which a particular component or section of logic has not been included in the testing. The complexity of some of these circuits, combined with a lack of understanding of the depth of the review required to verify the testing overlap, has resulted in continuing occurrences of inadequate test scope.

Related Generic Communications

Information Notice 93-38, "Inadequate Testing of Engineered Safety Features Actuation Systems," was issued on May 24, 1993, to alert licensees to inadequate testing of engineered safety feature actuation systems.

Information Notice 92-40, "Inadequate Testing of Emergency Bus Undervoltage Logic Circuitry," was issued on May 27, 1992, to alert licensees to a test method that failed to verify the capability of undervoltage logic circuitry to deenergize safety-related buses, thus preventing an emergency diesel generator from closing onto the bus.

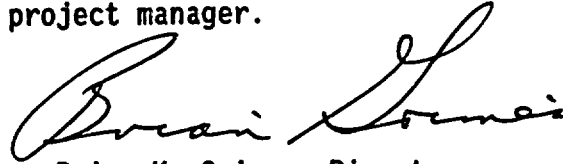
Information Notice 88-83, "Inadequate Testing of Relay Contacts in Safety-Related Logic Systems," was issued on October 19, 1988, to alert licensees to inadequate testing of relay contacts in safety-related logic systems.

LIST OF RECENTLY ISSUED
 NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
95-14	Susceptibility of Containment Sump Recirculation Gate Valves to Pressure Locking	02/28/95	All holders of OLs or CPs for nuclear power reactors.
95-13	Potential for Data Collection Equipment to Affect Protection System Performance	02/24/95	All holders of OLs or CPs for nuclear power reactors.
95-12	Potentially Nonconforming Fasteners Supplied by A&G Engineering II, Inc.	02/21/95	All holders of OLs or CPs for nuclear power reactors.
95-11	Failure of Condensate Piping Because of Erosion/Corrosion at a Flow-Straightening Device	02/24/95	All holders of OLs or CPs for nuclear power reactors.
95-10 Supp. 1	Potential for Loss of Automatic Engineered Safety Features Actuation	02/10/95	All holders of OLs or CPs for nuclear power reactors.
95-10	Potential for Loss of Automatic Engineered Safety Features Actuation	02/03/95	All holders of OLs or CPs for nuclear power reactors.
95-09	Use of Inappropriate Guidelines and Criteria for Nuclear Piping and Pipe Support Evaluation and Design	01/31/95	All holders of OLs or CPs for nuclear power reactors.
95-08	Inaccurate Data Obtained with Clamp-On Ultrasonic Flow Measurement Instruments	01/30/95	All holders of OLs or CPs for nuclear power reactors.

OL = Operating License
 CP = Construction Permit

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.



Brian K. Grimes, Director
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Office of Nuclear Reactor Regulation

Technical contacts: Hukam Garg, NRR
(301) 415-2929

David Skeen, NRR
(301) 415-1174

Attachment:

List of Recently Issued NRC Information Notices

Attachments filed in Jacket

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Original signed by
Brian K. Grimes

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DOCUMENT NAME: 95-1 .IN
*See previous concurrences.

OFC	OECB:DOPS	SC/OECB:DOPS	PUB:ADM	HICB:DRCH
NAME	DSkeen*	RDennig*	Tech Ed*	HGarg*
DATE	02/14/95	02/16/95	02/13/95	02/21/95
OFC	C/HICB:DRCH	OECB:DOPS	C/OECB:DOPS	D/OOPS
NAME	JWermiel*	RKiessel*	ACHaffee*	BGrimes
DATE	02/21/95	02/21/95	02/27/95	03/2/95

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DOCUMENT NAME: G:\DLS\IN95-XX.TST

OFC	OECD:DOPS	SC/OECD:DOPS	PUB:ADM	HICB:DRCH
NAME	DSkeen <i>DS</i>	RDennig <i>RD</i>	Tech Ed*	HGarg <i>HCG</i>
DATE	2/14/95	2/16/95	2/13/95	2/21/95
OFC	C/HICB:DRCH	OECD:DOPS	C/OECD:DOPS	D/DOPS
NAME	JWermiel <i>JW</i>	RKiesel <i>AK</i>	ACHaffee <i>ASB</i>	BGrimes <i>JG 2/25</i>
DATE	2/21/95	2/21/95	2/21/95	1/95

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NAME	DSkeen	RDennig	Tech Ed <i>Doc</i>	HGarg
DATE	/ /95	/ /95	02/31/95	/ /95

OFC	C/HICB:DRCH	DOPS	C/OECEB:DOPS	D/DOPS
NAME	JWermiel	RKiesel	AChaffee	BGrimes
DATE	/ /95	/ /95	/ /95	/ /95

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