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

December 8, 1987

NRC INFORMATION NOTICE NO. 87-62: MECHANICAL FAILURE OF INDICATING-TYPE FUSES

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 the mechanical failure of indicating-type fuses. 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:

The Nuclear Regulatory Commission has been notified of four separate events in the past two years related to the mechanical failure of indicating-type fuses. The events occurred at McGuire Nuclear Station, Unit 1; Catawba, Unit 2; and Sequoyah Nuclear Plant and are described herein.

On March 25, 1986, Duke Power Company's McGuire Nuclear Station, Unit 1, experienced a reactor trip on a steam generator low-low level signal when the mechanical failure of a Bussman FNA-type fuse caused a main feedwater containment isolation valve to close. McGuire personnel determined that the failure was the result of the fuse element having pulled loose from the solder joint inside the fuse. The solder joint was found unbroken; the element wire had pulled out of the solder joint. The licensee found that 8% of the spare fuses in stock also had failed mechanically. Previously, in December 1981 and December 1985, the licensee had reported to the NRC the mechanical failures of FNA-type fuses [Licensee Event Reports (LERs) 369-81-179 and 369-85-036].

On July 3, 1986, the NRC issued a Confirmation of Action Letter (CAL) to Duke Power Company as a followup to an event at Catawba, Unit 2. In that event one of the auxiliary feedwater trains failed to start during testing because of a mechanically failed FNA-type fuse. On July 7, 1986, Duke Power notified the NRC of the preliminary results of a review of all safety-related circuits where FNA-type fuses were used. The review included the inspection of approximately

2500 fuses. The inspection found 14 failed FNA-type fuses, 9 of which were determined to have failed mechanically. The inspection of the spare fuses in the warehouse stock found an additional 11 mechanically failed fuses.

On October 29, 1986, the Tennessee Valley Authority (TVA) submitted a notification on Bussman MIS-5-type fuses to the NRC pursuant to the requirements of 10 CFR Part 21. The Bussman MIS-5 actuating fuse consists of two very thin wires in a sand-like filler. One of the wires, which is approximately 96% silver, acts as a fuse link; the other, a nichrome alloy, acts as a retaining wire for a spring-loaded actuator/indicator rod that is located at one end of the fuse assembly. In the notification TVA indicated that fuses at the Sequoyah Nuclear Plant had exhibited partial actuation, not detectable in all cases by visual examination, that was the result of the elongation of very thin wires. The elongation of these wires could significantly change the characteristics of the fuse and its current-carrying characteristics. This is particularly true if the silver wire breaks but remains in contact with the elongated and unbroken nichrome wire. TVA contacted Bussman and established the resistance and current values that could be used to conclusively test the operability of the remaining fuses.

On July 20, 1987, TVA submitted an LER on Littlefuse Incorporated FLAS-5 type fuses to the NRC (LER 327-87-030). The LER noted that there had been two separate Engineered Safety Feature actuations of the Sequoyah Nuclear Plant's onsite emergency diesel generators as a result of blown FLAS-5-type fuses in the emergency diesel generator start logic circuitry. The FLAS-5 fuse consists of a fuse wire in parallel with a 560-ohm resistor, a spring-loaded indicator pin, and sand-like filler. The indicator pin is mechanically attached to the spring. At the end of the spring, the resistor and the fuse wire are soldered together. The solder material used is a eutectic alloy that has a low melting point. During normal operating conditions, the fuse wire carries the operating current. During a fault condition the solder material rapidly melts. During overcurrent conditions, the resistor heats up with increasing current and serves as the heat source that melts the solder material. When the solder joint melts it interrupts the circuit and releases the indicator pin. The indicator pin itself causes annunciation only and does not trigger any safety features. Because 69 out of 3200 installed FLAS-5-type fuses have failed to date, TVA perceives that a mechanical weakness, such as a defect in the solder joint, is the main cause of the blown fuses in at least two FLAS-5-type fuse lots. The vendor believes that the problem has been corrected by modification of the solder material and processes.

Discussion:

The fuses involved in the events described above are of the pin indicating type. These fuses have an internal spring-loaded indicating pin that protrudes from the end of the fuse when the fuse links separate. These fuse links are designed to melt when the current exceeds the design load; however, in the cases described above, the fuses apparently failed as a result of either a cold solder joint, creep, or fatigue induced by the internal spring tension. Bussman and Littlefuse supply other indicating-type fuses, and other fuse suppliers also make indicating-type fuses. The fuses that have failed mechanically are of the same type that have successfully undergone seismic testing.

The NRC staff reviewed 575 fuse-related LERs for the period 1981-1986. They showed no additional cases of specific mechanical failure; however, 183 reports indicated that the licensee had determined the failure to be from unknown causes, and many of the reports identified a blown fuse as the cause of the associated circuit failure. Fuse replacement was the usual corrective action taken. Because of the large number of fuses involved, the total number of fuse failures may not be abnormal. However, the experience of Duke Power Company and TVA shows that the safety significance evaluation is dependent on an accurate root-cause determination. In the event of an indicating fuse failure, additional investigation, including internal examination of the fuse, may be warranted if an electrical fault cannot be found.

No specific action or written response is required by this information notice. If you have any questions about this matter, please contact the technical contact 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: James C. Stewart, NRR
(301) 492-4644

Joseph J. Petrosino, NRR
(301) 492-4316

Attachment: List of Recently Issued NRC Information Notices

Attachment
IN 87-62
December 8, 1987

LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES 1987

Information Notice No.	Subject	Date of Issuance	Issued to
87-61	Failure of Westinghouse W-2-Type Circuit Breaker Cell Switches.	12/7/87	All holders of OLs or CPs for nuclear power reactors.
87-60	Depressurization of Reactor Coolant Systems in Pressurized-Water Reactors	12/4/87	All holders of OLs or CPs for PWRs.
86-108, Supp. 2	Degradation of Reactor Coolant System Pressure Boundary Resulting from Boric Acid Corrosion	11/19/87	All holders of OLs or CPs for nuclear power reactors.
87-59	Potential RHR Pump Loss	11/17/87	All holders of OLs or CPs for nuclear power reactors.
87-58	Continuous Communications Following Emergency Notifications	11/16/87	All nuclear power reactor facilities holding an OL and the following fuel facilities that have Emergency Notification Systems: Nuclear Fuel Services, Erwin, TN; General Atomics, San Diego, CA; UNC, Montville, CT; and B & W LRC and B & W Navy, Lynchburg, VA.
87-57	Loss of Emergency Boration Capability Due to Nitrogen Gas Intrusion	11/6/87	All holders of OLs or CPs for nuclear power reactors.
87-56	Improper Hydraulic Control Unit Installation at BWR Plants.	11/4/87	All holders of OLs or CPs for boiling water reactors (BWRs).
87-55	Portable Moisture/Density Gauges: Recent Incidents of Portable Gauges Being Stolen or Lost	10/29/87	All NRC licensees authorized to possess portable gauges.

OL = Operating License
CP = Construction Permit

The NRC staff reviewed 575 fuse-related LERs for the period 1981-1986. They showed no additional cases of specific mechanical failure; however, 183 reports indicated that the licensee had determined the failure to be from unknown causes, and many of the reports identified a blown fuse as the cause of the associated circuit failure. Fuse replacement was the usual corrective action taken. Because of the large number of fuses involved, the total number of fuse failures may not be abnormal. However, the experience of Duke Power Company and TVA shows that the safety significance evaluation is dependent on an accurate root-cause determination. In the event of an indicating fuse failure, additional investigation, including internal examination of the fuse, may be warranted if an electrical fault cannot be found.

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

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

Technical Contacts: James C. Stewart, NRR
(301) 492-4644

Joseph J. Petrosino, NRR
(301) 492-4316

Attachment: List of Recently Issued NRC Information Notices

The draft of this information notice was transmitted to DOEA by DRIS in a memorandum from J. Partlow dated 10/8/87.

*SEE PREVIOUS CONCURRENCES

*OGCB:DOEA:NRR	*SICB:DEST:NRR	*RVIB:DRIS:NRR	*PPMB:ARM	*C/OGCB:DOEA:NRR	D/DOEA:NRR
JGuillen	JCStewart	JJPetrosino	TechEd	CHBerlinger	CERossi
11/17/87	11/17/87	11/23/87	11/04/87	11/24/87	12/2/87

and TVA shows that the safety significance evaluation is dependent on an accurate root-cause determination. In the event of an indicating fuse failure, additional investigation, including internal examination of the fuse, may be warranted if an electrical fault cannot be found.

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

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

Technical Contacts: James C. Stewart, NRR
(301) 492-4644

Joseph J. Petrosino, NRR
(301) 492-4316

Attachment: List of Recently Issued NRC Information Notices

*SEE PREVIOUS CONCURRENCES

OGCB:DOEA:NRR	SICB:DEST:NRR	RVIB:DRIS:NRR	*PPMB:ARM	C/OGCB:DOEA:NRR	D/DOEA:NRR
JGuillen	JCStewart	JJPetrosino	TechEd	CHBerlinger	CERossi
11/17/87	11/17/87	11/23/87	11/04/87	11/24/87	11/ /87

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

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

Technical Contacts: James C. Stewart, NRR
(301) 492-4644

Joseph J. Petrosino, NRR
(301) 492-4316

Attachment: List of Recently Issued NRC Information Notices

OGCB:DOEA:NRR	SICB:DEST:NRR	RVIB:DRIS:NRR	PPMB:ARM	C/OGCB:DOEA:NRR	D/DOEA:NRR
JGuillen	JCStewart	JJPetrosino	TechEdatt	CHBerlinger	CERossi
10/ /87	10/ /87	10/ /87	10/4/87	10/ /87	10/ /87