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

March 6, 1991

NRC INFORMATION NOTICE NO. 91-15: INCORRECT CONFIGURATION OF BREAKER OPERATING SPRINGS IN GENERAL ELECTRIC AK-SERIES METAL-CLAD CIRCUIT BREAKERS

Addressees:

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

Purpose:

This information notice is intended to alert addressees to a potential problem caused by the incorrect configuration of the breaker operating springs in the AK-series metal-clad circuit breakers manufactured by the General Electric Company (GE). 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:

On October 28, 1990, the Florida Power and Light Company, the licensee for the St. Lucie Nuclear Power Plant (St. Lucie), Units 1 and 2, reported that a reactor trip circuit breaker failed to close at St. Lucie, Unit 1, during preparation for control element assembly testing. The St. Lucie reactor trip breakers are AK-series, metal-clad circuit breakers manufactured by the General Electric Company (GE). The licensee determined that the breaker failed to close because the configuration of an operating spring was incorrect. During a subsequent inspection of the remaining reactor trip breakers in Unit 1, the licensee determined that the configuration of the operating springs was incorrect on three of the breakers; however the breakers were functioning properly. St. Lucie personnel stated that the GE service shop in Atlanta, Georgia, had last serviced all of their reactor trip breakers.

On November 11, 1990, the Maine Yankee Atomic Power Company, the licensee for the Maine Yankee Atomic Power Station (Maine Yankee), reported that a reactor trip breaker failed to close during the performance of a surveillance test. The licensee determined that the two operating springs were disengaged. The licensee personnel, with the assistance of field service personnel from GE Nuclear Energy (GENE), inspected the remaining eight breakers and observed that the configuration of the springs was incorrect in one of these reactor trip breakers.

IDAR-11C

Discussion:

In a GE AK-series (AK-, AKF-, or AKR-) metal-clad circuit breaker, two operating springs are attached to the circuit breaker mechanism, which closes and latches the circuit breaker contacts. After the contacts close, the tension of the springs maintains latch engagement to keep the breaker in the closed position and supplies the motive force to open the contacts upon demand. If the two operating springs become disengaged from the mechanism, the circuit breaker contacts will not remain closed. On December 28, 1990, Maine Yankee reported to the NRC that, although an AK-2 breaker could close properly with one spring available, the disengaged spring could jam the operating mechanism and prevent the breaker from tripping.

GENE inspected the failed reactor trip breaker from St. Lucie at the GE service facility in Atlanta, Georgia, and confirmed that the failure was caused by the incorrect configuration of the operating springs in the breaker. GENE conducted tests to determine if the circuit breaker would fail to close with the operating springs installed incorrectly, and determined that the operating springs are less likely to disengage from the circuit breaker mechanism if the first curve between the spring hook and the first coil of the operating spring turns away from the centerline of the circuit breaker.

GENE informed the NRC that it has notified its four service centers, which periodically refurbish safety-related circuit breakers, to verify the correct configuration of the operating springs. The GE maintenance instructions provide neither instructions nor sufficient information to verify if the operating springs are correctly oriented.

This information notice requires no specific action or written response. If you have any questions about the information in this notice, please contact the technical contacts listed below or the appropriate NRC project manager.

Charles E. Rossi

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

Technical Contacts: Kamal R. Naidu, NRR
(301) 492-0980

Stephen D. Alexander, NRR
(301) 492-0995

Attachments:
1. List of Additional Failures in GE AK-series Circuit Breakers
2. List of Recently Issued NRC Information Notices

List of Additional Failures in GE AK-Series Circuit Breakers

On April 16, 1989, plant personnel at the St. Lucie plant observed that fuses were blowing when they attempted to close a reactor trip breaker. During an inspection, plant personnel determined that the operating springs had become disconnected from the mechanism. Plant personnel reconnected the operating springs, tested the breaker successfully, and returned it to service.

On January 1, 1989, while plant personnel performed surveillance tests on the reactor trip breakers at the Calvert Cliffs Nuclear Power Plant (Calvert Cliffs), Unit 2, a breaker failed to close. Plant personnel performed an inspection and determined that the left operating spring had become disconnected from the mechanism. Plant personnel reconnected the operating spring, tested the breaker for reclosing successfully, and returned it to service.

On March 21, 1988, while performing surveillance tests on a reactor trip breaker at Calvert Cliffs, Unit 2, plant personnel determined that the operating springs had become disconnected from the mechanism. After replacing the front frame assembly, plant personnel completed the appropriate portions of the surveillance tests and returned the breaker to service.

On March 12, 1988, while performing surveillance tests on reactor trip breakers at Calvert Cliffs, Unit 2, plant personnel observed that a breaker had failed to close. Plant personnel inspected the breaker and determined that the operating springs had become disconnected from the mechanism. Plant personnel reconnected the operating springs, functionally tested the breaker for operability, and returned it to service.

On January 8, 1987, during normal operations at Calvert Cliffs, Unit 2, a reactor trip breaker failed to close after plant personnel had opened it from the control room panel. Plant personnel inspected the breaker and determined that the operating springs had become disconnected from the mechanism. Plant personnel reconnected the operating springs and returned the breaker to service.

On December 15, 1986, during normal operations at Calvert Cliffs, Unit 2, a reactor trip breaker failed to close after an operator had opened it from the control room panel. Plant personnel inspected the breaker and determined that the operating springs had become disconnected from the mechanism. Plant personnel reconnected the operating springs and returned the breaker to service.

LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
91-14	Recent Safety-Related Incidents at Large Irradiators	03/05/91	All Nuclear Regulatory Commission (NRC) licensees authorized to possess and use sealed sources at large irradiators.
91-13	Inadequate Testing of Emergency Diesel Generators (EDGs)	03/04/91	All holders of OLs or CPs for nuclear power reactors.
91-12	Potential Loss of Net Positive Suction Head (NPSH) of Standby Liquid Control System Pumps	02/15/91	All holders of OLs or CPs for boiling water reactors (BWRs).
91-11	Inadequate Physical Separation and Electrical Isolation of Non-safety-related Circuits from Reactor Protection System Circuits	02/20/91	All holders of OLs or CPs for W-designed nuclear power reactors.
86-99, Supp. 1	Degradation of Steel Containments	02/14/91	All holders of OLs or CPs for nuclear power reactors.
89-32, Supp. 1	Surveillance Testing of Low-Temperature Overpressure-Protection Systems	02/12/91	All holders of OLs or CPs for nuclear power reactors.
91-10	Summary of Semiannual Program Performance Reports on Fitness-for-Duty (FFD) in the Nuclear Industry	02/12/91	All holders of OLs or CPs for nuclear power reactors.
91-09	Counterfeiting of Crane Valves	02/05/91	All holders of OLs or CPs for nuclear power reactors.
91-08	Medical Examinations for Licensed Operators	02/05/91	All holders of OLs or CPs for nuclear power, test and research reactors.

OL = Operating License
CP = Construction Permit

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Discussion:

In a GE AK-series (AK-, AKF-, or AKR-) metal-clad circuit breaker, two operating springs are attached to the circuit breaker mechanism, which closes and latches the circuit breaker contacts. After the contacts close, the tension of the springs maintains latch engagement to keep the breaker in the closed position and supplies the motive force to open the contacts upon demand. If the two operating springs become disengaged from the mechanism, the circuit breaker contacts will not remain closed. On December 28, 1990, Maine Yankee reported to the NRC that, although an AK-2 breaker could close properly with one spring available, the disengaged spring could jam the operating mechanism and prevent the breaker from tripping.

GENE inspected the failed reactor trip breaker from St. Lucie at the GE service facility in Atlanta, Georgia, and confirmed that the failure was caused by the incorrect configuration of the operating springs in the breaker. GENE conducted tests to determine if the circuit breaker would fail to close with the operating springs installed incorrectly, and determined that the operating springs are less likely to disengage from the circuit breaker mechanism if the first curve between the spring hook and the first coil of the operating spring turns away from the centerline of the circuit breaker.

GENE informed the NRC that it has notified its four service centers, which periodically refurbish safety-related circuit breakers, to verify the correct configuration of the operating springs. The GE maintenance instructions provide neither instructions nor sufficient information to verify if the operating springs are correctly oriented.

This information notice requires no specific action or written response. If you have any questions about the information in this notice, please contact the technical contacts listed below or the appropriate NRC project manager.

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

Technical Contacts: Kamal R. Naidu, NRR
(301) 492-0980

Stephen D. Alexander, NRR
(301) 492-0995

Attachments:
1. List of Additional Failures in GE AK-series Circuit Breakers
2. List of Recently Issued NRC Information Notices

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Discussion:

In a GE AK-series (AK-, AKF-, or AKR-) metal-clad circuit breaker, two operating springs are attached to the circuit breaker mechanism, which closes and latches the circuit breaker contacts. After the contacts close, the tension of the springs maintains latch engagement to keep the breaker in the closed position and supplies the motive force to open the contacts upon demand. If the two operating springs become disengaged from the mechanism, the circuit breaker contacts will not remain closed. On December 28, 1990, Maine Yankee reported to the NRC that, although an AK-2 breaker could close properly with one spring available, the disengaged spring could jam the operating mechanism and prevent the breaker from tripping.

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GENE informed the NRC that it has notified its four service centers, which periodically refurbish safety-related circuit breakers, to verify the correct configuration of the operating springs. The GE maintenance instructions provide neither instructions nor sufficient information to verify if the operating springs are correctly oriented.

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Other reported problems involving operating spring failures in AK-series circuit breakers are listed in Attachment 1 to this information notice.

Discussion:

In a GE AK-series (AK-, AKF-, or AKR-) metal-clad circuit breaker, there are two operating springs attached to the circuit breaker mechanism which closes and latches the circuit breaker contacts. After the contacts close, the spring's tension maintains latch engagement to keep the breaker in the closed position and supplies the motive force to open the contacts upon demand. If the two operating springs become disengaged from the mechanism, the circuit breaker contacts will not remain closed. On December 28, 1990, Maine Yankee reported to the NRC that, although a AK-2 breaker could close properly with one spring available, the disengaged spring could jam the operating mechanism and prevent the breaker from tripping.

GENE inspected the failed reactor trip breaker from St. Lucie at its service facilty in Atlanta, Georgia, and confirmed that the failure was caused by the incorrect configuration of the operating spring in the breaker. Based on tests conducted to determine if the circuit breaker would fail to close with the operating springs installed incorrectly, GENE determined that the operating springs are less likely to disengage from the circuit breaker mechanism if the first curve between the spring hook and the first coil of the operating spring curves away from the centerline of the circuit breaker.

GENE informed the NRC that it has notified its four service centers, which periodically refurbish safety-related circuit breakers, to verify the correct configuration of the operating springs. The GE Maintenance Instructions provide neither instructions nor sufficient information to verify if the operating springs are correctly oriented.

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Discussion:

In a GE AK-series (AK-, AKF-, or AKR-) metal-clad circuit breaker, there are two operating springs attached to the circuit breaker mechanism which closes and latches the circuit breaker contacts. After the contacts close, the spring's tension maintains latch engagement to keep the breaker in the closed position and supplies the motive force to open the contacts upon demand. If the two operating springs become disengaged from the mechanism, the circuit breaker contacts will not remain closed. On December 28, 1990, Maine Yankee reported to the NRC that, although a AK-2 breaker could close properly with one spring available, the disengaged spring could jam the operating mechanism and prevent the breaker from tripping.

GENE inspected the failed reactor trip breaker from St. Lucie at its service facilty in Atlanta, Georgia, and confirmed that the failure was caused by the incorrect configuration of the operating spring in the breaker. Based on tests conducted to determine if the circuit breaker would fail to close with the operating springs installed incorrectly, GENE determined that the operating springs are less likely to disengage from the circuit breaker mechanism if the first curve between the spring hook and the first coil of the operating spring curves away from the centerline of the circuit breaker.

GENE informed the NRC that it has notified its four service centers, which periodically refurbish safety-related circuit breakers, to verify the correct configuration of the operating springs. The GE Maintenance Instructions provide neither instructions nor sufficient information to verify if the operating springs are correctly oriented.

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stated that, based on information provided by GE, while a reactor trip breaker could close with one spring, the other spring could disengage and jam the operating mechanism, thus preventing the breaker from tripping.

Other reported failures on similar circuit breakers are listed on Attachment 1 to this information notice.

Discussion:

In a GE metal-clad circuit breaker, the circuit breaker mechanism which closes and latches the circuit breaker contacts has two operating springs attached to it. After the contacts close, the spring's tension maintains the contacts in the closed position and supplies the motive force to open the contacts upon a trip. If the operating springs become disengaged from the mechanism, the circuit breaker contacts will not remain closed. Therefore, it is unlikely that a breaker would fail to trip once the contacts have been latched closed.

GENE inspected the failed reactor trip breaker from St. Lucie at its service facilty in Atlanta, Georgia, and confirmed that the failure was caused by the incorrect configuration of the operating spring in the breaker. Based on tests conducted to determine if the circuit breaker would fail to close with the operating springs installed incorrectly, GENE determined that the operating springs are less likely to disengage from the circuit breaker mechanism if the first curve between the spring hook and the first operating spring coil curves away from the centerline of the circuit breaker. This is achieved in either orientation provided that the right side (facing the circuit breaker) operating spring has a clockwise spiral and the left side (facing the circuit breaker) operating spring has a counterclockwise spiral.

GENE informed the NRC that it has notified its four service centers, which periodically refurbish safety-related circuit breakers, to verify the correct orientation of the operating springs. The GE Maintenance Instructions provide neither instructions nor sufficient information to verify if the operating springs are correctly oriented.

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that based on information provided by GE, a reactor trip breaker could close with one spring while the other spring could disengage and jam the operating mechanism, thus preventing the breaker from tripping.

Other reported failures on similar circuit breakers are listed on Attachment 1 to this Information Notice.

Discussion:

In a GE metal-clad circuit breaker, the circuit breaker mechanism which closes and latches the circuit breaker contacts has two operating springs attached to it. After the contacts close, the spring's tension maintains the contacts in the closed position and supplies the motive force to open the contacts upon a trip. If the operating springs become disengaged from the mechanism, the circuit breaker contacts will not remain closed. Therefore, it is unlikely that a breaker would fail to trip once the contacts have been latched closed.

GENE inspected the failed reactor trip breaker from St. Lucie at its service facilty in Atlanta, Georgia, and confirmed that the failure was caused by the incorrect configuration of the operating spring in the breaker. Based on tests conducted to determine if the circuit breaker would fail to close with the operating springs installed incorrectly, GENE determined that the operating springs are less likely to disengage from the circuit breaker mechanism if the first curve between the spring hook and the first operating spring coil curves away from the centerline of the circuit breaker. This is achieved in either orientation provided that the right side (facing the circuit breaker) operating spring has a clockwise spiral and the left side (facing the circuit breaker) operating spring has a counterclockwise spiral.

GENE informed the NRC that it has notified its four service centers, which periodically refurbish safety-related circuit breakers, to verify the correct orientation of the operating springs. The GE Maintenance Instructions provide neither instructions nor sufficient information to verify if the operating springs are correctly oriented.

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Other reported failures on similar circuit breakers are listed on Attachment 1 to this Information Notice.

Discussion:

In a GE metal-clad circuit breaker, the circuit breaker mechanism which closes and latches the circuit breaker contacts has two operating springs attached to it. After the contacts close, the spring's tension maintains the contacts in the closed position and supplies the motive force to open the contacts upon a trip. If the operating springs become disengaged from the mechanism, the circuit breaker contacts will not remain closed. Therefore, it is unlikely that a breaker would fail to trip once the contacts have been latched closed.

GENE inspected the failed reactor trip breaker from St. Lucie at its service facilty in Atlanta, Georgia, and confirmed that the failure was caused by the incorrect configuration of the operating spring in the breaker. Based on tests conducted to determine if the circuit breaker would fail to close if the operating springs were installed incorrectly, GENE determined that the operating springs are less likely to disengage from the circuit breaker mechanism if the first curve between the spring hook and the first operating spring coil curves away from the centerline of the circuit breaker. This is achieved in either orientation provided that the right side (facing the circuit breaker) operating spring has a clockwise spiral and the left side (facing the circuit breaker) operating spring has a counterclockwise spiral.

GENE informed the NRC that it has notified its four service centers, which periodically refurbish safety-related circuit breakers, to verify the correct orientation of the oerating springs. The GE Maintenance Instructions provide neither instructions nor sufficient information to verify if the operating springs are correctly oriented.

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Other reported failures on similar circuit breakers are listed on Attachment 1 to this information notice.

Discussion:

In a GE metal-clad circuit breaker, the circuit breaker latch mechanism which closes and latches the circuit breaker contacts has two BOSs attached to it. After the contacts close, the BOS's tension maintains the contacts in the closed position and supplies the motive force to open the contacts upon a trip. If the BOSs become disengaged from the latch mechanism, the circuit breaker contacts will not remain closed. Therefore, it is unlikely that a RTB would fail to trip once the contacts have been latched closed.

GENE inspected the failed RTB from St. Lucie at its service facilty, in Atlanta, Georgia, and confirmed that the failure was caused by the incorrect configuration of a BOS in the RTB. Based on tests conducted to determine if the circuit breaker would fail to close if the BOSs are installed incorrectly, GENE determined that the BOSs are less likely to disengage from the circuit breaker latch mechanism if the first curve between the BOS hook and the first BOS coil curves away from the centerline of the circuit breaker. This is achieved in either orientation provided that the right side (facing the circuit breaker) BOS has a clockwise spiral and the left side (facing the circuit breaker) BOS has a counterclockwise spiral.

GENE informed the NRC that it has notified its four service centers, which periodically refurbish safety-related circuit breakers, to verify the correct orientation of the BOSs. The GE Maintenance Instructions provide neither instructions nor sufficient information to verify if the BOSs are correctly oriented.

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