

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
OFFICE OF NEW REACTORS
WASHINGTON, DC 20555

December 4, 2019

NRC INFORMATION NOTICE 2019-10: FAILURES REPORTED IN EATON/CUTLER HAMMER
A200 AND FREEDOM SERIES CONTACTORS

ADDRESSEES

All holders of an operating license or construction permit for a nuclear power reactor under Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," except those that have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel.

All holders of and applicants for a combined license under 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

PURPOSE

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice (IN) to inform addressees of operating experience with regard to failures of Eaton/Cutler Hammer A200 and Freedom series contactors.

These contactors are widely used throughout the nuclear industry in various applications, many of which are safety related. Under certain conditions, these contactors may stick closed, preventing the contactors from performing their safety function. The NRC expects that recipients will review the information in this IN for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. INs may not impose new requirements, and nothing in this IN should be interpreted to require specific action.

DESCRIPTION OF CIRCUMSTANCES

The NRC has received multiple reports^{1,2} of instances of Eaton/Cutler Hammer contactors sticking shut when power is removed, as shown in the table below. In addition, while not formally reported to the NRC, nuclear suppliers have also received information about additional failures.

¹ AZZ Nuclear, Part 21 Report No. P21-02082019, "Initial Notification of potential 10 CFR Part 21, EATON A200 Series Starters/Contactors," February 8, 2019 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML19053A499).

² Curtiss-Wright Corporation/QualTech NP, "Notification of 10 CFR Part 21 on Eaton/Cutler Hammer A200 series Starters (& Contactors)," December 18, 2015 (ADAMS Accession No. ML15357A042).

Contacting Type	# of Installed Failures	Mfg. Date Range	Failure Dates	Plant	Vendor
A200 Series	8	5/2008–12/2012	2008–2015	Diablo Canyon	Curtis Wright
A200 Series	7	2011-2015*	2017-2019	Susquehanna	AZZ/NLI
Freedom Series	6	2016–2017	2018	LaSalle	Westinghouse

*The manufacture date for one of the failed contactors is unknown.

These contactors are commercially manufactured components that have been dedicated for safety-related use. Many of the A200 series contactors were originally supplied by Westinghouse and installed in Westinghouse-manufactured motor control centers. Westinghouse and other third-party suppliers have also supplied Eaton/Cutler Hammer A200 and Freedom series contactors as replacements for both Westinghouse and non-Westinghouse original equipment.

Recently, failed contactors from LaSalle County Station and Susquehanna Steam Electric Station were returned to their respective supplying vendors, Westinghouse and AZZ/NLI, for examination. Both Westinghouse and AZZ/NLI performed root cause evaluations of the failed devices. Through its commercial relationship with the commercial manufacturer Eaton/Cutler Hammer, Westinghouse was able to perform an extensive examination of the overall root cause of this issue. Although the AZZ/NLI root cause analysis was limited to the specific returned components, both evaluations came to similar conclusions.

In its letter to the NRC dated September 24, 2019, Westinghouse provided a copy of its Nuclear Safety Advisory Letter (NSAL)-19-2, Revision 0, “Contactors Failing to Release/Open When De-energized,” dated August 28, 2019 (ADAMS Accession No. ML19269B709), that it had sent to all its nuclear-related customers about this issue. The results of the AZZ/NLI evaluation are summarized in its evaluation under 10 CFR Part 21, “Reporting of Defects and Noncompliance,” dated August 29, 2019, and, in general, are in agreement with the Westinghouse conclusions.

As multiple suppliers may have provided these contactors to facilities, this IN summarizes the Westinghouse NSAL and the AZZ/NLI 10 CFR Part 21 report below.

DISCUSSION

Previous failures of A200 series contactors had been attributed to certain materials used in the manufacturing process and were thought to be limited to certain manufacture date codes. However, more extensive analysis performed on returned sticking contactors that had manufacture date codes outside of the range thought to be affected has revealed the existence of an additional failure mechanism. Consequently, it is now believed that contactors under all manufacture date codes are potentially susceptible to the failure mechanism as described below.

The failure analysis of the returned contactors by Westinghouse and Eaton/Cutler Hammer identified a contaminant on the magnet and armature pole faces consistent with the breakdown of an organic material. The material emanates from the laminations of the contactor core and armature and is part of the original equipment design. It does not result from any recent design changes or from the manufacturing process itself. As part of an extent-of-condition review, Westinghouse tested more than 100 Freedom and A200 series contactors of various sizes under specific temperatures, voltages, and durations to replicate the failure mode. Westinghouse has confirmed that under the right conditions, the organic-based nonmetallic material can leach out and

migrate to the mating surface of the core and armature. Once migration to the pole-face surface occurs, the material degrades from heat, moisture, and oxygen, and causes the contactors to stick.

Factors that contribute to and accelerate the failure mode include the following:

- temperature
 - type of coil installed—low-voltage drop-out coils produce higher temperatures
 - voltage applied to coil—higher voltage drives much higher temperatures
 - environment—higher ambient temperatures
- time
 - energized duration—lack of cycling for extended periods of time

The following contactor series showed signs of sticking during the Westinghouse extent-of-condition testing:

- A200, Sizes 1–4
- Freedom, Sizes 2–4

While this same material may be used in other Eaton manufactured components such as D15, AR, and BF Relays, there have been no reports of similar failures and Westinghouse testing has shown that these components are not susceptible to the previously described failure mechanism.

In its NSAL, Westinghouse indicated that Eaton/Cutler Hammer is planning to change the laminate coating material used in the manufacture of the commercial contactors. The date the manufacturer will implement the design change is currently unknown.

Freedom and A200 series contactors, Sizes 1–4, are used in many different safety-related and non-safety-related applications; however, Westinghouse has determined that this potential failure mode is limited to components used in continuously energized applications. Operation at high ambient temperatures or high control voltages, or both, for an extended period increases the potential for a failure. Components used in momentary applications are not susceptible to this failure mode. Also, if continuously energized applications have been energized for a cumulative total of 1 year or more and have been successfully cycled, Westinghouse data suggests they may no longer be susceptible to this failure mode; however, testing done by AZZ/NLI on one contactor taken from the Susquehanna Nuclear Station tends to conflict with that conclusion as that contactor had been energized for over 1 year, had been successfully cycled, and then stuck closed.

For the affected contactors, the safety significance of this issue will vary based upon site-specific and application-specific conditions. Factors that would impact the safety significance include whether and how quickly loads are able to be deenergized locally through the manual opening of the breaker at the motor control center cubicle and whether the specific contactor is relied upon to open to perform automatic load shedding during certain accident scenarios.

In its NSAL, Westinghouse has recommended the following actions:

- Freedom and A200 series continuously energized contactors that have not been cycled since the original installation should be cycled at the earliest available opportunity.

- Any A200 or Freedom series contactors that fail to open should be replaced with contactors manufactured with the new material.

Although not in the NSAL specifically, Westinghouse has also recommended in recent webinars that its customers replace continuously energized contactors that are in critical applications that have had less than 1 year of cumulative service, regardless of whether or not they fail to open.

Westinghouse has indicated that it is implementing changes to its dedication procedures to ensure that all subsequently procured contactors are suitable for their safety-related applications and will be of the new material design.

Related NRC Generic Communications

None

CONTACT

This IN requires no specific action or written response. Please direct any questions about this matter to the technical contact listed below.

/RA/
Christopher Miller
Division of Reactor Oversight
Office of Nuclear Reactor Regulation

Technical Contacts: Jeffrey Jacobson, NRR/DRO
301-415-2977
E-mail: jeffrey.jacobson@nrc.gov

Kerri Kavanagh, NRR/DRO
301-415-3743
E-mail: kerri.kavanagh@nrc.gov

Note: NRC generic communications may be found on the NRC public Web site, <http://www.nrc.gov>, under "NRC Library," "Document Collections."

INFORMATION NOTICE 2019-10, "FAILURES REPORTED IN EATON/CUTLER HAMMER A200 AND FREEDOM SERIES CONTACTORS," DATE: DECEMBER 4, 2019

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OFFICE	NRR/DRO/IQVB	QTE	NRR/DRO/IQVB/BC	NRR/DRO/IOEB/PM
NAME	JJacobson	JDougherty	PPrescott for KKavanagh	BBenney
DATE	11/12/19	10/23/19	11/13/19	11/21/19
OFFICE	NRR/DRO/IOEB/LA	NRR/DRO/IOEB/BC	NRR/DRO/D	
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