

July 26, 2011

MEMORANDUM TO: Kenneth G. O'Brien, Deputy Director
Division of Reactor Safety
Region III

FROM: Robert A. Nelson, Deputy Director **/RA/**
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

SUBJECT: FINAL RESPONSE TO TASK INTERFACE AGREEMENT
2011-001, DAVIS-BESSE NUCLEAR POWER STATION
SAFETY-RELATED BATTERIES ELECTRICAL SEPARATION
DESIGN AND LICENSING BASES

By letter dated October 1, 2010 (Agencywide Documents Access and Management System Accession No. ML102770381), the U.S. Nuclear Regulatory Commission (NRC) Region III Office requested the Office of Nuclear Reactor Regulation (NRR) to provide answers to the following questions regarding the electrical separation design and licensing basis of the Davis-Besse Nuclear Power Station (Davis-Besse) safety-related batteries:

1. From a design and licensing basis perspective, what are the requirements for Davis-Besse to consider the electrical separation requirements for a grounded non-safety-related component in which the ground is not significant enough to trip or blow the automatic protective device connecting it to a safety-related 125/250 Volt battery?
2. From a design and licensing basis perspective, what are the requirements for Davis-Besse to consider the propagation of a grounded device in the use of the station's automatic bus transfer to swap load groups from one source to the redundant source? Specifically, does this comply with NRC Safety Guide 6 requirements?

The NRR staff's assessment is documented in the enclosed evaluation.

Enclosure:
As stated

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(301) 415-4117

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EVALUATION OF TASK INTERFACE AGREEMENT 2011-001

SAFETY-RELATED BATTERIES ELECTRICAL SEPARATION DESIGN AND LICENSING

BASES AT DAVIS-BESSE NUCLEAR POWER STATION

1.0 INTRODUCTION

By letter dated October 1, 2010 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML102770381), the U.S. Nuclear Regulatory Commission (NRC) Region III Office requested the Office of Nuclear Reactor Regulation (NRR) provide answers to the following questions regarding the electrical separation design and licensing basis of the Davis-Besse Nuclear Power Station (Davis-Besse) safety-related batteries:

1. From a design and licensing basis perspective, what are the requirements for Davis-Besse to consider the electrical separation requirements for a grounded non-safety-related component in which the ground is not significant enough to trip or blow the automatic protective device connecting it to a safety-related 125/250 Volt (V) direct current (dc) battery?
2. From a design and licensing basis perspective, what are the requirements for Davis-Besse to consider the propagation of a grounded device in the use of the station's automatic bus transfer switches (ATSs) to swap load groups from one source to the redundant source? Specifically, does this comply with NRC Safety Guide 6 requirements?

2.0 BACKGROUND

During a 2007 Component Design Basis Inspection, the inspectors reviewed the design and current configuration of the station's 125/250 Vdc safety-related distribution system. During the inspection, the inspectors identified a concern regarding the electrical separation of non-safety-related loads supplied by the station's 125/250 Vdc safety-related batteries. The inspectors postulated that the non-safety-related loads (reactor coolant back-up lift pumps and lighting panel L49E1) could become grounded in the environment following a high-energy-line break (HELB) or loss-of-coolant accident (LOCA). The equipment was postulated to be partially grounded, which was not sufficient to blow or trip the automatic protective device (i.e., fuse or breaker). Under this scenario, the non-class, grounded component would impart an additional load on the station batteries that was not considered within the station's calculation of record.

In addition, the inspectors also determined that six ATSs transfer their non-safety-related loads between non-safety-related inverters "YVA" and "YVB." The licensee stated that these switches were added in response to an industry operating experience (NRC IE Bulletin No. 79-27) after the operating license was issued. The non-class loads in question include the station annunciators, the plant computer, the non-nuclear instrumentation channels "X" and "Y," and the integrated control system channels "X" and "Y." Although these inverters are powered from the safety-related batteries, they are not safety-related and power other non-safety-related loads. Therefore, if a ground fault existed on the ATSs, this fault could result in an automatic transfer of loads from one dc power source to its redundant dc power source, potentially impacting the ability of both divisions of safety-related batteries to perform their safety function. The above concerns remain unresolved as two open items from the aforementioned inspection. NRC Region III requested NRR to review and provide a response to the above questions.

3.0 REGULATORY EVALUATION

The NRR staff used the following regulations, regulatory guidance, and plant design basis documents in its evaluation of this Task Interface Agreement (TIA):

- Title 10 of the *Code of Federal Regulations* (10 CFR) 50.49, “Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants,” Section (b)(2) requires non-safety-related electric equipment to be environmentally qualified if the failure of the non-safety-related electric equipment under postulated environmental conditions could prevent satisfactory accomplishment of safety functions specified in subparagraphs (b)(1)(i) (A) through (C) of paragraph (b)(1) of this section by the safety-related equipment.
- 10 CFR 50.59, “Changes, Tests and Experiments,” Section (d)(1) states that the licensee shall maintain records of changes in the facility, of changes in procedures, and of tests and experiments made pursuant to paragraph (c) of this section. These records must include a written evaluation which provides the bases for the determination that the change, test, or experiment does not require a license amendment pursuant to paragraph (c)(2) of this section.
- Regulatory Guide (RG) 1.6 (Safety Guide 6, 1971), “Independence Between Redundant Standby (Onsite) Power Sources and Between Their Distribution Systems (Safety Guide 6, dated 03/10/1971),” Regulatory Position D.4.b states that no provision should exist for automatically connecting one load group to another load group. Additionally, Regulatory Position D.4.c states that no provision should exist for automatically transferring loads between redundant power sources.
- RG 1.75, Revision 0, February 1974, “Physical Independence of Electric Systems,” describes a method acceptable to the NRC staff for complying with separation and independence requirements between all redundant train components.
- NRC IE Bulletin No. 79-27, “Loss of Non-Class -1-E Instrumentation and Control Power System Bus during Operation,” required the licensee to review this bulletin and implement design modifications (if needed) to the Class 1E and non-Class 1E buses supplying power to non-safety- and safety-related instrumentation and control (I&C) systems which could affect the ability to achieve a cold shutdown condition due to loss of a non-Class 1E I&C power system bus during operation based on an event at the Oconee Power Station, Unit No. 3 on November 10, 1979.
- Davis-Besse Updated Final Safety Analysis Report (UFSAR), Section 3.11.1 states, “Non-safety related electrical equipment, whose failure under postulated environmental conditions could prevent satisfactory accomplishment of the specified safety-related electric equipment required safety functions or mislead an operator, is qualified as required.”

- Davis-Besse UFSAR, Section 3D.2.6 Safety Guide 6, “Independence Between Redundant Standby (Onsite) Power Sources And Between Their Distribution Systems,” March 1971, states, “This system electrical design as described in UFSAR Chapter 8, Subsection 8.3.1, incorporates the requirements of this Safety Guide.”
- Davis-Besse UFSAR, Section 8.1.5 states, in part, that the electrical systems are designed to ensure that no single component failure will prevent operation of engineered safety systems. Redundant power sources are provided to ensure continuous operation of equipment under all modes of operation....Electrical and physical separation of cables and equipment associated with redundant elements is provided.

4.0 STAFF EVALUATION

Question 1. From a design and licensing basis perspective, what are the requirements for Davis-Besse to consider the electrical separation requirements for a grounded non-safety-related component in which the ground is not significant enough to trip or blow the automatic protective device connecting it to a safety-related 125/250 Vdc battery?

Evaluation

Based on our review of the Davis-Besse UFSAR, Revision 26, and the original safety evaluation report of the plant, the NRR staff finds the following design basis requirements are applicable to Davis-Besse related to TIA Question 1:

1. UFSAR Section 8.1.5, page 8.1-7 states, “During the design phase of Davis Besse Unit 1, complete adherence to the RG 1.75, February 1974 was not possible since plant design pre-dated the issuance of RG 1.75 as well as IEEE [Institute of Electrical and Electronics Engineers] 384-1974. However, independence principles followed in the design are considered adequate to preclude a common failure mode for any design basis event and do, in fact, represent partial conformance....Separation between redundant Class 1E equipment and circuits is mainly by separate safety class structures (rooms).”

Based on the above, the staff finds that the licensee is not fully committed to the guidelines in RG 1.75.

2. UFSAR Section 3.11.1, “Non-safety-related electrical equipment, whose failure under postulated environmental conditions could prevent satisfactory accomplishment of the specified safety-related electric equipment required safety functions or mislead an operator, is qualified as required..”

The staff did not find any specific requirement(s) on the electrical separation for a grounded non-safety-related component in which the ground fault current is not significant enough to trip or blow the automatic protective device connecting it to a safety-related 125/250 Vdc battery. The NRR staff’s review of Davis-Besse drawings indicated that the 125/250 Vdc system design included a 500 ampere fuse to separate the safety bus from the non-safety bus. In addition, the staff found that Davis-Besse UFSAR Section 3.11.1, “Equipment Qualification Program,” states,

“Non-safety related electrical equipment, whose failure under postulated environmental conditions could prevent satisfactory accomplishment of the specified safety-related electric equipment required safety functions or mislead an operator, is qualified as required.” This statement is consistent with the requirements of 10 CFR 50.49 and reduces the potential for a fault or a ground in non-safety-related equipment, due to postulated environmental conditions, from adversely affecting associated safety-related equipment.

In the licensee’s March 23, 2011, response (ADAMS Accession No. ML110870898) to the NRR staff’s request for additional information (RAI) (ADAMS Accession No. ML110320434), the licensee stated that the reactor coolant pump (RCP) backup-oil-lift-pump motors, associated cables, and the Emergency Lighting Panel L49E1 are located inside containment and that they are not environmentally qualified (EQ) for the postulated environmental conditions following a design basis event. The licensee’s current position is that any fault on the motors, associated cables, or emergency lighting panel that may occur as a result of the post-accident environment will be cleared by the associated supply fuses (located outside of containment in a mild environment). The licensee contends that this arrangement ensures that the associated safety-related equipment continues to perform its required safety functions. The staff finds the licensee’s response acceptable only for the condition when high ground current will blow the fuse. However, the staff finds that the licensee failed to address other aspects of this condition, particularly a ground fault in non-safety equipment not significant enough to blow the supply fuse. Furthermore, the staff finds that the licensee did not address the impact of this condition on the safety function of the safety-related batteries. This condition could challenge the adequacy of electrical separation between the grounded non-safety-related RCP backup-oil-lift-pump motors, associated cables, and the Emergency Lighting Panel L49E1 and the safety-related batteries. This unanalyzed condition appears inconsistent with Davis-Besse UFSAR Section 3.11.1.

Question 2. From a design and licensing basis perspective what are the requirements for Davis-Besse to consider the propagation of a grounded device in the use of the station’s automatic bus transfer to swap load groups from one source to the redundant source? Specifically, does this comply with NRC Safety Guide 6 requirements?

Evaluation

Based on the review of the Davis-Besse UFSAR, RG 1.6 (Safety Guide 6, 1971), and the original safety evaluation report written for Davis-Besse, the NRR staff finds the following design basis requirements applicable to Davis-Besse regarding use of ATs to transfer loads between redundant power sources in case of a grounded device:

- 1) UFSAR Section 3D.2.6 (Safety Guide 6, 1971)
- 2) Original Safety Evaluation Report (NUREG-0136, December 1976)

The original safety evaluation report stated that the NRC staff approved the plant design basis based on NRC RG 1.6 (Safety Guide 6). Regulatory Position D.4.c of this Safety Guide states, “No provisions should exist for automatically transferring loads between redundant power sources.” In accordance with the licensee’s design basis requirement in UFSAR

Section 3D.2.6, Safety Guide 6 prohibits automatic transfer of loads between redundant power sources. The NRR staff did not find any exemptions or exceptions to the regulatory guide (Safety Guide 6) for Davis-Besse. Based on its review, the NRR staff finds that the licensee is committed to RG 1.6 (Safety Guide 6) in its entirety, including Regulatory Position D.4.c. Therefore, the NRR staff finds that current UFSAR Section 3D.2.6 and RG 1.6 (Safety Guide 6) do not allow “automatic transfer” of loads between redundant power sources in any condition, including ground faults.

In its March 23, 2011, response to the staff’s RAI, the licensee confirmed that the Emergency Lighting Panel L49E1 has a potential to develop an electrical fault under a postulated environmental condition that may exist following a design basis event such as a LOCA or HELB. Panel L49E1 is not included in the station EQ program and is located inside containment and is susceptible to moisture intrusion which could result in an electrical fault. In its RAI response, the licensee stated, “However, any fault that may occur as a result of the post-accident environment is expected to be cleared by the 80 ampere Class 1E supply fuses to ensure the associated safety-related equipment can continue to perform its required safety functions.” The staff did not find any licensee evaluation on an electrical fault with a fault current lower than the fuse rating of 80 amperes. Therefore, the ground may not be cleared by the fuse and may continue to exist in the circuit. Under such condition, the associated safety-related battery will continue to supply power to the electrical fault as a load, potentially draining its capacity. If the safety-related battery is not sized to account for this additional load, the battery capacity and capability may not be adequate to operate the emergency loads. Therefore, the licensee must demonstrate that the battery has adequate capacity to account for the maximum possible current (without being cleared by the 80 ampere fuse).

The NRR staff reviewed the licensee’s current position on the design of the dc system including the installation of ATs to transfer loads from one battery power source to a redundant battery power source.

The licensee’s current position on this issue is as follows:

- 1) A ground current would blow the 80 ampere supply fuse(s) on one source, be automatically transferred to the other source, and then blow the supply fuse(s) on that source. Therefore, the postulated non-safety-related loads would not affect the safety-related batteries and do not need to be considered in the battery load calculations.
- 2) The ATs were installed in response to NRC IE Bulletin 79-27 regarding concerns on loss of power to each Class 1E and Non-Class 1E bus supplying power to plant instrumentation and controls. The NRC staff previously reviewed the licensee’s response to IE Bulletin 79-27 for Davis-Besse and accepted it.

The NRR staff disagrees with the licensee’s current positions based on the following:

- 1) UFSAR Section 3D.2.6 (Safety Guide 6, 1971) Regulatory Position D.4.b and D.4.c do not allow “automatic transfer” of loads to automatically connect redundant load groups or redundant power sources in any condition. As such, the licensee’s argument, that a ground on a non-safety-related component will blow the fuse on one power source, and then will automatically transfer to the redundant power source and blow the fuse on the

redundant power source, is contrary to the guidance provided in Safety Guide 6, Regulatory Position D.4.c.

- 2) The staff's research of correspondence, letters, and documents related to Davis-Besse resulted in locating a safety evaluation attached to a letter (ADAMS Legacy Accession No. 8909150352, Micro Form Address 51246, Frames 295-308) pertaining to an audit performed by the NRC at Davis-Besse for verification of resolution of concerns related to NRC IE Bulletin No. 79-27, "Loss of Non-Class-1-E Instrumentation and Control Power System Bus During Operation." The staff finds that this safety evaluation was specifically written for the resolution of IE Bulletin 79-27 specific concerns related to losing power to safety- and non-safety- related instrumentation and control systems and did not include an evaluation of other NRC requirements. In this safety evaluation, the staff found that Davis-Besse's modifications to install ATs between redundant dc power sources was acceptable for complying with IE Bulletin 79-27 concerns only. The staff did not find any exemption to Safety Guide 6 as a result of its review. Based on this and the lack of a licensee evaluation pertaining to the issue presented in this TIA, the NRR staff finds that the licensee failed to identify and resolve potential conflicts with Safety Guide 6 in resolving IE 79-27 concerns. Furthermore, the staff finds that the licensee was required to evaluate the impact of the ATs on design basis commitments (e.g., Safety Guide 6) before installing them.

The licensee was unable to provide a copy of its 10 CFR 50.59 evaluation associated with installation of the ATs when requested by the NRC. Based on its review, the NRR staff did not find any documentation or evidence of any 10 CFR 50.59 evaluation being performed by the licensee for the above mentioned plant modification. Therefore, the staff finds that the licensee appears to be in non-compliance with 10 CFR 50.59.

Based on the above evaluation, the NRR staff finds that Davis-Besse UFSAR Section 8.1.5 contains the design basis requirement for preventing propagation of ground faults (RG 1.6 (Safety Guide 6)). Specifically, UFSAR Section 8.1.5 references Davis-Besse's commitment to RG 1.6 (Safety Guide 6). Regulatory Position D.4.c of this Safety Guide states that no provision should exist for automatic transferring loads between redundant power sources. In addition, Regulatory Position D.4.b states that no provision should exist for automatically connecting one load group to another load group. Based on this information, the NRR staff finds that the licensee is not meeting the design basis commitments for Davis-Besse.

5.0 CONCLUSION

Based on its review of TIA 2011-001, the NRR staff finds the following:

- TIA Question 1. "From a design and licensing basis perspective, what are the requirements for Davis-Besse to consider the electrical separation requirements for a grounded non-safety-related component in which the ground is not significant enough to trip or blow the automatic protective device connecting it to a safety-related 125/250 Vdc battery?"

The NRR staff finds that the licensee failed to address the impact of a ground fault in non-safety equipment, not significant enough to blow the supply fuse, on the ability of safety-related

equipment to perform their intended safety functions. Specifically, the staff finds that the licensee did not address the impact of this condition on the safety function of the safety-related batteries as described in UFSAR Section 3.11.1. This condition could challenge the adequacy of electrical separation between grounded non-safety-related equipment and safety-related equipment.

TIA Question 2. “From a design and licensing basis perspective, what are the requirements for Davis-Besse to consider the propagation of a grounded device in the use of the station’s automatic bus transfer to swap load groups from one source to the redundant source? Specifically, does this comply with NRC Safety Guide 6 requirements?”

The NRR staff finds that the applicable design basis requirement for TIA Question 2 is identified in UFSAR Sections 3D.2.6 and 8.1.5 which refer to Davis-Besse’s alignment with RG 1.6 (Safety Guide 6). Section D.4.c of Safety Guide 6 states that “No provisions should exist for automatic transferring loads between redundant power sources.”

Based on our evaluation, the NRR staff concludes that the current design of Davis-Besse to automatically transfer loads between redundant power sources does not comply with UFSAR Sections 3D.2.6 and 8.1.5.

The NRR staff finds that the licensee met the requirement of NRC IE Bulletin 79-27 by installing ATSS between redundant power sources. However, in doing so, the licensee’s action resulted in non-conformance with its existing design basis requirement described in UFSAR Sections 3D.2.6 and 8.1.5, which the licensee failed to address. The NRR staff finds that the licensee is required to demonstrate by analysis or by test that a low ground current in non-safety-related equipment, lower than the fuse rating under postulated environmental conditions, would not adversely impact the safety function of the safety-related equipment.

Furthermore, the NRR staff did not find any documentation or evidence of any 10 CFR 50.59 evaluation being performed by the licensee for the above mentioned plant modification. Based on this information, the staff finds that the licensee appears to be in non-compliance with 10 CFR 50.59. Accordingly, the staff also finds that the licensee appears to have failed to maintain a record of the 10 CFR 50.59 screening and evaluation pertaining to the installation of the ATSS, which is contrary to the requirements of 10 CFR 50.59(d)(1).

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Date: