



NUREG-0800

U.S. NUCLEAR REGULATORY COMMISSION STANDARD REVIEW PLAN

BRANCH TECHNICAL POSITION 8-8

ONSITE AND OFFSITE POWER SOURCES COMPLETION TIME EXTENSIONS

REVIEW RESPONSIBILITIES

Primary - Organization responsible for electrical engineering

Secondary - Organization responsible for the review of technical specifications

A. BACKGROUND

Regulatory Guide (RG) 1.93 [Reference 1] provides guidance with respect to operating restrictions, that is Technical Specification (TS) Completion Times (CT), if the number of available onsite emergency diesel generators (EDGs) and offsite power sources is less than that required by the TS. RG 1.93 suggests a maximum CT of 72 hours for an inoperable onsite (EDG) or offsite power source.

Draft Revision 1 –October 2019

USNRC STANDARD REVIEW PLAN

This Standard Review Plan (SRP), NUREG-0800, has been prepared to establish criteria that the U.S. Nuclear Regulatory Commission (NRC) staff responsible for the review of applications to construct and operate nuclear power plants intends to use in evaluating whether an applicant/licensee meets the NRC's regulations. The Standard Review Plan is not a substitute for the NRC's regulations, and compliance with it is not required. However, an applicant is required to identify differences between the design features, analytical techniques, and procedural measures proposed for its facility and the SRP acceptance criteria and evaluate how the proposed alternatives to the SRP acceptance criteria provide an acceptable method of complying with the NRC regulations.

The SRP sections are numbered in accordance with corresponding sections in Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)." Not all sections of Regulatory Guide (RG) 1.70 have a corresponding review plan section. The SRP sections applicable to a combined license application for a new light-water reactor (LWR) are based on RG. 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)."

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Similarly, RG 1.93 recommends a maximum of 2 hours for an inoperable direct current (dc) power source such as a Class 1E battery and 24 hours for an inoperable Class 1E inverter.

The NRC staff evaluates CT extension requests for onsite or offsite power sources to allow on-line maintenance on onsite and offsite power source equipment. The on-line maintenance can help reduce the risk for loss of power during plant refueling outages. The purpose of this BTP is to provide guidance for performing deterministic reviews of license amendment requests (LARs) for CT extensions of onsite and offsite power source equipment.

Consistent with SRP Section 16.1, "Risk Informed Decision Making: Technical Specifications," licensee-initiated TS changes consistent with currently approved staff positions (e.g., RGs, SRPs, BTPs, or the Standard Technical Specifications (STSSs)) normally are evaluated by the staff using traditional engineering analyses; licensees would not be expected to submit risk information in support of proposed changes. Applications that deviate from the deterministic criteria outlined in this BTP should be reviewed in accordance with SRP Section 16.1, "Risk-Informed Decision Making: Technical Specifications," and SRP Section 19.2, "Review of Risk Information Used to Support Permanent Plant-Specific Changes to the Licensing Basis: General Guidance." Such reviews are outside the scope of this BTP.

The process used to exercise enforcement discretion for unanticipated temporary noncompliance with applicable limiting conditions for operation (LCO) or other license conditions is contained within Inspection Manual Chapter (IMC) 0410. The process within IMC 0410 should be used when evaluating requests for a notice of enforcement discretion (NOED). BTP 8-8 is not to be used for evaluation of requests for NOEDs.

B. BRANCH TECHNICAL POSITION

A supplemental power source should be available as a backup to the inoperable onsite or offsite power source during an extended CT, to maintain the defense-in-depth design philosophy of the electrical power system to meet its intended safety function. The supplemental source must have capacity to bring a unit to safe shutdown (cold shutdown)¹ in case of a loss of offsite power (LOOP) event. The staff's objective of requiring a supplemental power source for an inoperable onsite or offsite power source is to mitigate a potential Station Blackout (SBO) event and/or plant transients (design basis accidents are excluded) during the period of an extended CT if normal power sources cannot be restored in a timely manner, commensurate with plant safety.

According to NUREG-1784 [Reference 2], as a result of the changes in electric grid performance post-deregulation, the duration of LOOP events has increased *and the probability of a LOOP event as a consequence of a reactor trip has increased*. This evaluation was performed before the August 14, 2003, Blackout in the Northeast. The lessons learned from this Blackout event indicate that restoration of offsite power will take longer than previously considered, indicating that post-deregulation conditions challenge grid reliability. The projected time for restoration of offsite power is now considered to be more than the time previously evaluated for the SBO rule. The staff considers that a replacement (i.e., supplemental) ac power source is needed to back up an inoperable EDG or offsite power source during an extended CT to maintain the defense-in-depth of the electrical power sources.

The staff has previously granted CT extensions to those licensees who have installed an alternate alternating current (AAC)¹ power source (i.e., additional diesel generators (DGs), gas or combustion turbines, hydro units, or other power sources) credited for SBO events which can be substituted for an inoperable EDG in the event of a LOOP, provided the power source has enough capacity to carry all LOOP loads needed to bring the unit to cold shutdown according to plant procedures used for LOOP events.

To facilitate approval of an extended CT for an onsite or offsite power source, some licensees have installed commercial-grade DGs capable of supplying power to the required safe-shutdown loads on the train removed from service for the maintenance outage.

Some licensees at multi-unit sites have qualified their existing EDGs as an AAC source for meeting the SBO rule requirements (see Reference 3 for qualifications of the AAC source). For existing Class 1E EDGs to qualify as a supplemental ac source in the adjacent unit (provided with cross-connection within the same division of loads) for extending the CT, the EDGs must have excess capacity to meet their dedicated unit's LOOP loads (without load shedding) while complying with the single failure criteria, and have spare capacity to support the other unit in maintenance to bring the plant to cold shutdown, if needed.

For multi-unit sites with shared safety related or important to safety systems, such as service water or component cooling water or heating and ventilation systems, the capacity and capability of the supplemental source to power the shared systems of the affected units should be considered when sizing and connecting the power source.

Multi-unit sites that have installed a single AAC power source for SBO may substitute it for the inoperable onsite ac power source as long as the AAC source has enough capacity to carry all LOOP loads necessary to bring the unit to a cold shutdown and carry all SBO loads for the unit that has an SBO event without any load shedding.

The supplemental permanent or temporary power source can be either a DG, gas or combustion turbine, FLEX power sources or power from nearby hydro units. If the power source is located offsite, then the feeder from the power source should be protected from postulated external events. This source can be credited as a supplemental source that can be substituted for an inoperable onsite or offsite power source during the period of extended CT in the event of a LOOP, provided the deterministic evaluation supports the proposed CT and the power source has enough capacity to carry all LOOP loads to bring the unit to cold shutdown.

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- 1 By "cold shutdown" it is not implied that the plant needs to go to cold shutdown during LOOP. The unit can remain in either hot shutdown or hot standby in accordance with its licensing basis for the short term. However, if the offsite power is not recovered in a timely manner it may become necessary for the unit to go to cold shutdown, therefore the supplemental or AAC power source should have the capacity and capability to accomplish this function if needed.
 2. The AAC power source is a supplementary AC power source, such as non-safety diesel or gas turbine that can be substituted as a replacement power source for an EDG to power one train of LOOP loads to take the plant to cold shutdown if necessary.

The current design of boiling-water reactor (BWR) and pressurized-water reactor (PWR) safety systems, required for reactor core decay heat removal and containment heat removal, are dependent on alternating current (ac) power. For some boiling water reactors, the Division III EDG (High Pressure Core Spray Pump (HPCS) EDG) may be used as a supplemental ac source. The staff has determined that the HPCS EDG can be considered a supplemental ac source provided cross-connect capability exists so that the HPCS EDG can be cross-connected to either Division I or Division II ac buses to power safe-shutdown loads. All support systems for the HPCS EDG should be verified to be available during the extended CT. In addition, the HPCS EDG should have the capacity to power LOOP loads to bring the unit to cold shutdown without any load shedding.

For plants using AAC or supplemental power sources discussed above, plant procedures should ensure that the AAC or supplemental source can be started and connected to power the safety related buses within one hour to enable restoration of battery chargers and prevent reactor coolant system losses from exceeding the allowable TS limits. The availability of the AAC or supplemental power source should be verified within the last 5 days before entering extended CT by operating or bringing the power source to its rated voltage and frequency for 5 minutes and ensuring all its auxiliary support systems are available or operational. The supplemental AC source should have adequate fuel for full load operation for 24 hours with provisions to operate for a longer duration.

To support the one-hour connection time for making the power source available, plants must assess their ability to cope with loss of all ac power for one hour independent of an AAC power source (coping analysis). A coping analysis is not required if the supplemental or AAC power source can be connected to one of the safety buses within 10 minutes of an SBO event. The plant should have formal engineering calculations for equipment sizing and protection and have approved procedures for connecting the AAC or supplemental power sources to the safety buses.

The EDG or offsite power CT should be limited to 14 days to perform maintenance activities. This time period is based on industry operating experience; for example, a maximum of 216 hours (13.5 days, consisting of two shifts, each shift working 8 hours) is considered to be sufficient for a major EDG overhaul or offsite power major maintenance. The licensee should provide justification for the duration of the requested CT (actual hours plus margin based on plant-specific past operating experience). On a case-by-case basis, staff may consider licensee requests for a reasonable amount of time if needed beyond 14-days to support sufficient time for the licensee to complete the EDG overhauls or repairs, if supported by risk information.

The TS must contain Required Actions and Completion Times to verify that the supplemental ac source is available before entering extended CT. The availability of AAC or supplemental power source shall be verified to be available every 8-12 hours (once per shift). If the AAC or supplemental power source becomes unavailable any time during extended CT, the unit shall restore the AAC or start shutting down within 24 hours or within the CT allowed by the TS, whichever is shorter. This 24-hour period will be allowed only once within any given extended CT. Additionally, the licensee should provide the following information in order to ensure adequate defense-in-depth:

- The extended CT will be used no more than once in a 24-month period (or refueling interval) on a per diesel basis to perform EDG maintenance activities, or any major maintenance on offsite power transformer and bus.
- The preplanned maintenance will not be scheduled if severe weather conditions are anticipated.
- The system load dispatcher will be contacted once per day to ensure no significant grid perturbations (high grid loading unable to withstand a single contingency of line or generation outage) are expected during the extended CT.
- Component testing or maintenance of safety systems and important non-safety equipment in the offsite power systems that can increase the likelihood of a plant transient (unit trip) or LOOP will be avoided. In addition, no discretionary switchyard maintenance will be performed.
- TS required systems, subsystems, trains, components, and devices that depend on the remaining power sources will be verified to be operable and positive measures will be provided to preclude subsequent testing or maintenance activities on these systems, subsystems, trains, components, and devices.
- Steam-driven emergency feed water pump(s) in the case of PWR units, and Reactor Core Isolation Cooling and High Pressure Coolant Injection systems in the case of BWR units, will be controlled as "protected equipment."

In summary, considering the recent experiences in grid outages, it is the staff's position that the availability of an additional power source is a condition for approval of the extended onsite or offsite power CT. Therefore, a supplemental power source must be available when extending the current CT allowed by the plant TS for a single inoperable EDG or offsite power source. License amendments requesting an extended EDG or offsite power CT without a risk-informed evaluation should include adequate justification for the requested CT based solely on deterministic criteria and should be limited to 14 days. Licensees requesting an extension of the onsite or offsite power CT should either install permanently, or make available on a temporary basis, a supplemental ac source capable of powering the inoperable onsite or offsite power source bus LOOP loads during the period of CT extension. Although this extended CT is allowed for pre-planned maintenance activities, it could be used for corrective maintenance on a limited basis, provided the licensee meets the maintenance rule availability/reliability

requirements, and the reactor oversight process performance indicator criteria for availability/reliability. On a case-by-case basis, the staff may consider licensee requests for a reasonable amount of time if needed beyond 14-days to support sufficient time for the licensee to complete the EDG overhauls or repairs, if supported by risk information. The staff's review of risk information is beyond the scope of this BTP.

Similarly, CTs for other power sources such as batteries, battery chargers, and inverters, could be extended based on installing a spare or temporary power source capable of performing the same design safety function of the safety-related power source that it replaces. The purpose of a spare or temporary power source that is connected in place of an inoperable battery, battery charger, and inverter is to prevent potential plant transients or undesirable failure modes that could lead to the plant entering an unanalyzed condition. If non-Class 1E spare power sources are used, the electrical separation, independence, and single failure criteria should be satisfied consistent with the plant's licensing basis. No specific CT extension duration is specified for power sources such as battery, battery charger, and inverter since the replacement and testing duration of these equipment are plant-specific. However, the licensee should provide justification for the duration of the requested CT (actual hours plus margin based on plant-specific past operating experience).

The quality assurance for supplemental power source equipment should meet the guidance provided in NRC RG 1.155, Appendix A, "Quality Assurance Guidance for Non-Safety Systems and Equipment."

C. REFERENCES

1. RG 1.93, December 1974, "Availability of Electric Power Sources"
2. NUREG-1784, December 2003, "Operating Experience Assessment – Effects of Grid Events on Nuclear Power Plant Performance"
3. RG 1.155, August 1988, "Station Blackout"
4. SRP 16.1, March 2007, "Risk-Informed Decision Making: Technical Specifications"
5. SRP 19.1, June 2007, "Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities"

Paperwork Reduction Act Statement

This Standard Review Plan provides voluntary guidance for implementing the mandatory information collections in 10 CFR Parts 50 and 52 that are subject to the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et. seq.). These information collections were approved by the Office of Management and Budget (OMB), approval numbers 3150-0011 and 3150-0151. Send comments regarding this information collection to the Information Services Branch (T6-A10M), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by e-mail to Infocollects.Resource@nrc.gov, and to the OMB reviewer at: OMB Office of Information and Regulatory Affairs (3150-0011, 3150-0151), Attn: Desk Officer for the Nuclear Regulatory Commission, 725 17th Street, NW Washington, DC 20503; e-mail: oir_submission@omb.eop.gov.

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SRP BTP 8-8
“Onsite (Emergency Diesel Generators) and Offsite Power
Sources Allowed Outage Time Extensions”
Description of Changes

This is the second issuance of this BTP. The first issuance was released simultaneously with SRP Section 8.1, Revision 4, in February 2012.