UNITED STATES
NUCLEAR REGULATORY COMMISSION
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NRC INSPECTION MANUAL

EELB

TEMPORARY INSTRUCTION 2515/120

INSPECTION OF IMPLEMENTATION OF STATION BLACKOUT RULE
MULTI-PLANT ACTION ITEM A-22

SALP FUNCTIONAL AREA: ENGINEERING (SOETS-O)

APPLICABILITY: This TI is to be performed at two sites for Regions I, II, & III, and at one site for Regions IV & V. At the completion of those inspections an evaluation will be performed by NRR to determine if additional sites need to be inspected.

2515/120-01 OBJECTIVES

To verify through inspection the adequacy of licensee programs, procedures, training, equipment and systems, and supporting documentation for implementing the Station Blackout (SBO) Rule, 10 CFR 50.63.

2515/120-02 BACKGROUND

Station Blackout is defined as the complete loss of alternating current (ac) electric power to the essential and nonessential switchgear buses in a nuclear power plant (i.e., loss of the offsite electric power system concurrent with a turbine trip and the unavailability of the onsite emergency ac power system). Station blackout does not include the loss of available ac power to buses fed by station batteries through inverters or by an "alternate ac source" as defined in Section 50.2 of 10 CFR, nor does it assume a concurrent single failure or a design basis accident.

Because many safety systems, that are required for reactor core decay heat removal, containment heat removal, and containment isolation, are dependent on ac power, the consequences of a station blackout (SBO) could be severe. Risk analyses have shown that SBO is an important risk contributor at many plants.

In the event of a station blackout, the capability to cool the reactor core and maintain appropriate containment integrity would be dependent on the availability of systems that do not require ac power from the essential or nonessential switchgear buses or on the ability to restore ac power in a timely manner. Because of these concerns, Sections 50.2 and 50.63 of 10 CFR have been issued to include the station blackout definition and requirements, respectively.

Based on station blackout studies (USI A-44 and other reports), the NRC staff has developed Regulatory Guide (RG) 1.155, entitled "Station Blackout." This RG presents guidance for (a) maintaining a high level of reliability for emergency diesel generators, (b) developing procedures and training to cope with a station

blackout and to restore offsite and onsite emergency ac power should either one or both become unavailable, and (c) establishing the required plant-specific station blackout duration. Certain plants are able to cope with a station blackout event with the equipment that is currently installed. Other plants will be modifying plant systems to provide extra battery capacity, cooling to equipment used for coping with the station blackout, alternate alternating current (AAC) power sources, or other equipment that will provide core and containment cooling and maintain appropriate containment integrity under station blackout conditions.

The requirements for AAC power sources are specified in the SBO Rule. Guidance on how these requirements may be satisfied was issued to the industry in RG 1.155, Section C.3.3.5 (NUMARC 87-00, Appendix B).

In addition to the requirements provided in the SBO Rule and guidance in RG 1.155 regarding the criteria for qualifying emergency diesel generators (EDGs) as AAC power sources, the staff has made the following interpretation, and the industry has been advised of this interpretation in the NUMARC 87-00 guidelines:

> For plants at 2-unit sites which just meet minimum redundancy but where each EDG is of sufficient capacity to fully power all the normal LOOP loads of the non-blacked out (NBO) unit and also has sufficient excess capacity for powering the required safe shutdown loads of the SBO unit, the staff has accepted this availability of excess capacity as having the potential for meeting the intent of the rule for AAC power sources.

The licensee's written responses to the SBO rule has been evaluated in the staff's safety evaluations and in most instances the licensee's have stated that they will meet the objectives of the SBO rule. Therefore, the emphasis of the inspection activity should be on assuring that the licensee's implementation of the SBO Rule is consistent with the licensee's responses and the staff's safety evaluations. Those instances for which the licensee has specifically taken exception to the guidelines or the staff's evaluations may not be a violation of the SBO Rule. Such instances should be noted in the inspection report for further consideration as to whether further regulatory action is required.

2515/120-03 INSPECTION REQUIREMENTS

03.01 Physical Plant. As a minimum, the inspector should select plant areas, systems, etc. to be inspected based on the staff recommendations, licensee's commitments, and unconfirmed issues itemized in the staff's Safety Evaluation (SE) and/or Supplemental SE. In order to select the plant areas of importance, the inspector should carefully review the staff's SE and Supplemental SE for the plant that is to be inspected. In reviewing the SE and Supplemental SE, the inspector should, in addition to the explicit statements by the staff, consider any implicit acceptance, due to silence by the staff, of the licensee's positions. At the plant, the inspector should review drawings/procedures, conduct walkdowns, and make examinations as appropriate. When licensees take credit for manual operations, check adequacy of emergency lighting at the work area and for the ingress/egress routes. The following are candidates for the inspection:

a. Station Batteries, DC Power System, and Vital AC Power Systems

1. For the Station Batteries, verify that the battery is sized, consistent with the criteria of IEEE Standard 485, to power the SBO

loads for the required coping duration. If the EDGs depend on field flashing from the Station Batteries, the battery sizing calculation should consider at least two field flashings, one at the beginning and one at the end of the SBO coping duration. Also, assure that the battery calculation includes the direct current (dc) control power requirement for breaker operations needed for recovery from an SBO event.

2. If loads are to be stripped to preserve battery capacity, verify that a full division of instrumentation and control remains after the load stripping occurs, procedures identify the loads to be stripped, and credit in the battery sizing calculation is not taken for the load stripping prior to 30 minutes into the SBO.

3. For the vital ac power system, review loading and verify that adequate voltage is available to the inverter during worst case battery output voltage.

4. Input Current (dc) requirement for constant KW loads shall be based on appropriate load terminal voltage and efficiency. Battery terminal voltage varies with time and efficiency varies with loading.

5. Battery terminal voltage shall be based on battery load profile with appropriate multiplication factors (aging, temperature correction and design margin, if used).

b. Alternate AC Power Source

For sites using an AAC power source, verify:

1. That a test has been conducted to demonstrate that the AAC source can be connected to the required safety bus(es) within the claimed time frame. For licensees claiming a 10-minute AAC power source, this should be within 10 minutes after the licensee has determined that a SBO exists. For sites claiming a 1-hour AAC power source, this should be within 1 hour after the licensee has determined that an SBO exists. In addition, for the 1-hour AAC power source, the test should demonstrate that the SBO required loads can be powered within the 1-hour time frame.

2. That the AAC power source meets the criteria of RG 1.155, Section C.3.3.5 (NUMARC 87-00, Appendix B).

c. Containment Isolation System

1. Verify that the site has a list of the containment isolation valves that are not excluded by the exclusion criteria of RG 1.155, Section C.3.2.7 (NUMARC 87-00, Section 7.2.5), and are required to function during a station blackout for the specified duration.

2. From this list, select at least three valves and verify that the valves can be operated independent of the preferred and normal Class 1E power supplies and that they have valve position indication that is powered (e.g., local mechanical, DC powered, or AAC powered) independent of the preferred and black-out unit's normal Class 1E power supplies.

d. Condensate Storage Facilities

For the areas containing the condensate storage tank or other water sources:

1. Verify that the condensate storage tank (CST) capacity is consistent with that discussed in the SE(s) and that no credit is taken for the volume below the suction connections.

2. Verify that the transfer capability of the alternate water sources, if required, is independent of the preferred and blacked-out unit's normal Class 1E power supplies.

e. Compressed Air System

For the areas consisting of safety and nonsafety-related air-operated equipment that provide safe shutdown during a station blackout event:

1. Verify that the site has a list of air-operated valves for decay heat removal that are required to function during a station blackout for a specified duration.

2. From this list, select at least three valves and verify that the valves can be manually operated or have backup air system(s) or backup local sources and can be operated independent of the preferred and normal Class 1E power sources to obtain and maintain safe shutdown for a station blackout event.

3. Verify that the backup air systems to the necessary air-operated valves are adequate to perform their intended function.

f. Control Area Complex Ventilation Systems

For the areas consisting of the control room, battery room, switchgear room, relay room, and other miscellaneous electrical equipment rooms identified for station blackout mitigation:

1. Verify, based on the existing reactor power, ventilation and outside air conditions, maximum room/component temperatures for worst case conditions (power operation mode at maximum plant power at maximum outside temperature and with only vital ventilation in service) from calculations and tests to provide threshold temperature for the identified areas at the onset of a station blackout, and confirm that the temperatures are less than or equal to those assumed in the station blackout coping analysis. Also, verify that Technical Specifications, Administrative Procedures or other means, consistent with the SE, are in place to ensure that the maximum temperatures at the beginning of the station blackout event are less than or equal to those assumed in the station coping analysis.

2. Confirm, for equipment that will be energized during an SBO, that the maximum analyzed temperature during a station blackout event would be below the design operability limit of the station blackout equipment.

3. Verify that remedial action, if required, for conformance with equipment operability limits, is provided.

g. Essential Safety Features Ventilation System

For the high pressure core injection (HPCI)/high pressure core spray (HPCS) and reactor core isolation cooling (RCIC) rooms boiling water reactors (BWRs), the auxiliary feedwater (AFW) pump area pressurized water reactors (PWRs), and other areas containing equipment for safe shutdown (e.g., main steam tunnel):

1. Verify, based on the existing reactor power, ventilation and outside air conditions, maximum room/component temperatures for worst case conditions (power operation mode at maximum plant power at maximum outside temperature and with only vital ventilation in service) from calculations and tests to provide threshold temperature for the identified areas at the onset of a station blackout, and confirm that the temperatures are less than or equal to those assumed in the station blackout coping analysis.

2. Witness plant technique to measure ambient temperatures for the areas during a maximum power operation mode, and confirm that the temperatures are less than or equal to the analysis assumptions.

3. Audit area equipment (electrical and mechanical) design documentation, and confirm that plant-specific room temperature limits during a station blackout for the specified duration do not exceed component operability limits.

4. Verify that remedial action, if required, for conformance with equipment operability limits, is provided.

h. Main Steam System

For the areas consisting of the secondary side of the steam generator of PWRs:

Verify that atmospheric dump valves (ADVs) can be operated remotely or locally, independent of the preferred and blacked-out unit's normal Class 1E ac power sources.

i. Auxiliary Feedwater System

Verify that the valves within the AFW system flow path and the valves within the flow path from the CST and/or alternate water sources can be operated independent of the preferred and blacked-out unit's normal Class 1E ac power sources.

j. Reactor Core Isolation Cooling System

Verify that the valves within the RCIC system flow path can be operated independent of the preferred and blacked-out unit's normal Class 1E ac power sources.

k. Emergency Core Cooling System

Verify that the valves within the reactor coolant system makeup water flow path from the reactor water storage tank (RWST) or alternate water source can be operated independent of the preferred and blacked-out unit's normal Class 1E ac power sources and that the reactor coolant automatic depressurization system can be operated independent of the

preferred and blacked-out unit's normal Class 1E ac power sources.

1. Chemical and Volume Control System (CVCS)

Verify that the valves within the CVCS makeup flow path from the RWST or alternate water source can be operated independent of the preferred and blacked-out unit's normal Class 1E ac power source.

03.02 Documents. As a minimum, the inspector should select procedures, guidelines, training programs, etc. to review based on the staff recommendations, licensee's commitments, and unconfirmed issues itemized in the SE(s). The following are candidates for the review. Provisions that:

a. Verify that the EDG reliability program meets as a minimum the guidelines of RG 1.155, Section C.1.2.

b. Verify that a quality assurance (QA) program for the SBO equipment has been implemented consistent with Regulatory Guide (RG) 1.155, Appendix A.

c. Promptly restore offsite power and/or use nearby onsite gas turbine generators, portable or other available compatible diesel generators, hydrogenerators, or black-start capable fossil fuel power plants.

d. Provide any dc load stripping (including which loads and when they are to be stripped) and restoration of any Technical Specification limiting condition of operation (LCO) for equipment, such as the re-connection of a battery that was off-line for an equalizing charge.

e. Verify specific actions to prevent or limit significant inventory loss; identify specific actions for air-operated valves; establish a flow path for makeup flow from the condensate storage tank to the steam generator/nuclear boiler; and identify water sources(s) to the condensate storage tank, including transferring to the next preferred source of water.

f. Permit containment isolation by providing safe shutdown valve operations (closure) and indicating capability independent of the preferred and normal Class 1E ac power sources.

g. Identify portable lighting for ingress and egress of plant areas containing shutdown or AAC equipment requiring manual operation.

h. Deal with loss of ventilation effects on specific energized equipment necessary for safe shutdown in the concerned areas, such as the main steam tunnel, control room, HPCIS/HPCS, RCIC and AFW system pump rooms; and maintain control room area habitability and habitability requirements in the concerned areas.

i. Deal with the components, pumps, instruments, piping, etc., that rely on heat tracing for freeze protection while the preferred and normal Class 1E ac power sources are not available.

j. Ensure that the reactor has properly tripped.

k. Ensure that decay heat removal by ac independent means has begun.

l. Ensure that purging has stopped and containment integrity exists.

m. Direct the restoration of onsite ac (diesel) power.

n. Monitor and preserve remaining battery capacity.

o. Ensure dc power is available for the operation of the AAC power source.

p. Ensure the AAC power source is made available, aligned to necessary loads within the required time, and monitored from the control room, if this is part of the coping plan.

q. Ensure the sharing of air, fluid, and electrical systems with another unit at the site, if this is part of the coping plan.

r. Address erratic or failed instruments.

s. Address the lack of normal ventilation and cooling of inservice components, pumps, instruments, and equipment.

t. Verify the status of all shutdown systems and supporting equipment available to bring the reactor to safe shutdown (non-design bases accident (DBA)).

u. Verify adequate communication capability exists for station blackout conditions.

v. Verify where used, any AAC power source(s) is not automatically loaded.

w. Verify where used, any AAC power source isolation is accomplished using two circuit breakers in series to protect the Class 1E source. One breaker must be a Class 1E isolation-type breaker at the Class 1E bus; the other may be a non-Class 1E breaker.

03.03 Inspection for Category A Sites. The inspection for sites where no system addition or modifications are required (Category A sites) should be in accordance with inspection requirements identified in 03.01 and 03.02 above.

03.04 Inspection for Category B Sites. The inspection activities for Category B sites having system additions or modifications (Category B sites) shall include, in addition to those cited in 03.01 and 03.02, a sample inspection of the procurement and installation of modifications to existing systems and equipment required to meet the station blackout coping duration.

a. The inspector should select (from the system modifications identified in the SE(s)), and examine documents, drawings and procedures; interview selected licensee or applicant personnel; and, by plant walkdown, verify as applicable depending on the stage of completion that:

   1. The modification is being or has been implemented using controlled drawings, documents, and procedures.

   2. The licensee's or applicant's onsite support organization is exercising or has exercised management control over the modifications.

   3. The capacity of air, fluid, and electrical systems support the modification as identified in the SE(s) and supporting documents.

4. The utility is using or has used the latest installation specifications, drawings, or procedures.

5. The modifications conform or will conform to the separation criteria (existing safety-related systems and equipment, new nonsafety-related systems, and equipment installed for station blackout mitigation) applicable to the unit's licensing basis.

6. The equipment being installed or that was installed meets the configuration specified (i.e., type, range, capacity, and materials).

7. The equipment is being or has been installed in the proper location.

8. The equipment that has been installed is identified, orientated, and supported as specified.

9. The installers are using or used suitable equipment and tools.

10. Equipment adjacent to the job site is or was protected.

11. Housekeeping, radiological, and fire protection controls are being or were observed.

12. Appropriate surveillance and maintenance (i.e., corrective and preventative maintenance and post-maintenance testing and inspection) procedures are in place for the new installation.

13. The system or equipment is being or was tested at power following installation.

14. The procurement specifications for station blackout coping equipment conform with the requirements to Appendix A and B of Regulatory Guide 1.155.

15. A program is or was in place to handle station blackout equipment during receipt and storage and to determine that receipt inspection, identification, and storage controls are being or were properly applied.

16. The appropriate quality control hold points which were established have been or are being observed and that the related inspections by utility personnel have been or are being performed.

17. Non-conformances identified during installation have been or are being corrected in a timely manner.

2515/120-04 GUIDANCE

General Guidance

Equipment and procedures relied upon in a station blackout should ensure that satisfactory performance of necessary decay heat removal systems will be maintained during the SBO event including keeping the core covered for the required station blackout coping duration. However, for a BWR, a momentary core uncovery is allowed. For both BWRs and PWRs, appropriate containment integrity should be provided during a station blackout such that required isolation valves have position indication and closure capability independent of preferred and

normal Class 1E ac power sources.

Systems of concern include the high pressure coolant injection system/high pressure core spray system (HPCIS/HPCSS), the reactor core isolation cooling system (RCICS), equipment in the main steam tunnel, the auxiliary feedwater (AFW) system, the containment isolation system (CIS), the condensate storage facilities (CSF), the compressed air system (CAS), the control room area ventilation system (CRAVS), the essential safety features ventilation (ESFV) system, the emergency core cooling system (ECCS), the chemical and volume control system (CVCS), the DC and the 115V vital ac power systems, the alternate ac (AAC) power system, and instrumentation and control systems to support the required equipment and monitor safe shutdown conditions.

Conformance to the SBO Rule does not require consideration of failures beyond the SBO event. Therefore, licensees are not required to provide contingency plans other than to provide for containment isolation in the event that systems/components relied upon are unavailable.

The following documents should be used for general guidance:

Regulatory Guide 1.155, "Station Blackout," June 1988.

NUMARC 87-00, Rev. 1, "Guidelines And Technical Bases For NUMARC Initiatives Addressing Station Blackout At Light Water Reactors," August 1991. Table 1 of RG 1.155 provides a cross reference between RG 1.155 and NUMARC 87-00. In general, NUMARC 87-00 provides more detailed guidance than RG 1.155 and is therefore the preferred choice. However, there is no equivalent guidance in NUMARC 87-00 corresponding to the Quality Assurance and Specification guidance of RG 1.155 (Section C.3.5, and Appendices A and B). Therefore, RG 1.155 should be used for this guidance. Also, the staff has accepted Appendix D of NUMARC 87-00, Rev. 1, as the guidance for the EDG reliability program.

The NRC Staff's safety evaluations (SEs) and supplemental safety evaluations (SSEs) provide specific issues regarding staff concerns identified during the reviews of licensees' submittals. In some instances, the staff has accepted without detailed review licensee's commitments to perform additional calculations or to take certain actions to obtain or verify habitability, equipment operability, or equipment adequacy within certain areas of the plant. The inspector should place special emphasis on assuring that these commitments have been properly performed. In addition, the SSEs and supporting documentation provide the following:

1. The bases used in determining the minimum required coping duration.

2. The systems/equipment considered in the coping analysis.

3. Licensee plant-specific assumptions about the existing equipment or system(s) configuration.

4. Deviations from the guidance taken to comply with the station blackout rule.

IEEE Standard 485, "IEEE Recommended Practice For Installation Design and Installation of Large Lead Storage Batteries for Generating Stations and Substations" provides specific guidance pertaining to the evaluation of the adequacy of station batteries.

Specific Guidance

No specific guidance is provided for this TI.

2515/120-05 REPORTING REQUIREMENTS

Inspection findings will be documented in a routine inspection report.

2515/120-06 COMPLETION

The inspection requirement identified in this TI should be completed by 03/30/94.

2515/120-07 EXPIRATION

This Temporary Instruction will remain in effect until 09/24/95.

2515/120-08 CONTACT

Any questions regarding this Temporary Instruction should be addressed to Chief, Electrical Engineering Branch (EELB).

2515/120-09 STATISTICAL DATA REPORTING

Report the direct inspection effort for the TI against 2515/120 for RITS reporting. The IPE and IMI codes are SI and IENG , respectively. The MPA number is A-22.

2515/120-10 ORIGINATING ORGANIZATION INFORMATION

10.01 Organizational Responsibility. The Division of Engineering (DE) and the Division of Systems Safety and Analysis (DSSA) are responsible for the safety review of the station blackout rule implementation.

10.02 Team Composition. The Special Inspection Branch (RSIB) will provide team leaders for this TI to the extent that they can support each region's schedule. The regions should contact RSIB for team leader verification. Every attempt should be made by the team leader to limit the size of the team to only those personnel essential to perform an effective inspection as determined by the scope of the effort planned for a particular site. Generally, the SBO inspection team should be comprised of the team leader and 4 inspectors, but a reduction may be considered for a Category A site. The inspectors should be assigned as follows:

Inspector	Assigned Area
Electrical Engineer	SBO Coping Duration, Battery Adequacy, EDG Reliability
Plant System Engineer	Condensate Capacity, Compressed Air, Heating and Ventilation, Containment Isolation
Electrical Inspector	Plant Modifications, Communication, Security & Emergency Lighting
Operations Inspector	Operations/ Surveillance, RCS Inventory and plant procedures

10.03 Inspection Schedule. The following schedule is provided to allow the commitment of resources and planning for conducting a SBO inspection.

Week 1	Preparation for the inspection at the office in headquarters or the region
Week 2	The entire team on site for the inspection
Week 3	Inspection report input prepared by the team
Weeks 4-8	Inspection report assembled by the team leader, reviewed, and issued.

In addition to the above, it is estimated that an average resource of 48 hours of training (4 trainees at 12 hours each) per region will be required.

10.04 Parallel Procedures. There are no parallel inspection procedures or specific inspection requirements satisfied by this temporary instruction. Therefore no credit time is given toward any other specific inspection requirements.

10.05 Training. The NRC headquarters staff has provided regional training for the Station Blackout Rule implementation inspections. The training included determination of items to be inspected, based on the inspector's review of the SE and supplemental SE, discussion of (1) Regulatory Guide 1.155, "Station Blackout," June 1988, (2) NUMARC 87-00, Rev. 1, "Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors," August 1991, and (3) IEEE Std. 485, IEEE Recommended Practice for Installation Design and Installation of Large Lead Storage Batteries for Generating Stations and Substations.

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