U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

OFFICE OF NUCLEAR REACTOR REGULATION

8.3.1 AC POWER SYSTEMS (ONSITE)

REVIEW RESPONSIBILITIES

Primary - ~~Power Systems~~Electrical Engineering Branch (~~PSB~~EELB)[1]

Secondary - None

I. AREAS OF REVIEW

The descriptive information, analyses, and referenced documents, including functional logic diagrams, functional piping and instrument diagrams, electrical single-line diagrams, tables, physical arrangement drawings, and electrical schematics, for the ac onsite power system presented in the applicant's safety analysis report (SAR) are reviewed. The intent of the review is to determine that the ac onsite power system satisfies the requirements of General Design Criteria 2, 4, 5, 17, 18, and 50 and will perform its intended functions during all plant operating and accident conditions.

The ac onsite power system includes those standby power sources, distribution systems, and ~~vital~~auxiliary[2] supporting systems provided to supply power to safety-related equipment. Diesel generator sets have been widely used as the standby power source for the ac onsite power system and will be covered in this SRP section. Other standby power sources such as nearby hydroelectric, nuclear, or fossil units, including gas turbine-generator sets, will not be addressed herein. These sources, when proposed, will be evaluated on an individual case basis. In addition, those interface areas between the onsite and offsite power systems at the station distribution system level are within the scope of review of this Standard Review Plan (SRP)[3] section insofar as they relate to the independence of the onsite power system.

The ~~PSB~~EELB[4] will review the following features of the ac onsite power system during both the construction permit (CP) and operating license (OL) stages of the licensing process:

1. System Redundancy Requirements

   The onsite power system is reviewed to determine that the required redundancy of safety-related components and systems is provided. This includes an examination of the ac power system configuration, including the power supplies, power supply feeders, switchgear arrangement, loads supplied from each bus, and power connections to the instrumentation and control devices of the power system.

2. Conformance with the Single Failure Criterion

   In establishing the adequacy of this system to meet the single failure criterion, both electrical and physical separation of redundant power sources and associated distribution systems are examined to assess the independence between redundant portions of the system. This will include a review of interconnections between redundant buses, buses and loads, and buses and power supplies; physical arrangement of redundant switchgear and power supplies; criteria and bases governing the installation of electrical cables for redundant power systems; and proposed sharing of the ac power system between units at the same site.

3. Onsite and Offsite Power System Independence

   In evaluating the independence of the onsite power system with respect to the offsite power system, the scope of review extends to the station distribution load centers which are powered from the unit auxiliary transformers and the startup transformers (considered for the purposes of this SRP section as the offsite or preferred power sources). It includes the supply breakers connecting the "low" side of these transformers to the distribution buses. This evaluation includes a review of the electrical protective relaying circuits and power supplies to ensure that, in the event of a loss of offsite power, the independence of the onsite power system is established through prompt opening of isolation-feeder breakers.

4.[5] Standby Power Supplies

   Design information and analyses demonstrating the suitability of the diesel generators as standby power supplies are reviewed to ensure that the diesel generators have sufficient capacity,~~ and~~ capability, and reliability[6] to perform their intended function. This will include an examination of the characteristics of each load and the length of time each load is required, the combined load demand connected to each diesel generator during the "worst" operating condition, automatic and manual loading and unloading of each diesel generator, voltage and frequency recovery characteristics of the diesel generators, continuous and short-term ratings for the diesel generators, acceptance criteria with regard to the number of successful diesel generator tests and allowable failures to demonstrate acceptability, and starting and load shedding circuits. In addition, where the proposed design provides for the connection of nonsafety loads to the diesel generators or sharing of diesel generators between nuclear units at the same site, particular review emphasis is given to the possibility of marginal capacity and degradation of reliability that may result from such design provisions.

5. Identification

The means proposed for identifying the ac onsite power system components including cables, raceways, and terminal equipment as safety-related equipment in the plant are reviewed. Also, the identification scheme used to distinguish between redundant cables, raceways, and terminal equipment of the power system is reviewed.

6. ~~Vital Supporting~~Auxiliary Supporting Systems/Features[7]

The instrumentation, control circuits, and power connections of ~~vital supporting~~auxiliary supporting systems and features[8] are reviewed to determine that they are designed to the same criteria as those for the safety-related loads and power systems that they support. This will include an examination of the ~~vital supporting~~auxiliary supporting[9] system component redundancy; power feed assignment to instrumentation, controls, and loads; initiating circuits; load characteristics; equipment identification scheme; and design criteria and bases for the installation of redundant cables.

7. System Testing and Surveillance

Onsite testing capabilities are reviewed. The means proposed for automatically monitoring the status of system operability are reviewed.

8. Reliability Program for Emergency Onsite AC Power Sources

A reliability program for emergency onsite ac power sources is recommended to address onsite emergency source reliability with respect to station blackout. The program designed to attain and maintain the long-term reliability of each source at or above specified reliability targets is reviewed to verify its adequacy.[10]

~~8~~9. Other Review Areas[11]

The ac power system is reviewed to determine that:

a. The system and its components have the appropriate seismic design classification.

b. The system and its components are housed in a structure with seismic category I classification.

c. The system and its components are designed to withstand environmental conditions associated with normal operation, natural phenomena, and postulated accidents.

d. The system and its components have a "Class 1E" quality assurance classification.

Review Interfaces[12]

EELB also performs the following reviews under the SRP sections indicated:[13]

1. Reviews the adequacy of the offsite power system, including required preferred power circuits to the onsite power system, as part of its primary review responsibility for SRP Section 8.2. Also, where applicable, reviews the design of the alternate ac (AAC) power source for station blackout in accordance with relevant guidelines presented in SRP Section 8.2.[14]

2. Reviews overall conformance with the requirements of the Station Blackout Rule, 10 CFR 50.63, as part of its primary review responsibility for SRP Section 8.4 (proposed).[15]

In the review of other areas associated with the ac onsite power system, the ~~PSB~~EELB,[16] will coordinate other branches' evaluations that interface with the overall review of the system, as follows:

1. The ~~Auxiliary Systems Branch (ASB)~~Plant Systems Branch (SPLB)[17] evaluates the adequacy of those auxiliary supporting[18] systems that are vital to the proper operation and/or protection of the ac power system as part of its primary review responsibility for SRP Sections 9.4.1 through 9.4.5[19]. This includes such systems as the heating,~~ and~~ ventilation, and air conditioning[20] systems provided to maintain a controlled environment for safety-related instrumentation and electric equipment. In particular, ~~ASB~~SPLB[21] determines that the piping, ducting, and dampering for these heating and ventilation systems are adequate.

2. ~~In addition, the~~The[22] ~~ASB~~ SPLB[23] examines the physical arrangement of components and structures for Class 1E systems and their supporting auxiliary systems to determine that single events and accidents will not disable redundant features as part of its primary review responsibility for SRP Sections 3.4.1, 3.5.1.1, 3.5.2, and 3.6.1.

3. The ~~ASB~~SPLB[24] determines those system components requiring electric power as a function of time for each mode of reactor operation and accident condition as part of its primary review responsibility for SRP Sections 6.5.1, 6.7, 9.1.3, 9.1.4, 9.2.1, 9.2.2, 9.2.4, 9.2.5, 9.2.6, ~~9.3~~9.3.1, 9.3.3, 9.4.1 through 9.4.5, 9.5.1, 10.4.5, 10.4.7, and 10.4.9.[25]

4. The SPLB determines the adequacy of the environmental qualification of safety-related electrical equipment as part of its primary review responsibility for SRP Section 3.11. In particular, the SPLB determines the capability of safety-related electrical equipment to perform its intended safety functions when subjected to the effects of (1) accident

environments such as loss-of-coolant accidents (LOCAs) and/or steam line breaks, (2) abnormal environments that may temporarily exceed equipment continuous duty design parameters such as temperature and humidity, (3) abnormal environments caused by degradation or loss of heating, ventilation, and/or air conditioning systems, (4) seismic shaking, and (5) normal design environments on redundant safety-related electrical equipment that does not include design diversity (e.g., redundant components manufactured and designed by the same supplier).[26]

5. The SPLB examines fire detection and fire protection systems protecting the ac power system and its auxiliary supporting systems to ensure that the adverse effects of fire are minimized as part of its primary review responsibility for SRP Section 9.5.1. This review includes examining the adequacy of protection provided for redundant safe shutdown circuits to determine that a single design basis fire will not disable both redundant circuits.[27]

6. The Materials and Chemical Engineering Branch (EMCB) determines those system components requiring electric power as a function of time for each mode of reactor operation and accident condition as part of its primary review responsibility for SRP Sections 5.4.8, 9.2.3, 9.3.2, and 9.3.4.[28]

7. The Containment Systems and Severe Accident Branch (SCSB)[29] evaluates the adequacy of those containment ventilation systems provided for maintaining a controlled environment for safety-related electrical equipment located inside the containment as part of its primary review responsibility for SRP Section 6.2.2. The SCSB[30] determines those system components requiring electric power as a function of time for each mode of reactor operation and accident condition as part of its primary review responsibility for SRP Sections 6.2.2, 6.2.3,[31] 6.2.4, and 6.2.5.

~~The Equipment Qualification Branch (EQB) determines the environmental qualification of safety-related electrical equipment as part of their primary review responsibility for SRP Section 3.11. In particular, the EQB determines the capability of safety-related electrical equipment to perform their designed safety function when subject to and following (1) the effects of accident environments such as loss of coolant and steam line break accidents, (2) the effects of normal environments that exceed the equipments design parameters such as temperature and humidity, (3) the effects of environments caused by loss of non-Class 1E heating and ventilation systems, (4) the effects of seismic shaking, and (5) the effects of normal design environments on redundant safety-related electrical equipment that do not have diversity of design such as redundant components manufactured and designed by the same supplier.~~[32]

8. The Reactor Systems Branch (~~RSB~~SRXB)[33] determines those system components requiring electric power as a function of time for each mode of reactor operation and accident condition as part of its primary review responsibility for SRP Sections 4.6, 5.4.6, 5.4.7, 5.4.12, ~~and~~ 6.3, and 9.3.5.[34]

9. The Instrumentation and Controls ~~Systems~~ Branch (~~ICSB~~HICB)[35] determines those system components requiring electric power as a function of time for each mode of reactor operation and accident condition as part of its primary review responsibility for

SRP Sections 7.2 through 7.7. In addition, ~~ICSB~~HICB[36] verifies the adequacy of safety-related display instrumentation and other instrumentation systems required for safety as part of its primary review responsibility for SRP Sections 7.5 and 7.6.

~~The Effluent Treatment Systems Branch (ETSB) determines those system components requiring electric power as a function of time for each mode of reactor operation and accident condition as part of its primary review responsibility for SRP Section 6.5.1.~~[37]

10. The ~~Procedures and Test Review Branch (PTRB)~~Quality Assurance and Maintenance Branch (HQMB)[38] determines the acceptability of the preoperational and initial startup tests and programs as part of its primary review responsibility for SRP Section 14.2~~0~~.[39]

11. The HQMB reviews the adequacy of administrative, maintenance, testing, and operating procedure programs as part of its primary review responsibility for SRP Sections 13.5.1.2 and 13.5.2.2. The reviews of design, construction, and operations phase quality assurance programs, including the general methods for addressing periodic testing, maintenance, and reliability assurance, are also coordinated and performed by the HQMB as part of its primary review responsibility for SRP Chapter 17.[40]

12. The Mechanical Engineering Branch (EMEB),[41] ~~reviews~~ as part of its primary review responsibility for SRP Section ~~3.11~~3.10, reviews[42] the criteria for seismic qualification and the test and analysis procedures and methods to ensure the mechanical survivability of Category I instrumentation and electrical equipment (including raceways, switchgear, control room boards, and instrument racks and panels) in the event of a seismic occurrence.

~~Electrical operability is reviewed by EQB as described above.~~[43]

~~The Chemical Engineering Branch (CMEB) examines the fire detection and fire protection systems for the ac power system and its supporting auxiliary system components to assure that adverse effects of fire are minimized as part of its primary review responsibility for SRP Section 9.5.1. This includes the adequacy of protection provided redundant safe shutdown circuits to determine that a single design basis fire will not disable both redundant circuits.~~[44]

~~The reviews for technical specifications and quality assurance including periodic testing are coordinated and performed by the Licensing Guidance Branch and Quality Assurance Branch as part of their primary review responsibility for SRP Sections 16.0 and 17.0 respectively.~~[45]

13. The Technical Specifications Branch (TSB) coordinates and performs reviews of technical specifications as part of its primary review responsibility for SRP Section 16.0.[46]

14. The Human Factors Assessment Branch (HHFB), as part of its primary review responsibility for SRP Sections 13.5.1.1 and 13.5.2.1, reviews the adequacy of administrative, maintenance, testing, and operating procedure programs.[47]

For those areas of review identified ~~above~~ as being ~~reviewed as~~ part of the review under other SRP sections ~~primary review responsibility of other branches~~, the acceptance criteria necessary for the review and the~~ir~~ methods of application are contained in the referenced SRP sections ~~of the corresponding primary branch~~.[48]

II. ACCEPTANCE CRITERIA

In general, the onsite ac power system is acceptable when it can be concluded that this system has the required redundancy, meets the single failure criterion, is protected from the effects of postulated accidents, is testable, and has the capacity, ~~and~~ capability, and reliability[49] to supply power to all safety loads and other required equipment in accordance with ~~GDC~~ General Design Criteria[50] 2, 4, 5, 17, 18, and 50. Table 8-1 lists General Design Criteria ~~(GDC)~~, regulations,[51] regulatory guides, and branch technical positions used as the bases for arriving at this conclusion.

The design of the ac power system is acceptable if the integrated design is in accordance with the following criteria and guidelines:

1. General Design Criterion 2 (GDC 2),[52] as related to structures, systems, and components of the ac onsite power system being capable of withstanding the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, and floods, as established in Chapter 3 of the SAR, and reviewed by the ~~ASB and the Structural Engineering Branch (SEB)~~SPLB, the Civil Engineering and Geosciences Branch (ECGB), and EMCB[53] as part of their primary review responsibility.

2. General Design Criterion 4 (GDC 4),[54] as related to structures, systems, and components of the ac power system being capable of withstanding the effects of missiles and environmental conditions associated with normal operation and postulated accidents, as established in Chapter 3 of the SAR and reviewed by ~~ASB, RSB and EQB~~SPLB and EMCB[55] as part of their primary review responsibility.

3. General Design Criterion 5 (GDC 5),[56] as related to the sharing of structures, systems, and components of the ac power system and the following guidelines:

    a. Regulatory Guide 1.32 (see also IEEE Std[57] 308), as related to the sharing of structures, systems, and components of the ac power system.

    b. Regulatory Guide 1.81, as related to the sharing of structures, systems, and components of the ac power system, positions C.2 and C.3.

4. General Design Criterion 17 (GDC 17),[58] as related to the onsite ac power system's (a) capacity and capability to permit functioning of structures, systems, and components important to safety; (b) the independence, redundancy, and testability to perform its safety function assuming a single failure; and (c) provisions to minimize the probability of losing electric power from any of the remaining supplies as a result of, or coincident with, the loss of power generated by the nuclear power unit

or the loss of power from the transmission network. Acceptance is based on meeting the following specific guidelines:

a. Regulatory Guide 1.6, as related to the independence of the onsite ac power system, positions D.1, D.2, D.4, and D.5.

b. Regulatory Guide 1.9 (see also IEEE Std 387).

c. Regulatory Guide 1.32 (see also IEEE Std 308), as related to design criteria for onsite ac power systems.

d. Regulatory Guide 1.75 (see also IEEE Std ~~304~~384),[59] as related to the onsite ac power system.

e. ~~Regulatory Guide 1.108 as related to the testability of the onsite ac power system.~~[60]Regulatory Guide 1.153 (see also IEEE Std 603), as related to criteria for electrical portions of safety-related systems.[61]

f. Regulatory Guide 1.155, as related to consideration of onsite emergency source reliability in evaluating station blackout issues and establishing an acceptable reliability program for onsite emergency sources.[62]

[63] ~~f~~g. NUREG/CR-0660, as related to the following recommendations:

(1) The diesel generator sets shall be capable of operation at less than full load for extended periods of time without degradation of performance or reliability. With offsite power available, no-load operation of the diesel generators will occur following a safety injection signal. Extended no-load operation of this equipment shall be minimized. Operating procedures shall be provided that limit extended no-load operation of the diesel generators. The procedures shall require loading the diesel engine to a minimum of 25% of full load for 1 hour after 8 hours of continuous no-load operation or to a load as recommended by the engine manufacturer.

(2) A complete formal training program shall be provided for all personnel who will be responsible for the maintenance and availability of the diesel generators. The depth and quality of training shall be at least equivalent to that provided by major diesel engine manufacturers' training programs.

(3) A preventive maintenance program shall be provided which encompasses investigative testing of components which have a history of repeated malfunctioning and a plan for the replacement of those components which require constant attention and repair with other products of proven reliability.

(4) Repair and maintenance procedures shall provide for a final equipment check prior to an actual start-run-load test to ensure~~assure~~[64] that all electrical circuits are functional (i.e., fuses in place, no loose wires, test leads removed, etc.) and all valves are in the proper position. The test procedure(s) shall explicitly state that upon satisfactory test completion the diesel generator unit shall be returned to a ready automatic standby service under the control of the control room operator.

(5) Except for sensors and other equipment that must be directly mounted on the engine or associated piping, the controls and monitoring instruments shall be installed on a free-standing, floor-mounted panel located on a vibration-free floor area.

[NOTE: If the floor is not vibration free, the panel shall be equipped with vibration mounts.]

h. For new applications, the design should provide that at least one offsite circuit to each redundant safety division be supplied directly from an offsite power source with no intervening nonsafety buses, thereby permitting the offsite source to supply power for safety buses when a nonsafety bus fails. The design should also include an alternate power source to nonsafety loads, unless it can be demonstrated that existing design margins will result in transients for loss of nonsafety power events that are no more severe than those associated with the turbine-trip-only event specified in plant designs.[65]

5. General Design Criterion 18 (GDC 18),[66] as related to the testability of the onsite ac power system, and the following guidelines:~~ of Regulatory Guide 1.118 (see also IEEE 338), as related to the capability for testing the onsite ac power system.~~

a. Regulatory Guide 1.32 (see also IEEE Std 308), as related to capability for testing of the onsite ac power system.

b. Regulatory Guide 1.118 (see also IEEE Std 338), as related to the capability for testing the onsite ac power system.

c. Regulatory Guide 1.153 (see also IEEE Std 603), as related to the onsite ac power system.[67]

6. The design requirements for an onsite ac power supply for systems covered by General Design Criteria 33, 34, 38, 41, and 44 are encompassed in ~~General Design Criterion~~GDC 17.[68]

7. General Design Criterion 50 (GDC 50),[69] as related to the design of containment electrical penetrations containing circuits of the ac power system, and the guidelines of Regulatory Guide 1.63 (see also IEEE Stds 242, 317, and 741), as related to the capability of electric penetration assemblies in containment structures to withstand a loss of coolant accident without loss of mechanical integrity and the external circuit

protection for such penetrations ~~the capability of the electric penetration assemblies to withstand, without loss of mechanical integrity, the maximum possible fault current versus time condition that could occur given single random failure of circuit overload protective devices located in circuits of the onsite ac power systems~~.[70]

8. 10 CFR 50.63, as related to use of the redundancy and reliability of diesel generator units as a factor in limiting the potential for station blackout events. Acceptance is based on meeting the following specific guidelines:[71]

    a. Regulatory Guide 1.9, as related to the adequacy of the diesel generator reliability program provided to attain and maintain the target reliability levels of diesel generator units.[72]

    b. Regulatory Guide 1.155, as related to use of the reliability of emergency onsite ac power sources as a factor in determining the coping duration for station blackout and the establishment of a program for attaining and maintaining source target reliability levels.[73]

Branch technical positions and industry standards that provide information, recommendations, and guidance and in general describe a basis acceptable to the staff that may be used to implement the requirements of General Design Criteria 2, 4, 5, 17, 18, and 50 are identified in SRP Section 8.1, Table 8.1, and in Appendix 8-A. In addition, 10 CFR 50.34(f)(2)(v), (xiii), and (xx) related to Task Action Plan items I.D.3, II.E.3.1 and II.G.1 of NUREG-0718 and NUREG-0737 ~~and NUREG-0718~~[74] are also implemented to meet these regulations.

Technical Rationale[75]

The technical rationale for application of these acceptance criteria to reviewing onsite ac power systems is discussed in the following paragraphs:[76]

1. Compliance with GDC 2 requires that nuclear power plant structures, systems, and components important to safety be designed to withstand the effects of natural phenomena such as earthquake, tornado, hurricane, flood, tsunami, or seiche without loss of capability to perform their intended safety function.

    With regard to the ac power system, this criterion requires that capability for the onsite ac power system to perform its functions be retained during the most severe natural phenomena that have been historically reported for the site and surrounding area. Therefore, the ac power system and its components must normally be located in seismic Category I structures that provide protection from the effects of tornadoes, tornado missiles, and floods. Equipment and components comprising the onsite ac power system must also generally be seismically designed and/or qualified to perform their functions in the event of an earthquake.

    Meeting this requirement will provide assurance that equipment and structures will be designed to withstand the effects associated with natural phenomena, thus decreasing the probability that seismically- and/or climatology-related natural phenomena could initiate accidents or prevent equipment from performing its safety function during an accident.[77]

2. Compliance with GDC 4 requires that structures, systems, and components important to safety (a) be designed to accommodate the effects of, and be compatible with, the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents and (b) be appropriately protected against dynamic effects that may result from equipment failures, including missiles.

   The ac power system is required to provide power to systems important to safety during normal, abnormal, accident, and postaccident conditions.

   Meeting these requirements will provide assurance that the ac power system will supply electric power required for operation of systems important to safety even if/when subject to adverse environmental conditions and/or dynamic effects.[78]

3. Compliance with GDC 5 requires that structures, systems, and components important to safety shall not be shared among nuclear power units, unless it can be shown that such sharing will not significantly impair their ability to perform their safety functions, including, in the event of an accident in one unit, an orderly shutdown and cooldown of the remaining units.

   This criterion requires that component parts of the ac power system not be shared among units without sufficient justification, thereby ensuring that an accident in one unit of a multiple-unit facility can be mitigated using an available compliment of mitigative features, including required ac power, irrespective of conditions in the other units and without giving rise to conditions unduly adverse to safety in another unit. SRP Section 8.3.1 cites Regulatory Guides 1.32 and 1.81 to establish acceptable guidance related to the sharing of structures, systems, and components of the preferred offsite and onsite power systems. Sharing of onsite ac electric power systems and components is no longer permitted per Regulatory Guide 1.81.

   Meeting the requirements of GDC 5 provides assurance that an accident within any one unit of a multiple-unit plant may be mitigated irrespective of conditions in other units without affecting the overall operability of the offsite and onsite power systems.[79]

4. Compliance with GDC 17 requires that onsite and offsite electrical power be provided to facilitate the functioning of structures, systems, and components important to safety. Each electric power system, assuming the other system is not functioning, must provide sufficient capacity and capability to ensure that specified acceptable fuel design limits and the design conditions of the reactor coolant pressure boundary are not exceeded as a result of anticipated operational occurrences and that the core is cooled and containment integrity and other vital functions are maintained in the event of postulated accidents.

   GDC 17 further requires that electric power from the transmission network to the onsite electric distribution system be supplied by two physically independent circuits designed and located so as to minimize the likelihood of their simultaneous failure under operating, postulated accident, and postulated environmental conditions. Each of these circuits is required to be designed to be available in sufficient time following a loss of all onsite alternating current power supplies and the other offsite electric power circuit, to assure that specified acceptable fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded. One of these circuits is also required to be designed to be available within a few seconds following a loss-of-coolant accident to assure that core cooling, containment integrity, and other vital safety functions are maintained.

Provisions must also be included to minimize the probability of losing electric power from any of the remaining supplies as a result of, or coincident with, the loss of power generated by the nuclear power unit, the loss of power from the transmission network, or the loss of power from the onsite electric power supplies.

GDC 17 also requires that the onsite power supplies and the onsite electrical distribution system have sufficient independence, redundancy, and testability to perform their safety functions assuming a single failure. Therefore, no single failure will prevent the onsite power system from supplying electric power, thereby permitting safety functions and other vital functions requiring electric power to be performed in the event of any single failure in the power system.

SRP Section 8.3.1 cites Regulatory Guides 1.6, 1.9, 1.32, 1.75, 1.153, and 1.155, and NUREG/CR-0660 as establishing acceptable guidance for meeting the requirements of GDC 17.

Meeting the requirements of GDC 17 provides assurance that a reliable electric power supply will be provided for all facility operating modes, including anticipated operational occurrences and design basis accidents to permit safety functions and other vital functions to be performed, even in the event of a single failure.[80]

5. Compliance with GDC 18 requires that electric power systems important to safety be designed to permit appropriate periodic inspection and testing of key areas and features to assess their continuity and the condition of their components. These systems shall be designed to test periodically (1) the operability and functional performance of the components of the systems, such as onsite power sources, relays, switches, and buses, and (2) the operability of the systems as a whole and, under conditions as close to design as practical, the full operation sequence that brings the systems into operation, including operation of applicable portions of the protection system, and the transfer of power among the nuclear power unit, the offsite power system, and the onsite power system.

This criterion requires that the ac power system provide the capability to perform integral testing of Class 1E systems on a periodic basis. Regulatory Guides 1.9, 1.32, 1.47, 1.118, and 1.153 and Branch Technical Position ICSB 21 (PSB) are cited in SRP Section 8.3.1 as establishing acceptable guidance for meeting the requirements of this criterion.

Meeting the requirements of GDC 18 provides assurance that, when required, onsite power systems can be appropriately and unobtrusively accessed for required periodic inspection and testing, enabling verification of important system parameters, performance characteristics, and features and detection of degradation and/or impending failure under controlled conditions.[81]

6. General Design Criteria 33, 34, 35, 38, 41, and 44 set forth requirements for the safety systems for which the access to both offsite and onsite power sources must be provided. Compliance with these criteria requires that capability be provided for reactor coolant makeup during small breaks, residual heat removal, emergency core cooling, containment heat removal, containment atmosphere cleanup, and cooling water for structures, systems, and components important to safety. These systems must be available during normal and accident conditions, as required by the specific system.

   General Design Criteria 33, 34, 35, 38, 41, and 44 require safety system redundancy such that, for onsite power system operation (assuming offsite power is unavailable), the system safety function can be accomplished, assuming a single failure. Redundancy must be reflected in the standby power system with regard to both power sources and associated distribution systems. Also, redundant safety loads must be distributed between redundant distribution systems, and the instrumentation and control devices for the Class 1E loads and power system must be supplied from associated redundant distribution systems. For the ac power system, these requirements are met if the minimum design required by GDC 17 is provided.

   Meeting the requirements of these criteria as encompassed by GDC 17 provides assurance that required electric power will be provided for all facility operating modes, including transients and design basis accidents so that the safety functions required in these criteria may be performed, even in the event of any single failure.[82]

7. Compliance with GDC 50 requires that the reactor containment structure, including access openings, penetrations, and containment heat removal systems, be designed so that the containment structure and its internal compartments can accommodate, without exceeding the design leakage rate and with sufficient margin, the calculated pressure and temperature conditions resulting from any LOCA. Containment electric penetrations must therefore be designed to accommodate, without exceeding their design leakage rate, the calculated pressure and temperature conditions resulting from a LOCA.

   This criterion, as it applies to this SRP section, relates specifically to ensuring the integrity of containment electrical penetrations in the event of design basis LOCA conditions. SRP Section 8.3.1 cites Regulatory Guide 1.63 as guidance acceptable to the staff for meeting the requirements of this criterion.

   Meeting the requirements of GDC 50 provides assurance that a LOCA will not cause a containment structure, including its electrical penetrations, to exceed the design leakage rate, thus limiting the consequences of a LOCA.[83]

8. Compliance with 10 CFR 50.63 requires that each light-water-cooled nuclear power plant be able to withstand and recover from a station blackout of a specified duration.

As specified in 10 CFR 50.63, the reliability of emergency onsite ac power sources must be used as a factor in determining the duration for which the plant must be capable of coping with a station blackout event. A reliability program should also be provided to attain and maintain the target reliability levels of emergency onsite ac sources with respect to station blackout considerations. Regulatory Guides 1.9 and 1.155, and SRP Section 8.4 (proposed) describe guidance acceptable to the staff for meeting the requirements of 10 CFR 50.63 related to addressing emergency onsite ac source reliability for station blackout.

Meeting the requirements of 10 CFR 50.63 provides assurance that nuclear power plants will have adequate onsite ac source reliability to maintain risks associated with station blackout within acceptable levels.[84]

III. REVIEW PROCEDURES

The primary objective in the review of the ac power system is to determine that this system satisfies the acceptance criteria stated in subsection II and will perform its design functions during plant normal operation, anticipated operational occurrences, and accident conditions. In the CP review, the descriptive information — including the design bases and their relation to the acceptance criteria, preliminary analyses, electrical single-line diagrams, functional logic diagrams, preliminary functional piping and instrumentation diagrams (P&IDs), and preliminary physical arrangement drawings — are examined to determine that there is reasonable assurance that the final design will meet these objectives. At the OL stage, these objectives are verified during the review of final electrical schematics, functional P&IDs, and physical arrangement drawings and are confirmed during a visit to the site. To ensure that acceptance criteria stated in subsection II are satisfied, the review is performed as detailed below.

The primary reviewer will coordinate this review with the other branch areas of review as stated in subsection I. The primary reviewer obtains and uses such input as required to ensure that this review procedure is complete.

1. System Redundancy Requirements

   General Design Criteria 33, 34, 35, 38, 41, and 44 set forth requirements with regard to the safety systems that must be supplied by the ac onsite power system. Also, these criteria state that safety system redundancy should be such that, for onsite power system operation (assuming offsite power is not available), the system safety function can be accomplished assuming a single failure. The acceptability of the onsite power system with regard to redundancy is based on conformance to the same degree of redundancy of safety-related components and systems required by these General Design Criteria. IEEE Std 603, as endorsed by Regulatory Guide 1.153, provides criteria used to evaluate all aspects of the electrical portions of safety-related systems and the onsite power system, including criteria addressing redundancy.[85] The descriptive information — including electrical single-line diagrams ~~(CP and OL stage)~~, functional P&IDs ~~(CP and OL stage)~~, and electrical schematics ~~(OL stage)~~[86] — is reviewed to verify that this redundancy is reflected in the standby power system with regard to both power sources and associated distribution systems. Also, it is verified in coordination with other branches that redundant safety loads are distributed between redundant distribution systems and that the instrumentation and control devices for the Class 1E loads and power system are supplied from the related redundant distribution systems.

2. Conformance with the Single Failure Criterion

As required by ~~General Design Criterion~~GDC 17, the onsite ac power system must be capable of performing its safety function assuming a single failure.

In evaluating the adequacy of this system in meeting the single failure criterion, both electrical and physical separation of redundant power sources and distribution systems, including their connected loads, are reviewed to assess the independence between redundant portions of the system.

To ensure electrical independence, the design criteria, analyses, description, and implementation as depicted on functional logic diagrams, electrical single-line diagrams, and electrical schematics are reviewed to determine that the design meets the requirements set forth in IEEE Std 308 and satisfies the positions of Regulatory Guide 1.6. IEEE Std 603, as endorsed by Regulatory Guide 1.153, provides criteria used to evaluate all aspects of the electrical portions of safety-related systems and the onsite power system, including basic criteria for addressing single failures.[87] Additional guidance in evaluating this aspect of the design is derived from IEEE Std 379, "Guide for the Application of the Single-Failure Criterion to Nuclear Power Generating Station Protection Systems," as augmented by Regulatory Guide 1.53, "Application of the Single-Failure Criterion to Nuclear Power Plant Protection Systems." Other aspects of the design where special review attention is given to ascertain that the electrical independence and physical separation has not been compromised are as follows:

a. Should the proposed design provide for sharing of the ac onsite power system between units at the same site, the criteria of IEEE Std 308 governing the sharing of this system between units are not specific enough to be used as the basis for assessing the adequacy of the design in meeting the requirements of ~~General Design Criterion~~ GDC 5 and satisfying the single failure criterion. Therefore, the acceptability of such a design is determined by reviewing the proposed system design criteria and electrical schematics and analyses substantiating the adequacy of the design to withstand the consequences of electrical faults and failures in one unit with respect to the others. Generally, the ~~PSB~~EELB[88] is guided by~~ the requirements set forth in~~[89] Position C.2[90] of Regulatory Guide 1.81, "Shared Emergency and Shutdown Electric Systems for Multi-Unit Nuclear Power Plants," for CP applications docketed before June 1, 1973~~, and for OL applications~~[91]. Position C.3[92] of this Regulatory Guide prohibits the sharing of onsite power systems between nuclear units for construction permit applications docketed after June 1, 1973. Further details of the review with regard to Position C.2[93] on sharing of the onsite power system between units are covered in item 4, below.

b. The interconnections between redundant load centers through bus tie breakers and multi-feeder breakers used to connect extra redundant loads to either of the redundant distribution systems are examined to ensure~~assure~~ that no single failure in the interconnections will cause the paralleling of the standby power supplies. To ensure this, the control circuits of the bus tie breakers or multi-feeder breakers must preclude automatic transferring of load centers or loads from the designated supply to the redundant counterpart upon loss of the designated supply (Position D.4[94] of Regulatory Guide 1.6). Regarding the interconnections through bus tie breakers, an acceptable design will provide for two tie breakers connected in series and physically separated from each other in accordance with the acceptance criteria for separation of the onsite power system, which is discussed below. Further, the interconnection of redundant load centers must be accomplished only manually. With respect to the interconnections through the multi-feeder breakers supplying power to extra redundant loads, the review relates to the use of the extra redundant unit as one of the required operating units (if the substituted-for-normal unit is inoperable). If this is the selected mode of operation prior to an accident concurrent with the loss of offsite power, it is verified by reviewing the breaker arrangement and associated control circuits that no single failure in the feeder breaker which is not connected to the extra redundant unit could cause the closing of this breaker, resulting in the paralleling of the power supplies. To ensure against compromising the independence of the redundant power systems under this situation, an acceptable design for connecting extra redundant loads to either distribution system will provide for at least dual means for connecting and isolating each load from each redundant bus. Such a design must also meet the acceptance criteria for electrical and physical separation of the onsite power system.

   In addition, the provisions of the design to automatically break all the interconnections (e.g., open tie and multi-feeder breakers) between redundant load centers immediately following an accident condition concurrent with the loss of offsite power are reviewed to ascertain that the independence of the redundant portions of this system is established given a single failure.

c. To ~~assure~~ensure physical independence, the criteria governing the physical separation of redundant equipment, including cables and raceways and their implementation as depicted on preliminary ~~(CP stage)~~ or final ~~(OL stage)~~[95] physical arrangement drawings, are reviewed to determine that the design arrangements satisfy the requirements set forth in IEEE Std 384 as augmented by Regulatory Guide 1.75. This standard and regulatory guide set forth acceptance criteria for the separation of circuits and electrical equipment contained in or associated with the Class 1E power system. To determine that the independence of the redundant cable installation is consistent with satisfying the requirements set forth in IEEE Std 384 as augmented by Regulatory Guide 1.75, the proposed design criteria governing the separation of Class 1E cables and raceways are reviewed, including such criteria as those for cable derating; raceway filling; cable routing in containment, penetration areas, cable spreading rooms, control rooms, and other congested areas; sharing of raceways with nonsafety-related cables or with cables of the same system or other systems; prohibiting cable splices in raceways; control wiring and components associated with Class 1E electric systems in control boards, panels, and relay racks; and fire barriers and separation between redundant raceways.

3. Onsite and Offsite Power System Independence

In ascertaining the independence of the onsite power system with respect to the offsite power system, the electrical ties between these two systems as well as the physical arrangement of the interface equipment are reviewed to ~~assure~~ensure that no single failure will prevent the separation of the redundant portions of the onsite power system from the offsite power system when required. The scope of the review for independence extends from the supply breakers connected to the low side of the unit auxiliary transformers and startup transformers (referred to as the offsite or preferred power supplies) to the station safety-related distribution system. The number and capability of electrical circuits from the offsite power system to the safety buses are to be consistent with satisfying the requirements of ~~General Design Criterion~~GDC 17. Then, downstream of the offsite power breakers at the safety buses, the design must satisfy the requirements for redundancy and independence of General Design Criteria 34, 35, 38, 41, and 44; that is, for onsite power system operation (assuming offsite power is not available), the system safety function can be accomplished assuming a single failure.

To determine that the physical independence of the preferred power circuits to the Class 1E buses is consistent with satisfying the requirements of ~~General Design Criterion~~GDC 17 and IEEE Std 308, the physical arrangement drawings are examined to verify that each circuit is physically separate and independent from its redundant counterparts. In addition, the final feeder-isolation breaker in each circuit through which preferred power is supplied to the safety buses must be designed and physically separated in accordance with the requirements for the onsite power system. Following the loss of preferred power, the safety buses are powered solely from the standby power supplies. Under this situation, the design of the feeder-isolation breaker in each preferred power circuit must preclude the automatic connection of preferred power to the respective safety bus upon the loss of standby power. In this regard, an acceptable design will include the capability for restoring preferred power to the respective safety bus by manual actuation only.

The staff has determined that supplying power to the Class 1E buses from offsite power sources through non-Class 1E buses, or from a common winding to that supplying non-Class 1E loads, are not the most reliable configurations. Such configurations make it difficult to obtain suitable voltage regulation at the Class 1E buses and subject the Class 1E loads to transients caused by non-Class 1E loads (e.g., Reactor Coolant Pump). Such configurations also result in additional failure points between the offsite power source and the Class 1E buses/loads. Therefore, for new applications, the staff has concluded that the design should include at least one offsite circuit be supplied directly to each redundant safety division from one of the offsite power sources with no intervening nonsafety buses in such a manner that the offsite source can power the safety buses in the event of failure of any nonsafety bus.

In plants where there is no alternate source to supply power to balance of plant loads such as Reactor Coolant Pumps, Reactor Recirculation Pumps, Feedwater Pumps, etc.; the loss of power to these loads due to a plant trip or a 100% load rejection caused by the opening of the main generator high-side circuit breaker will result in a loss of forced circulation in the reactor coolant system and reduced feedwater flow. Therefore, for new applications, the electrical drawings should also be examined to ensure that the design includes an alternate power source for nonsafety loads, unless it has been demonstrated that the design margins will result in transients for loss-of-nonsafety-power events that are no more severe that those associated with the turbine-trip-only event in existing plant designs.[96]

In assessing the adequacy of the electrical ties between the onsite and offsite power systems, and the capability of the preferred power circuits to deliver power to the safety-related buses, both primary and secondary backup protective relaying schemes and their coordination, relay settings, and assigned control power supplies are reviewed by ~~PSB~~EELB[97] to ~~assure~~ensure that, in the event of an electrical fault~~, occurring~~[98] between the preferred power transformer supply breakers and the safety buses, no single failure will result in reducing the number of preferred power circuits to less than the minimum required for safety or prevent the separation of the affected circuit from the respective redundant portion of the onsite power system. In addition, it is verified that no single protective relay or interlock failure will prevent separation of the required redundant portions of the onsite power system from the preferred power system upon loss of the latter.

In reviewing the mode of operation where both power systems are being operated in parallel (such is the case during full-load testing of standby power supply diesel-generator sets), the interlock scheme, including electrical protective relay coordination and settings, ~~are~~is[99] closely examined to verify that the independence of the required redundant portions of the onsite power system is established upon a failure in the offsite power system. The event of concern under this mode of operation is an accident concurrent with a loss of offsite power and a single failure preventing the opening of the feeder-isolation breaker through which the paralleling of the power systems was being accomplished. Because the signal to start the diesel-generator sets is normally derived from undervoltage relays, and under this situation the voltage is maintained above the trip relay settings by the diesel generator under test, the remaining redundant diesel generators will not be commanded to start running. Consequently, the added capacity resulting from the connection of nonsafety-related loads to the diesel generator under test will cause the tripping of this diesel due to overload or underfrequency[100]. The end result could be the total loss of power to the safety buses. However, this power interruption could be of momentary duration if the remaining redundant diesel generators are commanded automatically to start by undervoltage relay action immediately after total power is lost. The diesel generator under test will be inoperable due to the self-locking feature preventing restarting after an overload or underfrequency[101] trip condition. The reviewer ascertains that the time delay introduced in making power available to the safety buses as a result of this event is within the response time limits assumed in the accident analyses. Included is verification that subsequent failures such as those resulting from improper electrical relaying coordination and self-locking features will not impair the automatic starting of the remaining redundant diesel generators required to meet minimum safety requirements. If the time delay introduced in making power available to the safety buses is not tolerable, it must be demonstrated that either the probability of occurrence of this event is low when compared ~~to~~with[102] the frequency and duration of testing each diesel, or the design must provide diverse automatic signals, other than undervoltage, to ensure the availability of standby power to the safety buses.

As an outcome of reviewing the parallel operation of the offsite and onsite power systems, the use of the standby power supply diesel generator sets to supply power to the electrical system during peak load demand periods was found by the staff to be unacceptable. The basis for this conclusion is that the required frequent interconnections of the offsite and standby power supplies do not minimize the probability of their coincident loss (~~General Design Criterion~~GDC 17), nor can the design be made immune to common failure modes (Section 5.2.1(5) of IEEE Std 308). Further details amplifying the basis for this conclusion are included in Branch Technical Position ICSB 8 (PSB), which sets forth the basis for prohibiting the use of diesel-generator sets for purposes other than emergency standby power supplies.

4. <u>Standby Power Supplies</u>

In ensuring that the requirements of ~~General Design Criterion~~GDC 17 and IEEE Std 308 have been met with regard to the standby power supply diesel-generator sets having sufficient capacity and capability to supply the required distribution system loads, the design bases, design criteria, analyses, description, and implementation as depicted on electrical drawings and functional P&IDs, the diesel generator sets are reviewed to verify that the bases for their selection satisfy the positions of Regulatory Guide 1.9. Specifically, the reviewer first becomes familiar with the purpose and operation of each safety system, including system component arrangement as depicted on functional P&IDs, expected system performance as established in the accident analyses, modes of system operation and their interactions during normal and accident conditions, and interactions between systems. Following this, it is verified that the tabulation of all safety-related loads to be connected to each diesel generator is consistent with the information establishing the safety-related systems and loads and their required redundancy. The characteristics of each load (such as motor horsepower, volt-amp rating, in-rush current, starting volt-amps, and torque), the length of time each load is required, and the basis used to establish the power required for each safety load (such as motor nameplate rating, pump run-out condition, or estimated load under expected flow and pressure) are used to verify the calculations establishing the combined load demand to be connected to each diesel during the "worst" operating condition. In applying this combined load demand to the selection of each diesel generator capacity, an acceptable design must satisfy Positions C.1.2 and C.~~2~~1.3[103] of Regulatory Guide 1.9.

To ensure that each diesel generator is capable of starting and accelerating to rated speed all the connected loads in the required sequence and within the minimum time intervals established by the accident analyses, the ~~PSB~~EELB[104] reviewer examines for each diesel generator the loading profile curves, voltage and frequency recovering characteristic curves, and the response time of the excitation system to load variations. This examination must verify that the capability of each diesel generator to respond to voltage and frequency variations satisfies Position C.~~5~~1.4[105] of Regulatory Guide 1.9. In addition, the adequacy of the circuit design for starting and disconnecting and connecting safety loads from and to each diesel generator is checked. This includes a review of the starting initiating circuits; manual and automatic sequential loading and unloading circuits; interrupting capacity of switchgear, load centers, control centers, and distribution panels; grounding requirements; and electrical protective relaying circuits, including their coordination, relay settings, and assigned control power supplies for each load and each diesel generator. In reviewing the criteria governing the design of the thermal overload protection for motors of motor-operated safety-related valves, the reviewer is guided by Regulatory Guide 1.106.

Regarding the review of the electrical protective trip circuits of the diesel generator sets, Positions ~~8~~C.1.7 and ~~9~~C.1.8[106] of Regulatory Guide 1.9 are used as an evaluation guide. The capability of the automatic sequential loading circuits to reset during a sustained low-voltage condition on the diesel generators is reviewed to ensure that upon restoration of normal voltage, the safety-related loads can be connected in the prescribed sequence. Otherwise, the reconnection of all the loads at the same time could result in an overload condition causing the trip of the respective diesel generator. In ensuring that those safety-related loads being powered through latched-type breakers are capable of being reconnected to their respective buses after restoration of power, the design must provide for resetting the breaker anticycle feature when there is an undervoltage condition. The normal function of this feature is to prevent immediate reclosure of a breaker following a trip.

Where the proposed design provides for the sharing of diesel generators between units at the same site, and connection and disconnection of non-Class 1E loads to and from the Class 1E distribution buses, particular attention is given in the review to ensure that the implementation of such design provisions does not compromise the capacity or capability of the standby power supplies.

~~General Design Criterion~~GDC 5 prohibits sharing unless it can be shown that the diesel generators are capable of performing all required safety functions in the event of an accident in one unit and an orderly shutdown and cooldown of the remaining units. In ensuring that the proposed design for sharing diesel generators between units meets the requirements of General Design Criteria 5 and 17 as supplemented by General Design Criteria 34, 35, 38, 41, and 44 and satisfies the positions of Regulatory Guide 1.9, the ~~PSB~~EELB[107] reviewer is guided by Regulatory Guide 1.81. This guide sets forth two principal positions. Position C.3[108] applies to those construction permit applications docketed after June 1, 1973, and prohibits the sharing of onsite power systems between units. Conformance of the design with Position C.3 is verified by reviewing the descriptive information, including electrical drawings, to ensure that the onsite power system of each unit is electrically independent with respect to the onsite power system of other units.

Position C.2[109] of Regulatory Guide 1.81 establishes acceptable bases under which sharing of onsite power systems between units is permitted. Conformance with Position C.2[110] with regard to the adequacy of diesel generator capacity and capability under the sharing mode of operation is verified by following the procedure discussed above for tabulating and summing all loads. In particular, the load tabulation and calculations establishing the diesel generator capacity are examined to ensure that the selected capacity is sufficient to power the minimum engineered safety feature (ESF)[111] loads in any unit and safely shut down the remaining units in the event of an accident in one unit and a single failure or spurious or false accident signal from another unit and loss of preferred power to all the units. In addition, the physical arrangement of instrumentation and control devices on control room panels and consoles in one unit with respect to the other units is examined to ensure that the design minimizes the coordination needed between unit operators to accomplish sharing of the standby power systems.

In the absence of specific criteria in IEEE Std 308[112] governing the connection and disconnection of non-Class 1E loads to and from the Class 1E distribution buses, the review of the interconnections will consider isolation devices as defined in IEEE Std 384 and augmented by Regulatory Guide 1.75 to determine the adequacy of the design. In ensuring that the interconnections between non-Class 1E loads and Class 1E buses will not result in the degradation of the Class 1E system, the isolation device through which standby power is supplied to the non-Class 1E load, including control circuits and connections to the Class 1E bus, must be designed to meet Class 1E requirements. Should the standby power supplies not have been sized to accommodate the added non-Class 1E loads during emergency conditions, the design must provide for the automatic disconnection of those non-Class 1E loads upon the detection of the emergency condition. This action must be accomplished whether or not the load was already connected to the power supply. Further, the design must also prevent the automatic or manual connection of these loads during the transient stabilization period subsequent to this event.

The description of the qualification test program (CP stage) and the results of such tests (OL stage) for demonstrating the suitability of the diesel generators as standby power supplies are judged to be acceptable if they satisfy the acceptance criteria stated in subsection II. In the event that diesel generators have not been selected for a particular plant, a commitment from the applicant to obtain diesel generators of a design that has been previously qualified for use in nuclear power plant applications, or to perform qualification tests on diesel generators of a new design in accordance with the acceptance criteria, is considered acceptable~~ at the CP stage of review~~[113].

The review of the diesel generator auxiliary systems is reviewed in SRP Sections 9.5.4 through 9.5.8.

To ~~assure~~ensure that diesel generator reliability and operation will not be degraded, the reviewer evaluates the diesel generator descriptive information and the results of failure modes and effects analyses in the SAR and, using engineering judgment, verifies the following items:

a. Provisions have been made in the facility design and in the design and installation of electrical equipment associated with the starting of the diesel generators to minimize engine failure to start on demand due to accumulation of dust and other deleterious material ingested via the ventilation system or generated in the diesel engine room during normal plant operation on the electrical starting equipment (e.g., auxiliary relay contacts, control switches, etc.) panel or individually mounted.

b. The diesel generator sets are capable of operation at less than full load without degradation of performance or reliability and operating procedures limit no-load operation.

c. A complete formal training program is provided for all mechanical and electrical maintenance, quality control, and operating personnel, including supervisors who are responsible for the maintenance and availability of the diesel generators.

d. A preventive maintenance program is provided which encompasses investigative testing of components and a replacement plan as specified in subsection II.

e. The repair and maintenance procedures provide for a final equipment check and test procedures provide for returning the diesel engine to automatic standby service and under the control of the control room operator.

f. Operating experience at certain nuclear power plants which have two-cycle turbocharged diesel engines manufactured by the Electromotive Division (EMD) of General Motors driving emergency generators have experienced a significant number of turbocharger mechanical gear drive failures occurring as the result of running the emergency diesel generators at no-load or light-load conditions for extended periods. When this equipment is operated under no-load conditions, insufficient exhaust gas volume is generated to operate the turbocharger; as a result, the turbocharger is driven mechanically from a gear drive in order to supply enough combustion air to the engine to maintain rated speed. The turbocharger and mechanical drive gear normally supplied with these engines are not designed for standby service encountered in nuclear power plant application where the equipment may be called upon to operate at no-load or light-load condition and full-rated speed for a prolonged period, where no-load speeds for the engine and generator are much lower than full-load speeds. The locomotive turbocharger diesel hardly ever runs at full speed except at full load. EMD has developed heavy-duty turbocharger mechanical drive gear assemblies for installation on their diesel engines. EMD diesel engines drives proposed for driving emergency generators for nuclear power plants should be provided with heavy-duty turbocharger mechanical drive gear assembly as recommended by the manufacturer. The reviewer verifies that the EMD diesel engine is provided a heavy-duty turbocharger mechanical gear drive assembly to ~~assure~~ensure optimum availability of the emergency generators on demand.

g. Except for sensors and other equipment that must be mounted directly on the engine or associated piping, the controls and monitoring instruments are installed on a free-standing, floor-mounted panel located on a vibration-free floor area. If the floor is not vibration free, the panel should be equipped with vibration mounts. In the event that the instruments and controls cannot be removed from the engine skid, due to plant design, the controls and instrumentation should be environmentally qualified for vibration service. Until the environmental qualification of the components is completed, the applicant has implemented an augmented inspection, test, and calibration program. Verify that this program has been adequately described in the SAR.

5. Identification of Cables, Raceways, and Terminal Equipment

The identification scheme used for safety-related cables, raceways, and terminal equipment in the plant and internal wiring in the control boards is reviewed to see that it is consistent with IEEE Std 384 as augmented by Regulatory Guide 1.75. This includes the criteria for differentiating between (a) safety-related cables, raceways, and terminal equipment of different channels or divisions; (b) nonsafety-related cable which is run in safety raceways; (c) nonsafety-related cable which is not associated physically with any safety division; and (d) safety-related cables, raceways, and terminal equipment of one unit with respect to the other units at a multi-unit site.

6. ~~Vital Supporting~~Auxiliary Supporting Systems/Features[114]

The ~~PSB~~EELB[115] will review those auxiliary supporting[116] systems identified as being vital to the operation of safety-related loads and systems. IEEE Std 603, as endorsed by Regulatory Guide 1.153, provides criteria used to evaluate all aspects of the instrumentation, control, and electrical portions of auxiliary supporting systems and features, including basic requirements that call for auxiliary supporting systems and features to satisfy the same criteria as the supported safety systems.[117] The ~~PSB~~EELB[118] reviews the instrumentation, control, and electrical aspects of the ~~vital supporting~~auxiliary supporting systems and features[119] to ensure that their design conforms to the same criteria as those for the systems that they support.

Hence, the review procedure to be followed for ascertaining the adequacy of these ~~vital supporting~~ systems and features[120] is the same as that discussed herein for the onsite systems. In essence, the reviewer first becomes familiar with the purpose and operation of each ~~vital supporting~~auxiliary supporting system and feature[121], including its components arrangement as depicted on functional P&IDs. Subsequently, the design criteria, analyses, and description and implementation of the instrumentation, control, and electrical equipment, as depicted on electrical drawings, are reviewed to verify that the design is consistent with satisfying the acceptance criteria for Class 1E systems. In addition, it is verified that the ~~vital supporting~~auxiliary supporting[122] system redundant instrumentation, control devices, and loads are examined to verify that they are powered from the same redundant distribution system as the system that they support. The ~~PSB~~EELB[123] will also verify that the ~~vital supporting~~auxiliary supporting[124] systems which are associated with the emergency diesel engine such as the fuel oil storage and transfer system, cooling water system, starting air system, and lubrication system are in accordance with the acceptance criteria.

The ~~ASB~~SPLB[125] reviews the other aspects of the ~~vital supporting~~auxiliary supporting[126] systems to verify that the design, capacities, and physical independence of these systems are adequate for their intended functions. Included is a review of the heating~~, and~~ ventilation, and air conditioning (~~H&V~~HVAC)[127] systems identified as necessary to Class 1E systems, such as the ~~H&V~~HVAC[128] systems for the electrical switchgear and diesel generator rooms. The ~~ASB~~SPLB[129] will verify the adequacy of the ~~H&V~~HVAC[130] system design to maintain the temperature and relative humidity in the room required for proper operation of the safety equipment during both normal and accident conditions. It will also verify that redundant ~~H&V~~HVAC[131] systems are located in the same enclosure as the redundant unit they serve or are separated in accordance with the same criteria as those for the systems they support.

7. System Testing and Surveillance

In ensuring that the proposed periodic onsite testing capabilities of the ac onsite power system satisfies the requirements of ~~General Design Criterion~~GDC 18 and the positions of Regulatory Guides ~~1.108~~[132]1.9[133] and 1.118, the descriptive information ~~(CP and OL stages)~~, functional logic diagrams ~~(CP and OL stages)~~, and electrical schematics ~~(OL stage)~~[134] are reviewed to verify that the design has the built-in capability to permit integral testing of Class 1E systems on a periodic basis when the reactor is in operation[135]. Basic criteria relevant to the review of the surveillance and testability of safety-related aspects of the ac power system is also described in IEEE Std 603 as endorsed by Regulatory Guide 1.153.[136]

The descriptive information ~~(CP and OL stages)~~ and the design implementation as depicted on electrical drawings ~~(OL stage)~~[137] of the means proposed for automatically indicating at the system level a bypassed or deliberately inoperative status of a redundant portion of a safety-related system are reviewed to ascertain that the design is consistent with Regulatory Guide 1.47 and Branch Technical

Position ICSB 21 (PSB). This position establishes the basis to be considered in arriving at an acceptable design for the inoperable status indication system.

8. Fire Protection for Cable Systems[138]

In ensuring that the requirements of ~~General Design Criterion~~GDC 3 have been met, ~~CMEB~~SPLB[139] will review the design of the fire stops and seals, including the materials, their characteristics with regard to flammability and fire retardancy, and their fire underwriters rating in accordance with SRP Section 9.5.1. All cable and cable tray penetrations through walls and floors as well as any other types of cable ways or conduits should have fire stops installed. ~~PSB~~EELB[140] will review cable derating and raceway fill to ensure compliance with accepted industry practices.

9. Reliability Program for Emergency Onsite AC Power Sources

Regulatory Guide 1.155 provides guidance for setting minimum reliability goals for emergency onsite ac power sources. Review is conducted in accordance with SRP Section 8.4 (proposed) to verify that the target reliability for such sources satisfy the positions of Regulatory Guide 1.155.[141] Regulatory Guide 1.155 also recommends that the reliable operation of emergency onsite ac power sources be ensured by a reliability program designed to maintain and monitor the reliability level of each power source over time for assurance that the target reliability levels are being achieved. The reliability program is reviewed to verify its adequacy with respect to station blackout considerations. The reviewer verifies that the reliability program includes provisions that conform with Position C.1.2 of Regulatory Guide 1.155 and Positions C.2.2 and C.2.3 of Regulatory Guide 1.9. The reviewer also verifies that the effectiveness of maintenance activities under the program are monitored in accordance with Regulatory Guide 1.160.[142]

For standard design certification reviews under 10 CFR Part 52, the procedures above should be followed, as modified by the procedures in SRP Section 14.3 (proposed), to verify that the design set forth in the standard safety analysis report, including inspections, tests, analysis, and acceptance criteria (ITAAC), site interface requirements and combined license action items, meet the acceptance criteria given in subsection II. SRP Section 14.3 (proposed) contains procedures for the review of certified design material (CDM) for the standard design, including the site parameters, interface criteria, and ITAAC.[143]

IV. EVALUATION FINDINGS

The reviewer verifies that sufficient information has been provided and that the review supports conclusions of the following type, to be included in the staff's safety evaluation report:

The onsite power system includes the standby power sources, distribution systems, ~~vital~~[144] auxiliary supporting systems, and instrumentation and controls required to supply power to safety-related components and systems. The review of the ac power system for the ___________ plant covered the descriptive information ~~(CP and OL)~~, functional logic diagrams ~~(CP and OL)~~, functional piping and instrument diagrams ~~(CP and OL)~~, electrical single-line diagrams ~~(CP and OL)~~, preliminary ~~(CP)~~ and final ~~(OL)~~ physical arrangement drawings, and electrical schematics ~~(OL)~~[145].

The basis for acceptance of the ac power system in ~~our~~ this[146] review was conformance of the design criteria and bases to the Commission's regulations as set forth in the General Design Criteria ~~(GDC)~~ of Appendix A to 10 CFR Part 50. The staff concludes that the plant design is acceptable and meets the requirements of General Design Criteria~~GDC~~ 2, 4, 5, 17, 18, and 50 and 10 CFR 50.63.[147] This conclusion is based on the following:

1. The applicant has met the requirements of GDC 2, "Design Basis for Protection Against Natural Phenomena," with respect to structures, systems, and components of the ac power systems being capable of withstanding the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, and floods by locating the ac power system and components in seismic Category I structures which provide protection from the effects of tornadoes, tornado missiles, and floods. In addition, the ac power system and components have a quality assurance designation of Class 1E.

2. The applicant has met the requirements of GDC 4, "Environmental and ~~Missile~~Dynamic Effects[148] Design Bases," with respect to structures, systems, and components of the ac power system being capable of withstanding the effects of missiles and environmental conditions associated with normal operation and postulated accidents by adequate plant design and equipment qualification program.

3. The applicant has met the requirements of GDC 5, "Sharing of Structures, Systems, and Components," with respect to structures, systems, and[149] components of the onsite ac power system. The onsite ac power system and components associated with the multi-unit facility are housed in physically separate seismic Category I structures, are not shared between units, and the applicant has met the positions of Regulatory Guide 1.32, Position C.2.a, and Regulatory Guide 1.81, Positions C.2 and C.3.

4. The applicant has met the requirements of GDC 17, "Electric Power Systems," with respect to the onsite Class 1E ac power system's (a) capacity and capability to permit functioning of structures, systems, and components important to safety; (b) the independence and redundancy to perform their safety function assuming a single failure; and (c) provisions to minimize the probability of losing electric power from any of the remaining supplies as a result of, or coincident with, the loss of power generated by the nuclear power unit or the loss of power from the transmission network. Acceptability was based on the applicant meeting the positions of Regulatory Guides 1.6, 1.9, 1.32, 1.75~~, and 1.108~~, 1.153, 1.155,[150] and NUREG/CR-0660.

5. The applicant has met the requirements of GDC 18, "Inspection and Testing of Electric Power Systems," with respect to the onsite Class 1E ac power system. The

ac power system is designed to be testable during operation[151] of the nuclear power generating station as well as during those intervals when the station is shut down. This meets the positions of Regulatory Guide 1.118.

6. The applicant has met the requirements of GDC 50, "Containment Design Bases," with respect to penetrations containing circuits of the safety and nonsafety ac power system. Containment electric penetrations have been designed to accommodate, without exceeding their design leakage rate, the calculated pressure and temperature conditions resulting from any loss-of-coolant accident concurrent with the maximum short-circuit current versus time condition that could occur given single random failures of circuit ~~overload~~[152] protective devices. This meets the positions of Regulatory Guide 1.63.

7. The applicant has met the requirements of 10 CFR 50.63, "Loss of All Alternating Current Power," with respect to appropriate use of the redundancy and reliability of emergency onsite ac power sources as factors in determining an appropriate station blackout duration for which the plant should be capable of withstanding or coping with, and recovering from. The applicant has committed to suitable target reliability levels for emergency onsite ac power sources and a program that provides reasonable assurance that reliability targets will be achieved and maintained. The acceptable program is based on meeting the relevant positions of Regulatory Guides 1.9 and 1.155. The applicant's compliance with the requirements of 10 CFR 50.63 is discussed in further detail in Sections 8.2 and 8.4 of the safety evaluation report (SER).[153]

For design certification reviews, the findings will also summarize, to the extent that the review is not discussed in other safety evaluation report sections, the staff's evaluation of inspections, tests, analyses, and acceptance criteria (ITAAC), including design acceptance criteria (DAC), site interface requirements, and combined license action items that are relevant to this SRP section.[154]

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this SRP section.

This SRP section will be used by the staff when performing safety evaluations of license applications submitted by applicants pursuant to 10 CFR 50 or 10 CFR 52.[155] Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the method described herein will be used by the staff in its evaluation of conformance with Commission regulations.

The provisions of this SRP section apply to reviews of applications docketed six months or more after the date of issuance of this SRP section.[156]

Implementation schedules for conformance to parts of the method discussed herein are contained in the referenced regulatory guides and NUREG.

VI. REFERENCES

1. Standard Review Plan Section 8.1, Table 8-1, "Acceptance Criteria and Guidelines for Electric Power Systems." (See Table 8-1 for a detailed list of acceptance criteria and guidance references for all SRP Chapter 8 sections, including listing of relevant NRC-endorsed versions of standards)[157]

2. Standard Review Plan Appendix 8-A, "Branch Technical Positions (PSB)."

3. Standard Review Plan Appendix 8-B, "General Agenda, Station Site Visits."

4. NUREG-0718, "Licensing Requirements for Pending Applications for Construction Permits and Manufacturing License."

5. NUREG-0737, "Clarifications of TMI Action Plan Requirements."

6. NUREG/CR-0660, "Enhancement of Onsite Emergency Diesel Generators Reliability."

~~APPENDIX~~

~~CRITERIA FOR ALARMS AND INDICATIONS ASSOCIATED WITH DIESEL-GENERATOR UNIT~~
~~BYPASSED AND INOPERABLE STATUS~~

~~[Appendix to SRP Section 8.3.1 has been superseded by Branch Technical Position PSB-2]~~[158]

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SRP Draft Section 8.3.1
Attachment A - Proposed Changes in Order of Occurrence

Item numbers in the following table correspond to superscript numbers in the redline/strikeout copy of the draft SRP section.

Item	Source	Description
1.	Current PRB name and abbreviation	Changed PRB to Electrical Engineering Branch (EELB).
2.	Integrated Impact 862	Revised to reflect current terminology describing this class of systems/features based upon RG 1.153.
3.	Editorial	Defined "SRP" as "Standard Review Plan."
4.	Current PRB abbreviation	Changed PRB to EELB.
5.	Editorial change	Changed to reflect consecutive numbering.
6.	Integrated Impact No. 863	Added allusion to RG 1.155, which establishes standby emergency power source target reliability levels.
7.	Integrated Impact 862	Revised to reflect current terminology describing this class of systems/features based upon RG 1.153.
8.	Integrated Impact 862	Revised to reflect current terminology describing this class of systems/features based upon RG 1.153.
9.	Integrated Impact 862	Revised to reflect current terminology describing this class of systems/features based upon RG 1.153.
10.	Integrated Impact No. 863	Added area of review reflecting guidance of RG 1.155.
11.	Editorial change	Changed to reflect consecutive numbering.

Item	Source	Description
12.	SRP-UDP format item	Added "Review Interfaces" to AREAS OF REVIEW and organized in numbered paragraphs to describe how aspects of the ac power systems are reviewed under other SRP sections and how other branches support the review.
13.	SRP-UDP format item	Added standard Review Interfaces subsection introduction to other reviews performed by the PRB.
14.	Editorial	Added a review interface to reflect that the offsite power system and the AAC source for station blackout (which are extensively discussed in relation to the onsite power system in this SRP section) are reviewed in greater detail in SRP Section 8.2.
15.	SRP-UDP Integration of Station Blackout Issues	Added a review interface describing relevant reviews in new SRP Section 8.4.
16.	Current PRB abbreviation	Changed PRB to EELB.
17.	Current review branch responsibility	Changed to reflect that SPLB has PRB review responsibility for the cited SRP sections.
18.	Integrated Impact 862	Revised to reflect current terminology describing this class of systems/features based upon RG 1.153.
19.	Editorial	There is no SRP Section 9.4, thus updated references to the specific SRP sections involved.
20.	Editorial	Revised to use more common terminology for describing such systems.
21.	Current PRB abbreviation	Changed PRB to SPLB.

Item	Source	Description
22.	SRP-UDP format item	Revised the sentence structure to be consistent with the numbered paragraph format.
23.	Current review branch responsibility	Changed to reflect that SPLB has PRB review responsibility for the cited SRP sections.
24.	Current review branch responsibility	Changed to reflect that SPLB has PRB review responsibility for the listed SRP sections.
25.	Current review branch responsibility	Changed to reflect current SRP sections relevant to the described interface for which SPLB is the PRB.
26.	Current review branch responsibility	Changed to specify review responsibility for SRP Section 3.11 and performed editorial changes for clarity.
27.	Current review branch responsibility	Changed to reflect that SPLB has PRB review responsibility for SRP Section 9.5.1.
28.	Current review branch responsibility	Added review interface to reflect that EMCB has PRB review responsibility for SRP Sections 5.4.8, 9.2.3, 9.3.2, and 9.3.4 which include review of electrical loads.
29.	Current review branch responsibility	Changed to reflect that SCSB has PRB review responsibility for SRP Section 6.2.2.
30.	Current review branch responsibility	Changed to reflect that SCSB has PRB review responsibility for the listed SRP sections.
31.	Editorial	Since secondary containment features may contain valves or ventilation systems requiring electric power, added SRP Section 6.2.3 to the list.
32.	SRP-UDP format item	Moved section to interface 4.

Item	Source	Description
33.	Current PRB abbreviation	Changed PRB to SRXB.
34.	Current review branch responsibility	Changed to reflect that the PRB review responsibility for SRXB includes the listed sections which may involve review of electrical loads.
35.	Current review branch responsibility	Changed to reflect that HICB has PRB review responsibility for SRP Sections 7.2 through 7.7.
36.	Current PRB abbreviation	Changed PRB to HICB.
37.	SRP-UDP format item	Moved section listing to interface 3.
38.	Current review branch responsibility	Changed to reflect that HQMB has PRB review responsibility for SRP Section 14.2.
39.	Editorial	Changed "Section 14.0" to "Section 14.2" to reflect the SRP reference more accurately.

Item	Source	Description
40.	Current PRB review responsibilities, also see ROC 855	Changed to indicate HQMB review responsibility for SRP Chapter 17. Also added interface addressing reviews of procedure programs. Reference to RG 1.160 was added in this SRP section as it relates to evaluation of maintenance effectiveness for emergency ac power sources only. Coverage of other power system SSCs subject to monitoring or evaluation under the maintenance rule is to be verified in SRP Chapter 13 and/or 17. Compliance with the maintenance rule, including verification that appropriate maintenance activities are covered therein, is reviewed under SRP Chapter 17. Programs for incorporation of requirements into appropriate procedures are reviewed under SRP Sections 13.5.x.x. Thus added a review interface reflecting review of appropriate controls over procedure development activities.
41.	Current PRB abbreviation	Changed PRB to EMEB.
42.	Current PRB review responsibility	Changed to reflect that the review for seismic qualification of Category I instrumentation and electrical equipment is performed in SRP Section 3.10.
43.	Current review branch responsibility	This review is included in the SPLB review described in interface 4.
44.	SRP-UDP format item	Moved this interface description to interface 5.
45.	SRP-UDP format item	Moved interface descriptions to interfaces 11 and 13.
46.	Current review branch responsibility	Changed to reflect review responsibility for SRP Section 16.0.

Item	Source	Description
47.	Integrated Impact No. 855	Added interface to address the overall review of maintenance and testing practices including compliance with the maintenance rule. Reference to RG 1.160 was added in this SRP section as it relates to evaluation of maintenance effectiveness for emergency ac power sources only. Coverage of other power system SSCs subject to monitoring or evaluation under the maintenance rule is to be verified in SRP Chapter 13 and/or 17. Compliance with the maintenance rule, including verification that appropriate maintenance activities are covered therein, is reviewed under SRP Chapter 17. Programs for incorporation of requirements into appropriate procedures are reviewed under SRP Sections 13.5.x.x. Thus added a review interface reflecting review of appropriate controls over procedure development activities.
48.	SRP-UDP format item	Revised to cover interfaces with other sections, regardless of whether EELB or another PRB is responsible for them since both types of interfaces are covered herein.
49.	Integrated Impact No. 863	Added allusion to RG 1.155 guidance regarding power system reliability.
50.	Editorial	Changed "GDC" to "General Design Criteria" to accommodate plural usage (global change for this section).
51.	Editorial	Revised to reflect that Table 8-1 also lists relevant non-GDC regulations.
52.	Editorial	Provided "GDC 2" as initialism for General Design Criterion 2.

Item	Source	Description
53.	Current review branch responsibility SPLB, ECGB, and EMEB	Changed to reflect that SPLB, ECGB, and EMCB have PRB review responsibility for SRP Sections in Chapter 3 that pertain to natural phenomena.
54.	Editorial	Provided "GDC 4" as initialism for General Design Criterion 4.
55.	Current review branch responsibility	Changed to reflect that SPLB and EMCB have PRB review responsibility for SRP Sections in Chapter 3 that pertain to missiles and environmental conditions.
56.	Editorial	Provided "GDC 5" as initialism for General Design Criterion 5.
57.	Editorial	Added "Std" to correct citation format for IEEE standards (global change for this section).
58.	Editorial	Provided "GDC 17" as initialism for General Design Criterion 17.
59.	Editorial change	Changed to indicate that IEEE Std 384 is endorsed by RG 1.75. IEEE Std 304 is not referenced by RG 1.75.
60.	Integrated Impact No. 859	Deleted reference to Regulatory Guide 1.108, which was withdrawn August 5, 1993.
61.	Integrated Impact No. 862	Added reference to Regulatory Guide 1.153, "Criteria for Power, Instrumentation, and Control Portions of Safety-Related Systems," which was published in December 1985. It provides guidance for the design, reliability, qualification, and testability of the power, instrumentation, and control portions of safety-related systems of nuclear power plants. The RG endorses, with some modification and supplements, IEEE Std 603-1980.

Item	Source	Description
62.	Integrated Impact No. 863	Added reference to RG 1.155.
63.	Editorial	Renumbered/lettered to reflect addition of a previous item.
64.	Editorial	Changed "assure" to "ensure" (global change for this section).
65.	Integrated Impact 866, SRP-UDP Integration of Evolutionary Plant Issues	Added applicable regulations from ABWR and CE System 80+ FSERs as acceptance criteria for new applications.
66.	Editorial	Provided "GDC 18" for General Design Criterion 18.
67.	Editorial	Revised for consistency with presentation of this criterion in SRP Section 8.3.2.
68.	Editorial	Replaced "GDC" for "General Design Criterion" as introduced above (global change for this section).
69.	Editorial	Provided "GDC 50" for General Design Criterion 50.

Item	Source	Description
70.	Integrated Impact No. 665, Editorial, Incorporation of PRB Comment	Added "Stds" for consistency with other standards citations. Added reference to IEEE Stds 242 and 741 as recommended by the PRB. Did not update reference to IEEE Std 317-1983, which is endorsed by RG 1.63, Rev. 3 nor provide dates for other IEEE standards as recommended by the PRB. Instead, subsection VI refers to Table 8-1 of SRP Section 8.1 where versions of IEEE standards applicable for Chapter 8 are reflected. Note that RG 1.63 endorses Section 5.4 of IEEE Std 741-1986, thus Table 8-1 will reflect IEEE Std 741-1986 instead of the 1990 version as recommended. Also note that Section 5.4 of IEEE Std 741-1986 references IEEE Std 242-1975 instead of the 1986 version recommended by the PRB. Although contrary to normal practice under the SRP-UDP, reference to IEEE Std 242-1986 was added in Table 8-1 based on the PRB comment. In addition, the discussion of RG 1.63 guidance was modified to reflect the current revision of the RG (Rev. 3) which no longer explicitly discusses single-failure overcurrent withstand capabilities of penetrations, although these issues are still addressed through endorsement of IEEE Std 741.
71.	Integrated Impact No. 864	Added reference to the station blackout rule, 10 CFR 50.63.
72.	Integrated Impact No. 855	Added reference to Regulatory Guide 1.9, "Selection, Design, Qualification, and Testing of Emergency Diesel Generator Units Used as Class 1E Onsite Electric Power Systems at Nuclear Power Plants."

Item	Source	Description
73.	Integrated Impact No. 863	Added reference to RG 1.155.
74.	Current reference for Task Action Items, also see ROC 1003 for SRP Section 8.1	Changed to reflect relevant portions of 10 CFR 50.34(f) that specify the required TMI Task Action Items for CP and Part 52 applications and add TMI Item I.D.3 (detailed in NUREG-0718) as also relevant (see ROC 1003 for SRP Section 8.1). Also rearranged NUREG citations to better correspond with TMI item citations.
75.	SRP-UDP format item	Added "Technical Rationale" to ACCEPTANCE CRITERIA and organized in numbered paragraph to describe the basis for referencing the General Design Criteria.
76.	SRP-UDP format item	Added lead-in sentence for "Technical Rationale."
77.	SRP-UDP format item	Added technical rationale for GDC 2.
78.	SRP-UDP format item	Added technical rationale for GDC 4.
79.	SRP-UDP format item	Added technical rationale for GDC 5.
80.	SRP-UDP format item	Added technical rationale for GDC 17.
81.	SRP-UDP format item	Added technical rationale for GDC 18.
82.	SRP-UDP format item	Added technical rationale for General Design Criteria 34, 35, 38, 41, and 44 as encompassed by GDC 17.
83.	SRP-UDP format item	Added technical rationale for GDC 50.
84.	SRP-UDP format item	Added technical rationale for 10 CFR 50.63.

Item	Source	Description
85.	Integrated Impact No. 862	Added reference to Regulatory Guide 1.153, "Criteria for Power, Instrumentation, and Control Portions of Safety-Related Systems," which was published in December 1985. It provides guidance for the design, reliability, qualification, and testability of the power, instrumentation, and control portions of safety-related systems of nuclear power plants. The RG endorses, with some modification and supplements, IEEE Std 603-1980.
86.	Editorial, Incorporation of PRB Comment	Deleted references to CP and OL review stages at the request of the PRB (see February 29, 1996 Memorandum to R.W. Borchardt from J.A. Calvo (TAC NO. M88581) transmitting comments on draft revisions to SRP Section 8.3.1).
87.	Integrated Impact No. 862	Added reference to Regulatory Guide 1.153, "Criteria for Power, Instrumentation, and Control Portions of Safety-Related Systems," which was published in December 1985. It provides guidance for the design, reliability, qualification, and testability of the power, instrumentation, and control portions of safety-related systems of nuclear power plants. The RG endorses, with some modification and supplements, IEEE Std 603-1980.
88.	Current PRB abbreviation	Changed PRB to EELB.
89.	Editorial	Revised so that RG content is not characterized as "requirements."
90.	Editorial	Revised for consistency between position citations and their locations in RGs.

Item	Source	Description
91.	Editorial, Incorporation of PRB Comment	Deleted references to OL applications at the request of the PRB (see February 29, 1996 Memorandum to R.W. Borchardt from J.A. Calvo (TAC NO. M88581) transmitting comments on draft revisions to SRP Section 8.3.1).
92.	Editorial	Revised for consistency between position citations and their locations in RGs.
93.	Editorial	Revised for consistency between position citations and their locations in RGs.
94.	Editorial	Revised for consistency between position citations and their locations in RGs.
95.	Editorial, Incorporation of PRB Comment	Deleted references to CP and OL review stages at the request of the PRB (see February 29, 1996 Memorandum to R.W. Borchardt from J.A. Calvo (TAC NO. M88581) transmitting comments on draft revisions to SRP Section 8.3.1).

Item	Source	Description
96.	Integrated Impact No. 866	Added reference to the staff policy stated in SECY-91-078 and subsequently approved in an SRM dated August 15, 1991. The policy states that "plant design should include ... an alternate power source to the non-safety loads unless the design can demonstrate that the design margins will result in transients for a loss of non-safety power event that are no more severe that those associated with the turbine-trip-only event in current existing plant designs." The policy also states that "plant design should include ... at least one offsite circuit to each redundant safety division supplied directly from one of the offsite power sources with no intervening non-safety buses in such a manner that the offsite source can power the safety buses upon failure of any non-safety bus."
97.	Current PRB abbreviation	Changed PRB to EELB.
98.	Editorial	Simplified for clarity.
99.	Editorial	Changed "are" to "is" for noun-verb agreement.
100.	Editorial, Incorporation of PRB Comment	Added underfrequency as a trip that could also occur at the request of the PRB(see February 29, 1996 Memorandum to R.W. Borchardt from J.A. Calvo (TAC NO. M88581) transmitting comments on draft revisions to SRP Section 8.3.1).

Item	Source	Description
101.	Editorial, Incorporation of PRB Comment	Added underfrequency as a trip that could also occur at the request of the PRB(see February 29, 1996 Memorandum to R.W. Borchardt from J.A. Calvo (TAC NO. M88581) transmitting comments on draft revisions to SRP Section 8.3.1).
102.	Editorial	Changed "compared to" to "compared with."
103.	Integrated Impact No. 855	Changed the referenced regulatory position numbers to agree with those in Revision 3 of RG 1.9.
104.	Current PRB abbreviation	Changed PRB to EELB.
105.	Integrated Impact No. 855	Changed the referenced regulatory position numbers to agree with those in Revision 3 of RG 1.9.
106.	Integrated Impact No. 855	Changed the referenced regulatory position numbers to agree with those in Revision 3 of RG 1.9.
107.	Current PRB abbreviation	Changed PRB to EELB.
108.	Editorial	Revised for consistency between position citations and their locations in RGs.
109.	Editorial	Revised for consistency between position citations and their locations in RGs.
110.	Editorial	Revised for consistency between position citations and their locations in RGs.
111.	Editorial	Defined "ESF" as engineered safety feature.

Item	Source	Description
112.	No change	It should be noted that recent versions of IEEE Std 308 contain specific criteria governing connection and disconnection of non-Class 1E loads to and from the Class 1E distribution buses. The PRB may wish to alter this sentence such that it would not be untrue with respect to recent versions of IEEE Std 308.
113.	Editorial, Incorporation of PRB Comment	Deleted references to the CP review stage at the request of the PRB (see February 29, 1996 Memorandum to R.W. Borchardt from J.A. Calvo (TAC NO. M88581) transmitting comments on draft revisions to SRP Section 8.3.1).
114.	Integrated Impact 862	Revised to reflect current terminology describing this class of systems/features based upon RG 1.153.
115.	Current PRB abbreviation	Changed PRB to EELB.
116.	Integrated Impact 862	Revised to reflect current terminology describing this class of systems/features based upon RG 1.153.
117.	Integrated Impact No. 862	Added reference to Regulatory Guide 1.153, "Criteria for Power, Instrumentation, and Control Portions of Safety-Related Systems," which was published in December 1985. It provides guidance for the design, reliability, qualification, and testability of the power, instrumentation, and control portions of safety-related systems of nuclear power plants. The RG endorses, with some modification and supplements, IEEE Std 603-1980.
118.	Current PRB abbreviation	Changed PRB to EELB.

Item	Source	Description
119.	Integrated Impact 862	Revised to reflect current terminology describing this class of systems/features based upon RG 1.153.
120.	Integrated Impact 862	Revised to reflect current terminology describing this class of systems/features based upon RG 1.153.
121.	Integrated Impact 862	Revised to reflect current terminology describing this class of systems/features based upon RG 1.153.
122.	Integrated Impact 862	Revised to reflect current terminology describing this class of systems/features based upon RG 1.153.
123.	Current PRB abbreviation	Changed PRB to EELB.
124.	Integrated Impact 862	Revised to reflect current terminology describing this class of systems/features based upon RG 1.153.
125.	Current review branch responsibility	Changed to reflect that SPLB has PRB review responsibility for HVAC systems.
126.	Integrated Impact 862	Revised to reflect current terminology describing this class of systems/features based upon RG 1.153.
127.	Editorial	Revised to use more common terminology for describing such systems and its acronym.
128.	Editorial	Revised to use more common terminology for describing such systems and its acronym.
129.	Current review responsibility for SPLB	Changed to reflect that SPLB has PRB review responsibility for HVAC systems.
130.	Editorial	Revised to use more common terminology for describing such systems and its acronym.

Item	Source	Description
131.	Editorial	Revised to use more common terminology for describing such systems and its acronym.
132.	Integrated Impact No. 859	Deleted reference to Regulatory Guide 1.108, which was withdrawn August 5, 1993.
133.	Integrated Impact No. 855	Added reference to Regulatory Guide 1.9.
134.	Editorial, Incorporation of PRB Comment	Deleted references to CP and OL review stages at the request of the PRB (see February 29, 1996 Memorandum to R.W. Borchardt from J.A. Calvo (TAC NO. M88581) transmitting comments on draft revisions to SRP Section 8.3.1).
135.	No change	The PRB should consider clarifying the basis, intent, and methods for review of electric power system testability when the reactor is in operation since 1) GDC 18 does not explicitly require testability when the reactor is in operation and 2) many features of the Class 1E system and associated protection system are not testable and/or are not normally tested while operating (e.g., undervoltage load shedding/sequencing testing).

Item	Source	Description
136.	Integrated Impact No. 862	Added reference to Regulatory Guide 1.153, "Criteria for Power, Instrumentation, and Control Portions of Safety-Related Systems," which was published in December 1985. It provides guidance for the design, reliability, qualification, and testability of the power, instrumentation, and control portions of safety-related systems of nuclear power plants. The RG endorses, with some modification and supplements, IEEE Std 603-1980. The current version, IEEE Std 603-1991, should be cited if RG 1.153 is revised to endorse the current version.
137.	Editorial, Incorporation of PRB Comment	Deleted references to CP and OL review stages at the request of the PRB (see February 29, 1996 Memorandum to R.W. Borchardt from J.A. Calvo (TAC NO. M88581) transmitting comments on draft revisions to SRP Section 8.3.1).
138.	Editorial change	Changed to reflect consecutive numbering.
139.	Current review branch responsibility	Changed to reflect that SPLB has PRB review responsibility for SRP Section 9.5.1.
140.	Current PRB abbreviation	Changed PRB to EELB.
141.	Integrated Impact No. 863	Added reference to RG 1.155.
142.	Integrated Impact No. 855	Added reference to Regulatory Guide 1.9 and Regulatory Guide 1.160.
143.	SRP-UDP Guidance, Implementation of 10 CFR 52	Added standard paragraph to address application of Review Procedures in design certification reviews.
144.	Integrated Impact 862	Revised to reflect current terminology describing this class of systems/features based upon RG 1.153.

Item	Source	Description
145.	Editorial, Incorporation of PRB Comment	Deleted references to CP and OL review stages at the request of the PRB (see February 29, 1996 Memorandum to R.W. Borchardt from J.A. Calvo (TAC NO. M88581) transmitting comments on draft revisions to SRP Section 8.3.1).
146.	Editorial	Changed "our" to "this" to eliminate use of personal pronoun.
147.	Integrated Impact No. 864	Added reference to the station blackout rule, 10 CFR 50.63.
148.	SRP-UDP format item	Updated title of GDC 4.
149.	Editorial	Modified to correct an apparent typographical error.
150.	Integrated Impact Nos. 859, 862, and 863, Editorial	Deleted reference to Regulatory Guide 1.108, which was withdrawn August 5, 1993. Also added listing of all guides listed in subsection II as relevant to compliance with GDC 17.
151.	No change	The PRB should consider clarifying the basis, intent, and methods for review of electric power system testability when the reactor is in operation since 1) GDC 18 does not explicitly require testability when the reactor is in operation and 2) many features of the Class 1E system and associated protection system are not testable and/or are not normally tested while operating (e.g., undervoltage load shedding/sequencing testing).
152.	Editorial	Revised to reflect that single failures of short circuit protection must also be considered.

Item	Source	Description
153.	Integrated Impact Nos. 855, 863, and 864	Added findings regarding the station blackout rule, 10 CFR 50.63, and references to relevant guidance in RG 1.9 and RG 1.155.
154.	SRP-UDP Format Item, Implement 10 CFR 52 Related Changes	To address design certification reviews a new paragraph was added to the end of the Evaluation Findings. This paragraph addresses design certification specific items including ITAAC, DAC, site interface requirements, and combined license action items relevant to this SRP section.
155.	SRP-UDP Guidance, Implementation of 10 CFR 52	Added standard sentence to address application of the SRP section to reviews of applications filed under 10 CFR Part 52, as well as Part 50.
156.	SRP-UDP Guidance	Added standard paragraph to indicate applicability of this section to reviews of future applications.
157.	Editorial, SRP-UDP format item	To address the non-standard manner in which references were listed for this SRP section, provided reference to Table 8-1 as containing the list of references rather than adding an extensive relisting herein.
158.	Editorial	Deleted as unnecessary.

SRP Draft Section 8.3.1

Attachment B - Cross Reference of Integrated Impacts

Integrated Impact No.	Issue	SRP Subsections Affected
855	Recommends incorporating changes resulting from revision 3 of RG 1.9 and RG 1.160.	II.8.a, III.4, III.9, IV.7
859	Recommends deleting references to RG 1.108	II.4.e, III.8, IV.4
860	Recommends revising to reflect that RG 1.118 Rev. 3 endorses IEEE Std 338-1987.	Addressed in Table 8-1 of SRP Section 8.1 per ROC 1520
862	Recommends adding references to RG 1.153.	one global terminology change throughout subsections I-IV, II.4.e, II.5.c, III.1, III.2, III.6, III.7, IV.4
863	Recommends adding references to RG 1.155.	I.4, I.9 II, II.4.f, II.8.b, III.4, III.9, IV.4, IV.7
864	Recommends adding references to 10 CFR 50.63.	II.8, III.9, IV, IV.7
865	Recommends adding references to NFPA-78 and IPCEA P-46-426 and addressing review of grounding, lightning protection, conductor derating, and cable tray fill issues.	Review of grounding and lightning protection issues are added in SRP Section 8.2 under ROC 368 since SER discussion of these issues was primarily located in section 8.2 of the SERs. No change was made to the SRP regarding cable tray fill and conductor derating issues.
866	Recommends adding offsite power-related policies described in SECY-91-078.	II.4.h, III.3
990	Consideration should be given to revising SRP Section 8.3.1 to cite the requirement 10 CFR 50.34(f)(2)(xx) related to the current citation of TMI action plan item II.G.1.	II
1041	Consideration should be given to revising SRP Section 8.3.1 to cite the requirement 10 CFR 50.34(f)(2)(xiii) related to the current citation of TMI action plan item II.E.3.1.	II