U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

OFFICE OF NUCLEAR REACTOR REGULATION

8.3.2 DC 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 electrical single-line diagrams, electrical schematics, functional piping and instrument diagrams, logic diagrams, tables, and physical arrangement drawings for the dc onsite power system presented in the applicant's safety analysis report (SAR), are reviewed. The intent of the review is to determine that the dc 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, and station blackout[2] conditions.

The dc power systems include those dc power sources and their distribution systems and ~~vital~~auxiliary[3] supporting systems provided to supply motive or control power to safety-related equipment and to equipment used to cope with a station blackout event.[4] Batteries and battery chargers are used as the power sources for the dc power system, and inverters are used to convert dc from the dc distribution system to ac instrumentation and control power, as required.

The ~~PSB~~EELB[5] will pursue the following phases in the review of the dc power systems during both the construction permit (CP) and operating license (OL) stages of the licensing process:

1. <u>System Redundancy Requirements</u>

The system is reviewed to determine that the required redundancy of components and subsystems is provided. This requires an examination of the dc power system configuration, including power supplies, power supply feeders, load center arrangements, loads supplied from each bus, and power connections to the instrumentation and control devices of the system.

2. <u>Conformance with the Single Failure Criterion</u>

In determining the adequacy of this system to meet the single failure criterion, the 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 the interconnections between redundant buses, buses and loads, and buses and power supplies; proposed sharing of the dc power system between units at the same site; the design criteria and bases governing the installation of electrical cable for redundant portions of the systems; and physical arrangement of redundant switchgear and power supplies.

3. <u>Power Supplies</u>

Design information and analyses demonstrating the suitability of batteries and battery chargers as dc power supplies and inverters that convert dc to ac for instrumentation and control power are reviewed to ~~assure~~ensure[6] that they have sufficient capacity and capability to perform their intended functions, including the ability to cope with a station blackout event.[7] This will require an examination of the characteristics and design requirements of each load, the length of time each load is required, the combined load demand connected to each battery or battery charger during the "worst" operating condition, the voltage recovering characteristics of the battery and battery chargers, and the continuous and short-term ratings for the battery and battery chargers. ~~In addition,~~ Where[8] the proposed design provides for the connection of nonsafety-related loads to the dc power system and sharing of batteries and battery chargers between units at the same site, particular review emphasis is given to ~~assuring~~ ensure against marginal capacity and degradation of reliability that may result from implementing such design provisions.

In addition, where the proposed design provides for portions of the onsite dc system to cope with a station blackout event, the capability and capacity of the batteries and system is verified as adequate to withstand and recover from an event of specified duration.[9]

4. <u>Identification</u>

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

5. ~~Vital Supporting~~Auxiliary Supporting Systems/Features[10]

The instrumentation, control circuits, and power connections of ~~vital supporting~~auxiliary supporting systems and features[11] 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[12] 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.

6. Surveillance and Testing

The means proposed for monitoring the status of system operability are reviewed. Periodic onsite testing capability is reviewed.

7. Other Review Areas

The dc 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.

(e) Station blackout events are addressed in the design of dc power systems.[13]

Review Interfaces[14]

EELB also performs the following reviews under the SRP sections indicated:

1. Reviews the adequacy of the offsite and onsite ac power system, including ac power sources, safety-related ac distribution systems, and ac instrumentation and control power systems, as part of its primary review responsibility for SRP Sections 8.2 and 8.3.1.[15]

2. In accordance with SRP Section 8.4 (proposed), the overall compliance with 10 CFR 50.63 requirements is reviewed including the adequacy of the station blackout analysis, the duration for which the plant will be able to withstand or cope with, and recover from a station blackout event, and the adequacy of dc system power supplies that are not a part of the onsite dc power system reviewed under SRP Section 8.3.2 with respect to the specified station blackout event/duration.[16]

In the review of other areas associated with the dc onsite power system, the PSBEELB[17] 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)[18] evaluates the adequacy of those auxiliary supporting[19] systems that are vital to the proper operation and/or protection of the dc power system as part of its primary review responsibility for Standard Review Plan (SRP)[20] Sections 9.4.1 through 9.4.5[21]. This includes such systems as the heating and ventilation systems for load center, battery, battery charger, and inverter rooms. In particular, the ASBSPLB[22] determines that the piping, ducting, and valving arrangements of redundant vital[23] auxiliary supporting systems meet the single failure criterion.

2. In addition, theThe[24] ASBSPLB[25] examines the physical arrangement of the dc power system and its supporting auxiliary system components and associated structures 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 ASBSPLB[26] 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, 9.39.3.1, 9.3.3, 9.4.1 through 9.4.5, 9.5.1, 10.4.5, 10.4.7, and 10.4.9.[27]

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).[28]

5. The SPLB examines the fire detection and fire protection systems for the dc 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.[29]

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.[30]

7. The Containment Systems and Severe Accident Branch (SCSB)[31] 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[32] 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,[33] 6.2.4, and 6.2.5.

~~The Equipment Qualification Branch (EQB) determines the environmental qualification of safety-related electrical equipment as part of its 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 steamline break accidents, (2) the effects of normal environments that exceed the equipment' s 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.~~[34]

8. The Reactor Systems Branch (~~RSB~~SRXB)[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 4.6, 5.4.6, 5.4.7, 5.4.12, ~~and~~ 6.3, and 9.3.5.[36]

9. The Instrumentation and Controls ~~Systems~~ Branch (~~ICSB~~HICB)[37] 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[38] verifies the adequacy of safety-related display instrumentation, alarms,[39] and other instrumentation systems (including bypass indication, status of batteries, and status of battery chargers required for safety)[40] 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.~~[41]

10. The ~~Procedures and Test Review Branch (PTRB)~~Quality Assurance and Maintenance Branch (HQMB)[42] 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~~.[43]

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.[44]

12. The Mechanical Engineering Branch (EMEB)[45] reviews 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.~~[46]

~~The Chemical Engineering Branch (CMEB) examines the fire protection and fire fighting systems for the d-c 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.~~[47]

~~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.~~[48]

13. The reviews for technical specifications are coordinated and performed by the Technical Specifications Branch (TSB) as part of its primary review responsibility for SRP Section 16.0.[49] TSB reviews will include evaluation of surveillance requirements and limiting conditions of operation for the use of interconnections, including those between safety-related dc power systems for multi-unit stations.[50]

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.[51]

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~~.[52]

II. ACCEPTANCE CRITERIA

In general, the dc 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 to supply dc power to all safety loads and other required equipment in accordance with ~~GDC~~ General Design Criteria[53] 2, 4, 5, 17, 18, and 50 and with 10 CFR 50.63.[54]

SRP Section 8.1, Table 8-1, lists General Design Criteria, regulatory guides, and staff technical positions utilized as the bases for arriving at this conclusion.

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

1. General Design Criterion 2 (GDC 2),[55] as related to structures, systems, and components of the dc 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 ~~ASB, and SEB~~SPLB, the Civil Engineering and Geosciences Branch (ECGB), and EMEB[56] as part of their primary review responsibilit~~y~~ies[57].

2. General Design Criterion 4 (GDC 4),[58] as related to structures, systems, and components of the dc 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 reviews by ~~ASB, RSB and EQB~~SPLB and EMCB,[59] as part of their primary review responsibility.

3. General Design Criterion 5 (GDC 5),[60] as related to the sharing of structures, systems, and components of the dc power system, and the following guidelines:

   a. Regulatory Guide 1.32 (see also IEEE Std[61] 308), as related to the sharing of structures, systems, and components of the dc power system, position C.2.a.

   b. Regulatory Guide 1.81, as related to the sharing of structures, systems, and components of the dc power system, position C.1.

4. General Design Criterion 17 (GDC 17),[62] as related to the onsite dc 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 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 onsite dc power system, positions D.1, D.3, and D.4.

   b. Regulatory Guide 1.32 (see also IEEE Std 308), as related to the onsite dc power system.

   c. Regulatory Guide 1.75 (see also IEEE Std 384), as related to the onsite dc power system.

   d. Regulatory Guide 1.128 (see also IEEE Std 484), as related to the onsite dc power system.[63]

   e. Regulatory Guide 1.153 (see also IEEE Std 603), as related to the onsite dc power system.[64]

5. General Design Criterion 18 (GDC 18),[65] as related to the testability of the onsite dc power system, and the following guidelines:

   a. Regulatory Guide 1.32 (see also IEEE Std 308), as related to ~~test~~ capability for testing[66] of the onsite dc power system.

   b. Regulatory Guide 1.118 (see also IEEE Std ~~378~~338),[67] as related to the capability for testing the onsite dc power system.

   c. Regulatory Guide 1.153 (see also IEEE Std 603), as related to the onsite dc power system.[68]

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

7. General Design Criterion 50 (GDC 50),[69] as related to the design of containment electrical penetrations containing circuits of safety-related and nonsafety-related dc power systems and 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 Class 1E and non-Class 1E dc power systems~~.[70]

8. 10 CFR 50.63, as related to the ability of the onsite dc power system to support the plant in withstanding or coping with, and recovering from a station blackout event, and the guidelines of Regulatory Guide 1.155, as related to the capability and the capacity of the onsite dc power system for an event of specified duration.[71]

Branch technical positions and regulatory guides 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 Appendix 8-A.

<u>Technical Rationale</u>[72]

The technical rationale for application of these acceptance criteria to reviewing spent fuel storage is discussed in the following paragraphs:[73]

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 functions.

With regard to the dc power system, this criterion requires that capability for the onsite dc 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 dc 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 dc 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.[74]

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 dc 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 dc 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.[75]

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 dc 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 dc power, irrespective of conditions in the other units and without giving rise to conditions unduly adverse to safety in another unit. SRP Section 8.3.2 cites Regulatory Guides 1.32 and 1.81 to establish acceptable guidance related to the sharing of structures, systems, and components of the onsite dc power system. Regulatory Guide 1.81, Position C.1 recommends that dc systems in multi-unit nuclear power plants should not be shared.

   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 onsite power systems.[76]

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 8.3.2 cites Regulatory Guides 1.6, 1.32, 1.75, 1.128, and 1.153 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.[77]

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 dc power system provide the capability to perform integral testing of Class 1E systems on a periodic basis. Regulatory Guides 1.32, 1.47, 1.118, and 1.153 and Branch Technical Position ICSB 21 (PSB) are cited in SRP Section 8.3.2 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.[78]

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 dc 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.[79]

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 8.3.2 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.[80]

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 specified duration. As required by 10 CFR 50.63, electrical systems must be of sufficient capacity and capability to ensure that the core is cooled and that appropriate containment integrity is maintained in the event of a station blackout.

The capacity of any onsite dc sources required for station blackout must therefore be verified to be adequate with respect to the worst-case station blackout load profile and specified duration. Regulatory Guide 1.155 and SRP Section 8.4 (proposed) describe guidance acceptable to the staff for meeting the requirements of 10 CFR 50.63.

Meeting the requirements of 10 CFR 50.63 provides assurance that nuclear power plants will be able to withstand or cope with, and recover from a station blackout by providing capability for maintaining core cooling and an appropriate level of containment integrity.[81]

III. REVIEW PROCEDURES

The primary objective in the review of the dc power system is to determine that this system satisfies the acceptance criteria stated in subsection II and will perform its design functions during normal plant operations, anticipated operational occurrences, ~~and~~ accident conditions, and station blackout events[82]. 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 ~~assure~~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~~ reviews[83] as stated in subsection I. The primary reviewer obtains and uses such input as required to ~~assure~~ensure that this review procedure is complete.

1. System Redundancy Requirements

GDCGeneral Design Criteria 33, 34, 35, 38, 41, and 44 set forth requirements with regard to safety-related systems that must be supplied by the onsite (ac and dc) power systems. Also, these criteria state that safety-related system redundancy shall 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 dc power system with regard to redundancy is based on conformance to the same degree of redundancy required of safety-related components and systems required by these GDC 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.[84] The descriptive information, including electrical single-line diagrams (CP and OL stages), functional P&IDs (CP and OL stages), and electrical schematics (OL stage)[85], is reviewed to verify that this redundancy is reflected in the dc power system with regard to both power sources and associated distribution systems. Also, it is verified in coordination with other branches that redundant safety-related loads are distributed between redundant distribution systems and that the instrumentation and control devices for the safety-related loads and power system are supplied from the related redundant distribution systems. The review verifies that reactor core cooling is maintained after the loss of any one dc power supply or bus and a single independent active failure in any other system required for shutdown cooling.[86]

2. Conformance with the Single Failure Criterion

As required by GDC 17, the dc power system must be capable of performing its safety function, assuming a single failure. In evaluating the adequacy of this system to meet 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 assureensure 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 fromdescribed in[88] 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. 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. 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 assureensure that no single failure in the interconnections or inadvertent closure of interconnecting devices will compromise division independence in a manner that will cause the[89] paralleling of the dc power supplies. To assureensure 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 4 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 safety-related systems which isas[90] discussed below. Further, the interconnection of redundant load centers must be accomplished only manually.

b. To assureensure physical independence, the criteria governing the physical separation of redundant equipment, including cables and cable trays and their implementation as depicted on preliminary (CP stage) or final (OL stage)[91] physical arrangement drawings, are reviewed to determine that the design arrangement satisfies the requirements of IEEE Std 384 and positions of Regulatory Guide 1.75. These guides and standards set forth acceptance criteria for the separation of circuits and electrical equipment contained in or associated with the safety-related power system. To determine that the independence of the redundant cable installation is consistent with the requirements set forth in IEEE Std 384 and the positions set forth in Regulatory Guide 1.75, the proposed design criteria governing the separation of safety-related 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; spacing of power and control wiring and components associated with safety-related electric systems in control boards, panels, and relay racks; and fire barriers and separation between redundant raceways.

3. DC Power Supplies and Distribution Systems

In assuring To ensure that the requirements of GDC 17 and IEEE Std 308 have been met with regard to the dc power system 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 performance characteristic curves are reviewed. To establish that the capacity of the dc supply is adequate to power the prescribed loads, the nameplate capacity claimed in the design bases is checked against the loads identified in electrical distribution diagrams. The capability of the system is reviewed by evaluating the performance characteristic curves that illustrate the response of the supplies to the most severe loading conditions at the plant. The performance characteristic curves would include voltage profile curves, discharge rate curves, and temperature effect curves. The capacity of the dc supplies should be assuredensured by periodic discharge tests of the batteries as described in IEEE Std 450 and Regulatory Guide 1.129.

The review of design practices and procedures for storage, location, mounting, ventilation, instrumentation, preassembly, assembly, and charging of large lead storage batteries is based on Regulatory Guide 1.128 and IEEE Std 484.[92]

~~The reviewer i~~In coordination with other branches, the reviewer[93] becomes familiar with the purpose and the operation of each safety system, including system component arrangements as depicted on functional P&IDs, expected system performance as established in the accident and/or other relevant analyses (e.g., for station blackout)[94], modes of system operation and 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 dc supply is consistent with the information obtained in coordination with other branches.

The characteristics of each load (such as motor horsepower and volt-amp ratings, inrush 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-related load (such as motor name plate rating, pump run out condition, or estimated load under expected flow and pressure) are utilized to verify the calculations establishing the combined load demand to be connected to each dc supply during the "worst" operating conditions. In reviewing the design of the thermal overload protection for motors of motor operated safety-related valves, the reviewer is guided by Regulatory Guide 1.106.

Where the proposed design provides for the sharing of dc supplies between units at the same site, and connection and disconnection of nonsafety-related loads to and from the safety-related distribution buses, particular attention is given in the review to ~~assure~~ensure that the implementation of such design provisions does not compromise the capacity, capability, or reliability of these supplies. Regulatory Guide 1.81, Position C.1 recommends that dc systems in multi-unit nuclear power plants should not be shared.[95]

In the absence of specific criteria in IEEE Std 308[96] governing the connection and disconnection of nonsafety-related loads to and from the safety-related distribution buses, the review of the interconnections will consider isolation devices as defined in Regulatory Guide 1.75 and engineering judgment to determine the adequacy of the design. ~~In assuring~~To ensure that the interconnections between nonsafety-related loads and safety-related buses will not result in the degradation of the safety-related system, the isolation device through which dc power is supplied to the nonsafety-related load, including control circuits and connections to the safety-related bus, must be designed to meet safety Class 1E requirements. Should the dc power supplies not have been sized to accommodate the added nonsafety-related loads during emergency conditions, the design must provide for the automatic disconnection of those nonsafety-related loads upon detection of the emergency condition. This action must be accomplished whether or not the load was already connected to the power supply.

4. <u>Identification of Cables, Raceways, and Terminal Equipment</u>[97]

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.

5. Auxiliary Supporting Systems/Features[98]

The EELB will review those auxiliary supporting 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.[99] The EELB reviews the instrumentation, control, and electrical aspects of the auxiliary supporting systems and features 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 systems and features 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 auxiliary supporting system and feature, 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 auxiliary supporting system redundant instrumentation, control devices, and loads are powered from the same redundant distribution system as the system that they support. The EELB will also verify that the auxiliary supporting systems which are associated with the emergency diesel engines such as the provisions for dc control power are in accordance with the acceptance criteria.

The SPLB reviews the other aspects of the auxiliary supporting 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, ventilation, and air conditioning (HVAC) systems identified as necessary to Class 1E systems, such as the HVAC systems for the electrical switchgear, battery, charger, and inverter rooms. The SPLB will verify the adequacy of the HVAC 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 HVAC 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.

6. System Testing and Surveillance[100]

To ensure that the proposed periodic onsite testing capabilities of the safety-related dc power system satisfies the requirements of GDC 18 and the positions of Regulatory Guides 1.32 and 1.118, the descriptive information, functional logic diagrams, and

electrical schematics are reviewed to verify that the design has the built-in capability to permit integral testing of safety-related dc systems on a periodic basis when the reactor is in operation[101]. The built-in capability for the testing recommended in Regulatory Guide 1.129 (see also IEEE Std 450) is also verified. Basic criteria relevant to the review of the surveillance and testability of the safety-related aspects of the dc power system is also described in IEEE Std 603 as endorsed by Regulatory Guide 1.153.[102]

The descriptive information and the design implementation as depicted on electrical drawings 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.[103]

7. Station Blackout Events

To ensure that plant systems have the capability and capacity to withstand a station blackout event of a specified minimum duration, the review of the onsite dc power systems should determine that the requirements of 10 CFR 50.63 regarding onsite dc system capability and capacity are met. The reviewer verifies, as applicable for portions of the onsite dc power system that are required for station blackout, that the guidelines of Regulatory Guide 1.155 Positions C.3.2.2 and/or C.3.3.1 have been implemented.[104]

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.[105]

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 (SER).[106]

The dc power system includes power supplies, distribution systems, and load groups arranged to provide dc electric power to safety-related dc loads and for control and switching of the safety-related power systems. The dc power system also provides dc electric power to inverters. The inverters[107] convert the dc to ac and are arranged to provide a dependable power supply for safety-related instrumentation and control loads. The review of the dc power system for the ________ plant covered the single-line diagrams ~~(CP and OL)~~, station layout drawings ~~(CP and OL)~~, schematic diagrams ~~(OL)~~[108], and descriptive information. The basis for acceptance of the dc power system in ~~our~~the[109] review was conformance of the design criteria and bases to the Commission's regulations as set forth in 10 CFR 50.63 and[110] the General Design Criteria ~~(GDC)~~[111] of Appendix A to 10 CFR Part 50. The staff concludes that the plant design is

acceptable and meets the requirements of ~~GDC~~ General Design Criteria 2, 4, 5, 17, 18, and 50 and of 10 CFR 50.63.[112] 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 dc power systems being capable of withstanding the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, and floods as the dc power system and components are located in seismic Category I structures, which provide~~s~~[113] protection from the effects of tornadoes, tornado missiles, and floods. In addition, the dc power system and components have a quality assurance designation "Class 1E."

2. The applicant has met the requirements of GDC 4, "Environmental and ~~Missile~~ Dynamic Effects[114] Design Bases," with respect to structures, systems, and components of the dc 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 components of the dc power system. The dc power system and components associated with the multi-unit design are housed in physically separate seismic Category I structures and are not shared between units. Acceptability was based on the applicant meeting Regulatory Guide 1.32, position C.2.a, and guidelines of Regulatory Guide 1.81, position C.1.

4. The applicant has met the requirements of GDC 17, "Electric Power Systems," with respect to the onsite dc 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's design of the dc power systems meeting the guidelines of Regulatory Guide 1.6, positions D.1, D.2, and D.4 and the guidelines of Regulatory Guides 1.32, ~~and the guidelines of Regulatory Guide~~ 1.75, 1.128, and 1.153.[115]

5. The applicant has met the requirements of GDC 18, "Inspection and Testing of Electric Power Systems," with respect to the onsite dc power system. The dc power system is designed to be testable during operation[116] of the nuclear power generating station as well as during those intervals when the station is shutdown. Acceptability was based on the applicant meeting test capability guidelines of Regulatory Guide 1.32 and the guidelines of Regulatory Guides 1.118 and 1.153.[117]

6. The applicant has met the requirements of GDC 50, "Containment Design Bases," with respect to penetrations containing circuits of the safety- and nonsafety-related dc 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 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 the onsite dc power system. The dc power systems have adequate capability and capacity to allow the plant to withstand and recover from a station blackout event of specified duration. Acceptability is based on meeting the relevant positions of Regulatory Guide 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 SER.[118]

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.[119]

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.[120] 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.[121]

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

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)[122]

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

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

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SRP Draft Section 8.3.2
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 No. 874	Added review area alluding to 10 CFR 50.63 requirements relevent to this section.
3.	Integrated Impact 877	Revised to reflect current terminology describing this class of systems/features based upon RG 1.153.
4.	Integrated Impact No. 874	Added review area alluding to 10 CFR 50.63 requirements relevent to this section.
5.	Current PRB abbreviation	Changed PRB to EELB.
6.	Editorial	Changed "assure" to "ensure" (global change for this section).
7.	Integrated Impact No. 874	Added review area alluding to 10 CFR 50.63 requirements relevent to this section.
8.	Editorial	Changed to combine the first and second paragraphs into one.
9.	Integrated Impact No. 874	Added review area alluding to 10 CFR 50.63 requirements relevent to this section.
10.	Integrated Impact 877	Revised (globally throughout this SRP section) to reflect current terminology describing this class of systems/features based upon RG 1.153.
11.	Integrated Impact 877	Revised to reflect current terminology describing this class of systems/features based upon RG 1.153.
12.	Integrated Impact 877	Revised to reflect current terminology describing this class of systems/features based upon RG 1.153.
13.	Integrated Impact No. 874	Added review area alluding to 10 CFR 50.63 requirements relevent to this section.
14.	SRP-UDP format item	Added "Review Interfaces" to AREAS OF REVIEW and organized in numbered paragraph form to describe how aspects of the dc power systems are reviewed under other SRP sections and how branches support the review.
15.	Editorial	Added a review interface to reflect that the onsite power system (which is extensively discussed in relation to the offsite power system in this SRP section) is reviewed in greater detail in SRP Sections 8.3.1 and 8.3.2.
16.	Integrated Impact 874, SRP-UDP Integration of Station Blackout Issues	Added an interface reflecting reviews under new SRP Section 8.4.

Item	Source	Description
17.	Current PRB abbreviation	Changed PRB to EELB.
18.	Current review responsibility for SPLB	Changed to reflect that SPLB has PRB review responsibility for SRP Section 9.4.
19.	Integrated Impact 877	Revised to reflect current terminology describing this class of systems/features based upon RG 1.153.
20.	Editorial	Defined "SRP" as "Standard Review Plan."
21.	Editorial	There is no SRP Section 9.4, thus updated references to the specific SRP sections involved.
22.	Current PRB abbreviation	Changed PRB to SPLB.
23.	Integrated Impact 877	Revised to reflect current terminology describing this class of systems/features based upon RG 1.153.
24.	SRP-UDP format item	Revised sentence structure to be consistent with the numbered paragraph format.
25.	Current PRB abbreviation	Changed PRB to SPLB.
26.	Current review responsibility for SPLB	Changed to reflect that SPLB has PRB review responsibility for SRP Sections 6.7, 9.1.3, 9.1.4, 9.2 (except for 9.2.3), 9.3.1, 9.3.3, 9.4, 9.5.1, 10.4.7, and 10.4.9.
27.	Current review branch responsibility	Changed to reflect current SRP sections relevant to the described interface for which SPLB is the PRB.
28.	Current SPLB review responsibility	Reflect review responsibility for SRP Section 3.11. (See note 26.)
29.	Current review responsibility for SPLB	Changed to reflect that SPLB has PRB review responsibility for SRP Section 9.5.1. (See note 40.)
30.	Current review responsibility for EMCB	Added interface to reflect current SRP sections relevant to determining electric power requirements for which EMCB is the PRB.
31.	Current review responsibility for SCSB	Changed to reflect that SCSB has PRB review responsibility for SRP Section 6.2.2.
32.	Current review responsibility for SCSB	Changed to reflect that SCSB has PRB review responsibility for SRP Sections 6.2.2, 6.2.4, and 6.2.5.
33.	Editorial	Since secondary containment features may contain valves or ventilation systems requiring electric power, added SRP Section 6.2.3 to the list.
34.	SRP-UDP format item	Moved section to "Review Interfaces," Item 4, to reflect current SRP format.
35.	Current PRB abbreviation	Changed PRB to SRXB.

Item	Source	Description
36.	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.
37.	Current review responsibility for HICB	Changed to reflect that HICB has PRB review responsibility for SRP Sections 7.2 through 7.7.
38.	Current PRB abbreviation	Changed PRB to HICB.
39.	Integrated Impact Nos. 875 and 876	The resolution of Generic Issue A-30 was included in the resolution of Generic Issue 128, which included six recommended areas of actions. These areas of action, documented in NUREG/CR-5414, include alarms and indications for informing operating personnel of the status of safety-related dc systems.
40.	Integrated Impact Nos. 875 and 876	The resolution of Generic Issue A-30 was included in the resolution of Generic Issue 128, which included six recommended areas of actions. These areas of action, documented in NUREG/CR-5414, include alarms and indications for informing operating personnel of the status of safety-related dc systems.
41.	SRP-UDP format item	Moved section to "Review Interfaces," Item 5, to reflect current SRP format.
42.	Current review branch responsibility	Changed to reflect that HQMB has PRB review responsibility for SRP Section 14.2.
43.	Editorial	Changed "Section 14.0" to "Section 14.2" to reflect the SRP reference more accurately.
44.	Current PRB review responsibilities, also see ROC 855 for SRP Section 8.3.1	Changed to indicate HQMB review responsibility for SRP Chapter 17. Also added interface addressing reviews of procedure programs. 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.
45.	Current PRB abbreviation	Changed PRB to EMEB.
46.	Current review responsibility for SPLB	This review is included in the review of SPLB as described in note 20 above.
47.	SRP-UDP format item	Section moved to "Review Interfaces," Item 6, to reflect current SRP format.
48.	SRP-UDP format item	Section moved to "Review Interfaces," Items 12 and 14, to reflect current SRP format.

Item	Source	Description
49.	Current SPLB review responsibility	Reflect review responsibility for SRP Section 16.0. (See note 39.)
50.	Integrated Impact Nos. 875 and 876	The resolution of Generic Issue A-30 was included in the resolution of Generic Issue 128, which included six recommended areas of actions. These areas of action, documented in NUREG/CR-5414, include surveillance requirements and limiting conditions of operation provisions in technical specifications.
51.	Editorial, see ROC 855 for SRP Section 8.3.1	Added interface to address the overall review of maintenance and testing practices including compliance with the maintenance rule. Coverage of 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.
52.	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.
53.	Editorial	Changed "GDC" to "General Design Criteria" to accommodate plural usage (global change for this section).
54.	Integrated Impact No. 874	Added reference to 10 CFR 50.63.
55.	Editorial	Provided "GDC 2" as initialism for "General Design Criterion 2."
56.	Current review responsibility for SPLB, ECGB, and EMEB	Changed to reflect that SPLB, ECGB, and EMEB have PRB review responsibility for SRP Sections in Chapter 3 that pertain to natural phenomena.
57.	Editorial	Provided plural for responsibilities since multiple responsibilities are discussed.
58.	Editorial	Provided "GDC 4" as initialism for "General Design Criterion 4."
59.	Current review responsibility for SPLB and EMCB	Changed to reflect that SPLB and EMCB have PRB review responsibility for SRP Sections in Chapter 3 that pertain to missiles and environmental conditions.
60.	Editorial	Provided "GDC 5" as initialism for "General Design Criterion 5."

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Attachment A - Proposed Changes in Order of Occurrence

Item	Source	Description
61.	Editorial	Added "Std" for consistency regarding IEEE standard citation format (global change for SRP Chapter 8).
62.	Editorial	Provided "GDC 17" as initialism for "General Design Criterion 17."
63.	Integrated Impact No. 872	Added reference to RG 1.128, "Installation Design and Installation of Large Lead Storage Batteries for Nuclear Power Plants," which was published in October 1978, and IEEE Std 484, "IEEE Recommended Practice for Installation Design and Installation of Large Lead Storage Batteries for Generating Stations and Substations." These documents provide an acceptable method for performing the design and installation of large lead storage batteries for all types of nuclear power plants.
64.	Integrated Impact No. 877	Added reference to Regulatory Guide 1.153.
65.	Editorial	Provided "GDC 18" as initialism for "General Design Criterion 18."
66.	Editorial	Revised to improve clarity/grammar.
67.	Editorial	Changed to reference the correct IEEE standard. RG 1.118 endorses IEEE Std 338 rather than IEEE Std 378.
68.	Integrated Impact No. 877	Added reference to Regulatory Guide 1.153.
69.	Editorial	Provided "GDC 50" as initialism 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 for incorporation by the PRB. Although contrary to the normal practices of 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. 874	Added reference to 10 CFR 50.63 and RG 1.155.
72.	SRP-UDP format item	Added "Technical Rationale" to ACCEPTANCE CRITERIA and organized in numbered paragraph form to describe the basis for referencing the General Design Criteria.
73.	SRP-UDP format item	Added lead-in sentence for "Technical Rationale."
74.	SRP-UDP format item	Added technical rationale for GDC 2.
75.	SRP-UDP format item	Added technical rationale for GDC 4.
76.	SRP-UDP format item	Added technical rationale for GDC 5.
77.	SRP-UDP format item	Added technical rationale for GDC 17.
78.	SRP-UDP format item	Added technical rationale for GDC 18.
79.	SRP-UDP format item	Added technical rationale for General Design Criteria 4, 35, 38, 41, and 44 as encompassed by GDC 17.
80.	SRP-UDP format item	Added technical rationale for GDC 50.
81.	SRP-UDP format item	Added technical rationale for 10 CFR 50.63.
82.	**Integrated Impact 874**	Added clarification that the review also covers station blackout events.
83.	Editorial	Modified to improve clarity.

Item	Source	Description
84.	Integrated Impact No. 877	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.
85.	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).
86.	Integrated Impact Nos. 875 and 876	The resolution of Generic Issue A-30 was included in the resolution of Generic Issue 128, which included six recommended areas of actions. These areas of action, documented in NUREG/CR-5414, include maintaining redundant capability following the loss of one dc power supply or bus.
87.	Integrated Impact No. 877	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.	Editorial	Revised to reflect that guidance is not “derived.”
89.	Integrated Impact Nos. 875 and 876	The resolution of Generic Issue A-30 was included in the resolution of Generic Issue 128, which included six recommended areas of actions. These areas of action, documented in NUREG/CR-5414, include interconnections between redundant divisions of the safety-related dc power systems.
90.	Editorial	Replaced "which is" with "as" for readability.
91.	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).
92.	Integrated Impact No. 872	Added reference to RG 1.128 and IEEE Std 484.
93.	Editorial	Modified to improve clarity.

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Item	Source	Description
94.	Integrated Impact 874, SRP-UDP Integration of Station Blackout Issues	Added direction to the reviewer to consider other relevant analyses, if/where necessary during the review. The load duty cycle imposed by non-DBA events such as station blackout could be more severe than the duty cycle reflected in accident analyses.
95.	Editorial	Revised for consistency with subsection II.3.b.
96.	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.
97.	Editorial	Added review procedures for review of cable/equipment identification for consistency with reviews of this area in SRP Section 8.3.1 and with the stated areas of review in subsection I.4 of this SRP section.
98.	Editorial	Added review procedures for review of auxiliary supporting systems and features for consistency with reviews of this area in SRP Section 8.3.1 and the stated areas of review in subsection I.5 of this SRP section.
99.	Integrated Impact No. 877	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.
100.	Editorial	Added new review procedure related to GDC 18, which is included in acceptance criteria, consistent with treatment of this issue in SRP Section 8.3.1 and consistent with the stated areas of review in subsection I.6 of this SRP section.
101.	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 are not testable and/or are not normally tested while operating (e.g., battery service or performance testing). This procedure is borrowed from SRP Section 8.3.1 and agrees with the findings regarding GDC 18 presented in subsection IV of this SRP section.

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Attachment A - Proposed Changes in Order of Occurrence

Item	Source	Description
102.	Integrated Impact No. 877	Added reference to Regulatory Guide 1.153.
103.	Integrated Impact No. 1366	Added reference to RG 1.47.
104.	Integrated Impact No. 874	Added procedure addressing relevant requirements of 10 CFR 50.63 and guidance of RG 1.155.
105.	SRP-UDP Guidance, Implementation of 10 CFR 52	Added standard paragraph to address application of Review Procedures in design certification reviews.
106.	Editorial	Provided "SER" as Initialism for "safety evaluation report."
107.	Editorial	Changed inverter to inverters for proper sentence construction.
108.	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).
109.	Editorial	Modified to eliminate use of personal pronoun ("our").
110.	Integrated Impact No. 874	Added reference to 10 CFR 50.63 and RG 1.155.
111.	Editorial	Deleted "GDC" as an initialism for "General Design Criteria." GDC is correctly used as an initialism for General Design Criterion.
112.	Integrated Impact No. 874	Added reference to 10 CFR 50.63 and RG 1.155.
113.	Editorial	Revised to improve grammar.
114.	Editorial	Updated title of GDC 4.
115.	Integrated Impact Nos. 872 and 877	Added reference to Regulatory Guides 1.128 and 1.153.
116.	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 are not testable and/or are not normally tested while operating (e.g., battery service or performance testing).
117.	Integrated Impact No. 877	Added reference to Regulatory Guide 1.153.
118.	Integrated Impact No. 874	Added finding related to 10 CFR 50.63 and RG 1.155.

Item	Source	Description
119.	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.
120.	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.
121.	SRP-UDP Guidance	Added standard paragraph to indicate applicability of this section to reviews of future applications.
122.	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.

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Attachment B - Cross Reference of Integrated Impacts

Integrated Impact No.	Issue	SRP Subsections Affected
872	Recommends referencing RG 1.128 and the latest version of IEEE Std 484.	II.4.e, III.3, IV.4
874	Recommends adding references to 10 CFR 50.63 and RG 1.155.	I, I.3, I.7(e), II, II.8, III, III.3, III.7, IV, IV.7
875	Recommends adding staff positions reflected in the resolution of Generic Issue A-30.	Review interfaces 9, 13, 14, III.1, III.2.a
876	Recommends adding references resolution of A-30 with regard to loss of an ac or dc bus.	Review interfaces 9, 13, 14, III.1, III.2.a
877	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.5, III.6, IV.4, IV.5, IV.7
1366	Recommends adding references to RG 1.47 and BTP ICSB-21.	III.6