8.0 ELECTRICAL POWER SYSTEMS

Electrical power systems are designed for operation of the proposed Northwest Medical Isotopes, LLC (NWMI or the applicant) production facility. In addition to the NWMI production facility's normal electrical power (NEP) system, the facility has an emergency electrical power system, comprising the diesel-generator-powered standby electrical power (SEP) system and several uninterruptable power supplies (UPSs). Given a loss of normal electrical service, the SEP and UPSs provide sufficient electrical power to mitigate accidents in order to: (1) shut down the facility and maintain it in a safe shutdown condition, and (2) prevent or minimize the offsite release of radioactivity in excess of applicable regulatory requirements and guidance. The UPSs provide power to certain systems and equipment that are considered items relied on for safety (IROFS), which are needed to protect workers and the public, in case of postulated design-basis events involving the loss of NEP.

This chapter of the NWMI construction permit safety evaluation report (SER) describes the U.S. Nuclear Regulatory Commission (NRC) staff (the staff) technical review and evaluation of the preliminary design of the NWMI production facility electrical power systems, as presented in Chapter 8.0, "Electrical Power Systems," of the NWMI preliminary safety analysis report (PSAR), Revision 3. As explained in SER Section 1.1.1, "Scope of Review," the NWMI construction permit application generally refers to the building that will house all activities, structures, systems, and components (SSCs) related to medical isotope production as its radioisotope production facility (RPF). The RPF consists of the production facility and the target fabrication area which are discussed below. In the SER, the staff refers to the SSCs within the RPF associated with the activities that NWMI states it will conduct under a license for a Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Domestic Licensing of Production and Utilization Facilities," production facility as "the NWMI production facility" or "the facility." In this SER, the staff refers to the SSCs within the RPF associated with the activities that NWMI states it will conduct under a separate 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material," license as "the target fabrication area." The staff reviewed the entire NWMI construction permit application to understand the anticipated interface between and impact on the NWMI production facility from the target fabrication area. However, the staff's findings and conclusions in this SER are limited to whether the NWMI production facility satisfies the 10 CFR Part 50 requirements for the issuance of a construction permit.

8.1 Areas of Review

The staff reviewed PSAR Chapter 8.0 against applicable regulatory requirements using appropriate regulatory guidance and standards to assess the sufficiency of the preliminary design of the NWMI production facility electrical power systems for the purposes of issuance of a construction permit. As part of this review, the staff evaluated descriptions and discussions of the electrical power systems, with special attention to design and operating characteristics, unusual or novel design features, and principal safety considerations. The preliminary design of the NWMI production facility electrical power systems was evaluated to ensure the sufficiency of principal design criteria; design bases; and information relative to types of major equipment, general arrangement and interconnections, and high-level functional descriptions, to provide reasonable assurance that the final design will conform to the design bases. In addition, the staff reviewed NWMI's identification and justification for the selection of those variables, conditions, or other items that are determined to be probable subjects of technical specifications (TSs) for the facility, with special attention given to those items that may significantly influence the final design.

Areas of review for this chapter included normal and emergency electrical power systems. Within these review areas, the staff assessed the preliminary analysis of the NEP systems to ensure the safe operation and shutdown of the NWMI production facility, including the response of the facility to interruptions of normal electrical service, the ability of the facility to be maintained in a safe condition with and without the availability of normal electrical service, the monitoring and control of routine releases, and the prevention of uncontrolled releases of radioactive material in the event that NEP service is interrupted. The staff examined the ranges of power required; the electrical power distribution schematic diagram, NWMI PSAR Figure 8-1, "Radioisotope Production Facility Electrical One Line Diagram," design and performance characteristics, and probable subjects for TSs.

The staff also assessed the preliminary design and analysis of the NWMI production facility emergency electrical power systems, including the design and functions of the emergency electrical power systems and their support of related systems required for protecting the health and safety of facility workers and the public.

8.2 Summary of Application

NWMI PSAR Section 8.1, "Normal Electrical Power Systems," provides a high-level description of the NWMI production facility NEP system. The NEP system receives 480-volt, 3-phase, 60-hertz, alternating current from the local utility, Columbia Water and Light, via the Grindstone Substation. The NEP system is used for normal operation and normal shutdown of the facility. The total power requirement of the RPF will be approximately 2,998 kilowatts (kW).

NWMI PSAR Section 8.1 states that the design basis of the NEP system is to provide sufficient and reliable power to all systems and components requiring electrical power for normal operations, including the electrical requirements of the systems, equipment, instrumentation, controls, communications, and devices related to the safety functions. The NEP system supports safety-related (SR) and non-SR systems during normal operations and normal shutdown. In the event of loss of normal power, several SR UPSs provide power to certain SR systems and components, considered IROFS, for protection of workers and the public, until the standby diesel generator (SDG) automatically comes on line and the automatic transfer switch shifts the SEP loads to the SDG bus. The SDG powers the SEP system, which supplies certain SEP loads to allow the facility to continue to operate on a limited basis, and also extends the supply of power to the UPS loads.

NWMI PSAR Section 8.2, "Emergency Electrical Power Systems," describes the NWMI production facility emergency electrical power systems. The emergency power systems consist of the diesel-generator-powered SEP and several UPSs, including unit devices, rack-mounted, and/or larger capacity cabinet units. The emergency electrical power is the temporary substitute of normal electric power in the event of a loss-of-offsite power (LOOP). Emergency electrical systems are designed to prevent damage to the facility and releases of radioactivity to the environment. While the facility is designed for passive shutdown, if normal electrical service is interrupted, certain functions require emergency electrical power for maintaining the facility in a safe condition following shutdown. As described in PSAR Section 8.2, in the event of a LOOP, the SEP provides power to allow the facility to continue to operate on a limited basis. The UPSs will be designed to provide reliable power for the SR equipment required for facility instrumentation, control, monitoring, and other vital functions (e.g., fire alarms, emergency lighting, and radiation monitoring) needed to shut down the facility and maintain it in a safe shutdown condition. Although not described in detail in the PSAR, the staff notes that UPSs typically consist of direct current storage batteries, battery chargers and inverters, and supply

distribution panels for SR loads. The UPSs are designed to provide emergency power to SR loads until the SDG can provide stable electrical power.

NWMI PSAR Table 8-1, "Summary of Radioisotope Production Facility and Ancillary Facilities Electrical Loads," provides the list of the systems and equipment served by the NEP, the SEP, and the UPSs. The systems that are served by the UPSs are facility process control and communication, fire protection, radiation monitoring and the criticality accident alarm system (CAAS), safeguards and security, and certain parts of the general facility electrical system, such as emergency lighting. All other systems are designed to fail safe in the event of a LOOP. Facility operation on a limited basis can continue once the SDG comes on line because many of the NEP loads can be powered by the SEP, which then also takes over to provide power to the UPSs and their loads.

NWMI PSAR Figure 8-1 shows NWMI Drawing NWMI-01-DWG-EP-0601, Revision B, "Electrical One-Line Diagram 15kV Site and RPF Building Distributions." Notably absent from this diagram are the UPSs. The absence of UPSs on the on-line diagram was discussed during the July 11, 2017, meeting of the Advisory Committee on Reactor Safeguards (ACRS) Northwest Medical Isotopes Subcommittee. The applicant stated during this meeting that the exact number and location of the UPSs are yet to be finally determined (Reference 21). NWMI PSAR Section 8.1 states that NWMI PSAR Figure 8-1 will be updated for the final design and submitted as part of the operating license (OL) application.

8.3 Regulatory Basis and Acceptance Criteria

The staff reviewed NWMI PSAR Chapter 8.0 against applicable regulatory requirements, using appropriate regulatory guidance and standards, to assess the sufficiency of the preliminary design and performance of the NWMI production facility's electrical power systems for the issuance of a construction permit under 10 CFR Part 50. In accordance with paragraph (a) of 10 CFR 50.35, "Issuance of construction permits," a construction permit authorizing NWMI to proceed with construction of a production facility may be issued once the following findings have been made:

(1) NWMI has described the proposed design of the facility, including, but not limited to, the principal architectural and engineering criteria for the design, and has identified the major features or components incorporated therein for the protection of the health and safety of the public.

(2) Such further technical or design information as may be required to complete the safety analysis, and which can reasonably be left for later consideration, will be supplied in the final safety analysis report (FSAR).

(3) Safety features or components, if any, which require research and development have been described by NWMI, and a research and development program will be conducted that is reasonably designed to resolve any safety questions associated with such features or components.

(4) On the basis of the foregoing, there is reasonable assurance that: (i) such safety questions will be satisfactorily resolved at or before the latest date stated in the application for completion of construction of the proposed facility, and (ii) taking into consideration the site criteria contained in 10 CFR Part 100, "Reactor Site Criteria," the

proposed facility can be constructed and operated at the proposed location without undue risk to the health and safety of the public.

With respect to the last of these findings, the staff notes that the requirements of 10 CFR Part 100 is specific to nuclear power reactors and testing facilities, and therefore not applicable to the NWMI production facility. However, the staff evaluated the NWMI production facility's site-specific conditions using site criteria similar to 10 CFR Part 100, by using the guidance in NUREG-1537, Part 1, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors, Format and Content," (Reference 8) and NUREG-1537, Part 2, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors, Standard Review Plan and Acceptance Criteria," (Reference 9) and "Final Interim Staff Guidance [ISG] Augmenting NUREG-1537, Part 1, 'Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors: Format and Content,' for Licensing Radioisotope Production Facilities and Aqueous Homogeneous Reactors," (Reference 10) and "Final Interim Staff Guidance Augmenting NUREG-1537, Part 2, 'Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors: Standard Review Plan and Acceptance Criteria,' for Licensing Radioisotope Production Facilities and Aqueous Homogeneous Reactors" (Reference 11). The staff's review in Chapter 2.0, "Site Characteristics," of this SER evaluated the geography and demography of the site; nearby industrial, transportation, and military facilities; site meteorology; site hydrology; and site geology, seismology, and geotechnical engineering to ensure that issuance of the construction permit will not be inimical to public health and safety.

8.3.1 Applicable Regulatory Requirements

The applicable regulatory requirements for the evaluation of the NWMI production facility's electrical power systems are as follows:

- 10 CFR 50.34, "Contents of applications; technical information," paragraph (a), "Preliminary safety analysis report."
- 10 CFR 50.35, "Issuance of construction permits."
- 10 CFR 50.40, "Common standards."

8.3.2 Regulatory Guidance and Acceptance Criteria

The staff used its engineering judgment to determine the extent that established guidance and acceptance criteria were relevant to the review of NWMI's construction permit application, as much of this guidance was originally developed for completed designs of nuclear reactors. For example, in order to determine the acceptance criteria necessary for demonstrating compliance with the NRC's regulatory requirements in 10 CFR, the staff used:

- NUREG-1537, Part 1, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors, Format and Content," issued February 1996 (Reference 8).
- NUREG-1537, Part 2, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors, Standard Review Plan and Acceptance Criteria," issued February 1996 (Reference 9).

- "Final Interim Staff Guidance [ISG] Augmenting NUREG-1537, Part 1, 'Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors: Format and Content,' for Licensing Radioisotope Production Facilities and Aqueous Homogeneous Reactors," dated October 17, 2012 (Reference 10).

- "Final Interim Staff Guidance Augmenting NUREG-1537, Part 2, 'Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors: Standard Review Plan and Acceptance Criteria,' for Licensing Radioisotope Production Facilities and Aqueous Homogeneous Reactors," dated October 17, 2012 (Reference 11).

The ISG Augmenting NUREG-1537 updated and expanded the guidance, originally developed for non-power reactors, to address medical isotope production facilities. For example, whenever the word "reactor" appears in NUREG-1537, it can be understood to mean "radioisotope production facility" as applicable. In addition, the ISG, at page vi, states that use of Integrated Safety Analysis methodologies as described in 10 CFR Part 70 and NUREG-1520, "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility" (Reference 24), application of the radiological and chemical consequence likelihood criteria contained in the performance requirements of 10 CFR 70.61, "Performance requirements," designation of IROFS, and establishment of management measures are acceptable ways of demonstrating adequate safety for a medical isotope production facility. The ISG also states that applicants may propose alternate accident analysis methodologies, alternate radiological and chemical consequence and likelihood criteria, alternate safety features and alternate methods of assuring the availability and reliability of safety features. The ISG notes that the use of the term "performance requirements" when referring to 10 CFR Part 70, Subpart H, does not mean that the performance requirements in Subpart H are required for a RPF license, only that their use may be found acceptable. NWMI used this ISG to inform the design of its facility and prepare its PSAR. The staff's use of reactor-based guidance in its evaluation of the PSAR is consistent with the ISG Augmenting NUREG-1537.

As appropriate, additional guidance (e.g., NRC regulatory guides, Institute of Electrical and Electronics Engineers (IEEE) standards, American National Standards Institute/American Nuclear Society standards) has been used in the staff's review of the PSAR. The use of additional guidance is based on the technical judgment of the reviewer, as well as references in NUREG-1537, Parts 1 and 2; the ISG Augmenting NUREG-1537, Parts 1 and 2; and the PSAR. Additional guidance documents used to evaluate NWMI's PSAR are provided as references in Appendix B, "References," of this SER.

8.4 Review Procedures, Technical Evaluation, and Evaluation Findings

The staff performed an evaluation of the technical information presented in NWMI PSAR Chapter 8.0 to assess the sufficiency of the preliminary design and performance of the NWMI production facility's electrical power systems for the issuance of a construction permit, in accordance with 10 CFR 50.35(a). The sufficiency of the preliminary design and performance of the electrical power systems is determined by ensuring the design and performance are consistent with the design bases, which meet the applicable regulatory requirements, guidance, and acceptance criteria, as discussed in Section 8.3, "Regulatory Basis and Acceptance Criteria," of this SER. A summary of the staff's technical evaluation is described in SER Section 8.5, "Summary and Conclusions."

For the purposes of issuing a construction permit, the preliminary design of the NWMI production facility normal and emergency power systems may be adequately described at a functional or conceptual level. The staff evaluated the sufficiency of the preliminary design of the NWMI production facility normal and emergency electrical power systems based on the applicant's design methodology and ability to provide reasonable assurance that the final design will conform to the design bases with adequate margin for safety. The staff's evaluation of the preliminary design of the NWMI production facility electrical power systems does not constitute approval of the safety of any design feature or specification. Such approval, if granted, would occur after an evaluation of the final design of the NWMI production facility electrical power systems, as described in the FSAR submitted as part of NWMI's OL application.

8.4.1 Normal Electrical Power System

The staff evaluated the sufficiency of the preliminary design of the NWMI production facility NEP system, as described in NWMI PSAR Section 8.1, for the issuance of a construction permit using the guidance and acceptance criteria from Section 8.1, "Normal Electrical Power Systems," of NUREG-1537, Parts 1 and 2. The staff review included the off-site power service, power distribution system, and the systems and equipment served by the NEP, as shown in NWMI PSAR Table 8-1.

Consistent with the review procedures in NUREG-1537, Part 2, Section 8.1, the staff: (1) compared the design bases of the normal electrical systems with the requirements of systems and components that rely on electrical power, (2) confirmed that the design characteristics and components of the normal electrical system could provide the projected range of services, (3) analyzed possible malfunctions, accidents, and interruptions of electrical services to determine their effect on safe facility operation, and (4) determined if proposed redundancy of electrical circuits is sufficient to ensure safe operation and shutdown and to avoid uncontrolled release of radioactive material.

Based on its review, the staff finds that the level of detail provided on the NWMI production facility's NEP systems demonstrates an adequate design basis for a preliminary design and satisfies the applicable acceptance criteria of NUREG-1537, Part 2, Section 8.1 allowing the staff to make the following findings: (1) the design bases and functional characteristics of the NEP systems will support all required loads, and (2) the design of the NEP system provides that, in the event of the loss or interruption of electrical power, the facility can be safely shut down and maintained in a safe shutdown condition.

Therefore, the staff concludes that the preliminary design of the NWMI production facility NEP systems, as described in NWMI PSAR Section 8.1, is sufficient and meets the applicable regulatory requirements and guidance for the issuance of a construction permit in accordance with 10 CFR Part 50. Further technical or design information required to complete the safety analysis (e.g., the design and location of electrical wiring that prevents inadvertent electromagnetic interference between the electrical power service and SR instrumentation and control circuits) can reasonably be left for later consideration since the facility's design bases support all required loads and safe shutdown. The staff will confirm that the final design conforms to this design basis during the evaluation of the NWMI FSAR.

8.4.2 Emergency Electrical Power Systems

The staff evaluated the sufficiency of the preliminary design of the NWMI production facility emergency electrical power systems, as described in PSAR Section 8.2, for the issuance of a construction permit using the guidance and acceptance criteria from Section 8.2, "Emergency Electrical Power Systems," of NUREG-1537, Parts 1 and 2.

Consistent with the review procedures of NUREG-1537, Part 2, Section 8.2, the staff compared the design bases of the emergency electrical power system with the requirements for emergency electrical power for systems and components requiring electrical power and compared the design and functional characteristics with the design bases to verify compatibility. The staff review included the SEP and UPSs and their loads, seismic and environmental qualification, independence, single-failure criterion, and safe shutdown.

NWMI PSAR Chapter 8.0 does not provide detailed information on seismic or environmental qualification of electrical equipment important to safety, and it does not give the safety/seismic classification of each individual component. However, the general approach to seismic and environmental qualification of electrical systems and components is described in NWMI PSAR Chapter 3.0, "Design of Structures, Systems, and Components."

8.4.2.1 Seismic Qualification of Electrical Equipment Relied on for Safety

NWMI PSAR Table 3-24, "System Safety and Seismic Classification and Associated Quality Level Group," lists the NEP system and the SEP system as having components that are classified as SR and are classified as Seismic Classification C-I and Quality Level Group QL-1. However, NWMI PSAR Section 8.1.1, "Design Basis of the Normal Electric Power System," clarifies this by stating, in part, that there are no items relied on for safety (IROFS) applicable to the NEP system, per Chapter 13.0, "Accident Analysis," Section 13.2.5, "Loss of Power."

NWMI PSAR Subsection 3.5.1.3.2, "Seismic Classification for Structures, Systems, and Components," states:

> SSCs identified as IROFS will be designed to satisfy the general seismic criteria to withstand the effects of natural phenomena (e.g., earthquakes, tornados, hurricanes, floods) without loss of capability to perform their safety functions. ASCE 7, Chapter 11, sets forth the criteria to which the plant design bases demonstrate the capability to function during and after vibratory ground-motion associated with the safe-shutdown earthquake conditions.
>
> The seismic classification methodology used for the RPF complies with the preceding criteria, and with the recommendations stated in Regulatory Guide 1.29, *Seismic Design Classification*. The methodology classifies SSCs into three categories: seismic Category I (C-I), seismic Category II (C-II), and non-seismic (NS).
>
> Seismic C-I applies to both functionality and integrity, while C-II applies only to integrity. SSCs located in the proximity of IROFS, the failure of which during a safe-shutdown earthquake could result in loss of function of IROFS, are designated as C-II. Specifically:
>
> - C-I applies to IROFS. C-I also applies to those SSCs required to support shutdown of the RPF and maintain the facility in a safe shutdown condition.

- C-II applies to SSCs designed to prevent collapse under the safe-shutdown earthquake. SSCs are classified as C-II to preclude structural failure during a safe-shutdown earthquake, or where interaction with C-I items could degrade the functioning of a safety-related SSC to an unacceptable level or could result in an incapacitating injury to occupants of the main control room.

- NS [non-seismic] SSCs are those that are not classified seismic C-I or C-II.

With respect to the methodology for seismic qualification of electrical equipment relied on for safety (i.e., SR and/or important to safety), NWMI PSAR Section 3.4.2, "Seismic Qualification of Subsystems and Equipment," discusses the methods by which the facility systems and components are qualified to ensure functional integrity. As described in NWMI PSAR Section 3.4.2, based on the characteristics and complexities of the subsystem or equipment, seismic qualification may be by rigorous analysis, testing, or a combination of analysis and testing.

NWMI PSAR Section 3.4.2.2, "Qualification by Testing," states that in accordance with NRC Regulatory Guide 1.100, "Seismic Qualification of Electrical and Active Mechanical Equipment and Functional Qualification of Active Mechanical Equipment for Nuclear Power Plants," active electrical equipment important to or relied on for nuclear safety will be required to be seismically qualified in accordance with IEEE Standard 344, "IEEE Standard for Seismic Qualification of Equipment for Nuclear Power Generating Stations."

NWMI PSAR Subsection 3.5.2.5.2, "Instrumentation and Electrical," states, in part:

> C-I instrumentation and electrical equipment (identified in Table 3-24) is designed to resist and withstand the effects of the postulated DBEQ [design-basis earthquake] without functional impairment. The equipment will remain operable during and after a DBEQ. The magnitude and frequency of the DBEQ loadings that each component experiences will be determined by its location within the RPF. In-structure response curves at various building elevations will be developed to support design. The equipment (e.g., batteries and instrument racks, control consoles) has test data, operating experience, and/or calculations to substantiate the ability of the components and systems to not suffer loss of function during or after seismic loadings due to the DBEQ. This information will be completed during final design of the RPF and provided in the Operating License Application.

Based on its review, the staff finds that the general approach to seismic qualification of electrical equipment described in the PSAR is consistent with the maturity of the design in that the details of seismic qualification are highly dependent on specific items of equipment, their design-basis earthquake functional requirements and locations. Therefore, the staff concludes that the general approach and information provided in the PSAR is sufficient for the purposes of issuance of a construction permit for the NWMI production facility as it describes the methods by which the facility systems and components are qualified to ensure functional integrity. Further details of the seismic qualification of electrical equipment important to safety can reasonably be left for later consideration in the FSAR. The staff will evaluate the FSAR and associated documents during the OL application review.

8.4.2.2 Environmental Qualification of Electrical Equipment Relied on for Safety

NWMI PSAR Table 3-22, "Design Criteria Requirements," states that for environmental and dynamic effects, the NWMI production facility design criterion is to provide for adequate protection from environmental conditions and dynamic effects associated with normal operations, maintenance, testing, and postulated accidents that could lead to loss of safety functions, but further states that SSCs important to safety are designed to accommodate effects of, and to be compatible with, the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents. As further described in PSAR Table 3-22, due to the low temperature and pressure of the NWMI production facility processes, dynamic effects due to pipe rupture and discharging fluids are not applicable to the facility.

NWMI PSAR Section 3.5.2, "Radioisotope Production Facility," states, in part:

> Safety-related systems and components will be qualified using the applicable guidance in the [IEEE] Standard IEEE 323, *IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations*. The qualification of each safety-related system or component needs to demonstrate the ability [to] perform the associated safety function:
>
> - Under environmental and dynamic service conditions in which they are required to function [and]
> - For the length of time the function is required

Further, this section states, in part, "Additionally, non-safety-related components and systems will be qualified to withstand environmental stress caused by environmental and dynamic service conditions under which their failure could prevent satisfactory accomplishment of the safety-related functions."

NWMI PSAR Section 3.5.2.6, "Qualification Methods," states:

> Environmental qualification of safety-related mechanical, instrumentation, and electrical systems and components is demonstrated by tests, analysis, or reliance on operating experience. Qualification method testing will be accomplished either by tests on the particular equipment or by type tests performed on similar equipment under environmental conditions at least as severe as the specified conditions. The equipment will be qualified for normal and accident environments. Qualification data will be maintained as part of the permanent plant record in accordance with the NWMI QAPP [Quality Assurance Program Plan].

Based on its review, the staff finds that the general approach to environmental qualification of electrical equipment described in the PSAR is consistent with the maturity of the design in that the details of environmental qualification are highly dependent on specific items of equipment, their design-basis event functional requirements and locations. Therefore, the staff concludes that the general approach and information provided in the PSAR is sufficient for the purposes of issuance of a construction permit for the NWMI production facility. Further details of the environmental qualification of electrical equipment important to safety can reasonably be left for later consideration in the FSAR because the worst-case design-basis event is not expected to subject SR electrical equipment to harsh environments. The staff will evaluate the FSAR and associated documents during the OL application review.

8.4.2.3 Independence

With regard to independence, NWMI PSAR Section 3.5.2 states, in part, that the NWMI production facility is designed to meet IEEE 603, “Standard Criteria for Safety Systems for Nuclear Power Generating Stations,” for separation and isolation of SR systems and components. Based on its review, the staff finds that this level of detail on electrical independence is sufficient for the purposes of issuance of a construction permit for the NWMI production facility because the design bases seek to avoid common mode failures. Further details of independence can reasonably be left for later consideration in the FSAR. The staff will evaluate the FSAR and associated documents during the OL application review.

8.4.2.4 Single-Failure Criterion

With regard to the single-failure criterion, NWMI PSAR Section 3.5.1.2, “Classification Definitions,” states, in part, that:

> Single failure is considered a random failure and can include an initiating event (e.g., component failure, natural phenomenon, external man-made hazard) or consequential failures. Mechanical, instrumentation, and electrical systems and components required to perform their intended safety function in the event of a single failure are designed to include sufficient redundancy and independence. This type of design verifies that a single failure of any active component does not result in a loss of the capability of the system to perform its safety functions. Mechanical, instrumentation, and electrical systems and components are designed to ensure that a single failure, in conjunction with an initiating event, does not result in the loss of the RPF's ability to perform its intended safety function. Design techniques such as physical separation, functional diversity, diversity in component design, and principles of operation, will be used to the extent necessary to protect against a single failure.

Based on its review, the staff finds that this level of detail on single-failure criterion is sufficient for the purposes of issuance of a construction permit for the NWMI production facility because the design bases consider physical separation, functional diversity, diversity in component design, and principles of operation to protect against single failure. Further details of the single-failure criterion can reasonably be left for later consideration in the FSAR. The staff will evaluate the FSAR and associated documents during the OL application review. In addition, based on discussions during meetings of the ACRS Northwest Medical Isotopes Subcommittee, the applicant committed to examine the possible effects of malfunctioning electrical equipment resulting in possible unexpected effects of interaction between otherwise unrelated, independent, and separate circuits (e.g., so-called “hot shorts”) caused by various credible hazards (e.g., fire, explosions, flooding, earthquakes, etc.). The staff is tracking this issue in Appendix A, “Post Construction Permit Activities – Construction Permit Conditions and Final Safety Analysis Report Commitments,” of this SER.

8.4.2.5 Safe Shutdown

NWMI PSAR Section 8.1.2, “Design for Safe Shutdown,” states that in the event of the loss of NEP, UPSs automatically provide power to the NWMI production facility systems and components that support the safety functions protecting workers and the public. UPSs support the process and facility monitoring and control systems, facility communication and security

systems, emergency lighting, fire alarms, and radiation protection and the CAAS until the SDG is running and powering the SEP loads.

During its review, the staff noted certain inconsistencies in the information presented on the emergency electrical power systems. Specifically, NWMI PSAR Section 8.1.2, Revision 0, stated that the UPSs will be designed to operate for up to 90 minutes, except that the UPS for the fire protection system will be designed to operate for up to 24 hours. The 90-minute value was also stated in NWMI PSAR, Revision 0, Sections 8.2.4 and 8.2.5. However, NWMI PSAR Section 3.5.2.7.9, Revision 0, "Standby Electrical Power," stated that the design basis value for the UPSs is to "maintain power availability for a minimum of 120 [minutes] post-accident…."

In response to request for additional information (RAI) 8.2-1 (Reference 57), the applicant stated: "PSAR Sections 8.1.2 and 8.2 were changed to 120 minutes to reflect the design basis in PSAR Section 3.5.2.7.9." The staff finds that this response resolves the identified inconsistency. The staff reviewed revision 3 to NWMI PSAR Chapter 8.0 and confirmed that the applicant's proposed resolution was incorporated in the PSAR.

NWMI PSAR Section 8.2, Revision 0, states that a 1,000-kW (1,341 hp) diesel generator will provide SEP. However, PSAR Section 8.2.2, Revision 0, "Ranges of Emergency Electrical Power Required," states, in part, that: "The total peak SEP required for the RPF is 1,140 kW (1,528 hp)." Further, Table 8-1, Revision 0, lists the facility electrical loads and shows that the total SEP required is 1,178.6 kW (1,585 hp). In addition, NWMI PSAR Chapter 19.0, Revision 0, "Environmental Review," Table 19-60, "Emissions for Standby Emergency Diesel Generator," cites 2,600 kW as the basis for diesel generator emissions.

In response to RAI 8.2-2 (Reference 57), the applicant stated: "The column headings in Table 8-1 of PSAR Chapter 8.0 were changed from '... power requirement' to '... peak power load' to be consistent with the description preceding the table. PSAR Section 8.2.2 will be modified to reflect the peak power of 1,178.6 kW (1,585 hp), as determined from Table 8-1. PSAR Chapter 19.0 used a larger estimate to ensure that emissions were bounded."

The staff finds that the applicant's explanation in its RAI response regarding the SEP DG power estimate of 2,600 kW to bound emissions in NWMI PSAR Chapter 19.0 (Table 19-60) is satisfactory in that this value is conservative as compared to the values provided in NWMI PSAR Chapter 8.0. Changing the power rating cited in NWMI PSAR Section 8.2.2 "Ranges of Emergency Electrical Power Required," to 1,178.6 kW (1,585 hp) to be consistent with Table 8-1 is also satisfactory in that it resolves the identified inconsistency. The staff reviewed the most recent revision to NWMI PSAR Chapter 8.0 and confirmed that the applicant's proposed resolution was incorporated in the PSAR. However, the first paragraph of PSAR Section 8.2 in Revision 3 of PSAR Chapter 8.0 still states, in part, that "A 1,000-kW (1,341 hp) diesel generator will provide SEP." Thus, neither the capacity of the SEP DG given as 1,000 kW (1,341 hp) in NWMI PSAR Section 8.2 nor the discrepancy between this value and that given in NWMI PSAR Table 8-1 and NWMI PSAR Section 8.2.2 was addressed in response to an RAI or corrected in subsequent revisions to NWMI PSAR Chapter 8.0.

The staff finds that this inconsistency is acceptable for the purposes of issuing a construction permit since the peak power estimates used in NWMI PSAR Chapter 8.0 are bounded by the SEP DG power estimates used to bound emissions in NWMI PSAR Chapter 19.0. The staff will review details of the fuel consumption rates at the peak load values in the FSAR in order to ensure that there is sufficient diesel fuel capacity for the complete range of 11-14 hours of operation as stated in NWMI PSAR Section 8.2. Additionally, based on its review, the staff finds

that this level of detail on safe shutdown is sufficient for the purposes of issuance of a construction permit for the NWMI production facility. Further details of safe shutdown can reasonably be left for later consideration in the FSAR. The staff will evaluate the FSAR and associated documents during the OL application review.

Based on its review, the staff finds that the level of detail provided on the NWMI production facility emergency electrical power systems demonstrates an adequate design basis for a preliminary design and satisfies the applicable acceptance criteria of NUREG-1537, Part 2, Section 8.2, allowing the staff to make the following findings: (1) the design bases and description of functional characteristics of the facility's emergency electrical power systems are sufficient to provide the necessary range of SR services; (2) the design and operating characteristics of the source of emergency electrical power are basic and reliable, ensuring availability if needed; and (3) the design of the emergency electrical power system should not interfere with safe facility shutdown or lead to facility damage if the system malfunctions during normal operation.

Therefore, the staff concludes that the preliminary design of the NWMI production facility emergency electrical power systems is sufficient and meets the applicable regulatory requirements and guidance for the issuance of a construction permit in accordance with 10 CFR Part 50. Further technical or design information required to complete the safety analysis can reasonably be left for later consideration in the FSAR. The staff will confirm that the final design conforms to this design basis during the evaluation of NWMI's FSAR.

8.4.3 Probable Subjects of Technical Specifications

In accordance with 10 CFR 50.34(a)(5), the staff evaluated the sufficiency of the applicant's identification and justification for the selection of those variables, conditions, or other items which are determined to be probable subjects of TSs for the NWMI production facility electrical power systems, with special attention given to those items which may significantly influence the final design.

NWMI PSAR Section 8.1.9, "Technical Specifications," (for the NEP system) states, "As evaluated in Chapter 13.0, the RPF is designed to safely shut down without NEP for occupational safety and for protection of the public and environment. The NEP system will not require a technical specification per the guidelines in Chapter 14.0, "Technical Specifications."

NWMI PSAR Section 8.2.13, "Technical Specifications," (for the emergency power systems) states, "As evaluated in Chapter 13.0, the RPF is designed to safely shut down without SEP consistent with occupational safety and protection of the public and the environment. The UPS systems, as required, are anticipated to be part of the technical specification for the system being supported. The SEP system will not require a technical specification per the guidelines in Chapter 14.0."

Based on the information provided in NWMI PSAR Sections 8.1.9 and 8.2.13, and in NWMI PSAR Chapter 14.0, the staff finds that the applicant's identification and justification for the UPS being the probable subject of a TS because of its required safety function to provide electrical power to engineering safety features, emergency lighting, radiation monitoring, and shutdown instrumentation and control during a loss of NEP is sufficient and meets the applicable regulatory requirements for the issuance of a construction permit in accordance with 10 CFR Part 50. A detailed evaluation of TSs, including limiting conditions for operation and surveillance requirements, will be performed during the review of the NWMI OL application.

8.5 Summary and Conclusions

The staff evaluated descriptions and discussions of the NWMI production facility electrical power systems, including probable subjects of TSs, as described in PSAR Chapter 8.0 and finds that the preliminary design of the electrical power systems, including the principal design criteria; design bases; and information relative to general arrangement, major SSCs, and a high-level functional description: (1) provides reasonable assurance that the final design will conform to the design basis, and (2) meets all applicable regulatory requirements and acceptance criteria in or referenced in applicable guidance. Based on these findings, the staff concludes the following regarding the issuance of a construction permit in accordance with 10 CFR Part 50:

(1) NWMI has described the proposed design of the NWMI production facility electrical power systems, including, but not limited to, the principal architectural and engineering criteria for the design, and has identified the major features or components incorporated therein for the protection of the health and safety of the public.

(2) Such further technical or design information as may be required to complete the safety analysis of the electrical power systems and which can reasonably be left for later consideration, will be supplied in the FSAR.

(3) There is reasonable assurance that taking into consideration the site criteria contained in 10 CFR Part 100, the proposed production facility can be constructed and operated at the proposed location without undue risk to the health and safety of the public. There is reasonable assurance that: (i) the construction of the NWMI production facility will not endanger the health and safety of the public, and (ii) construction activities can be conducted in compliance with the Commission's regulations.