General Introductory Information:

10 CFR Part 50 section 50.12 grants the NRC authority to grant exemptions from the requirements of the regulations of 10 CFR Part 50, so long as they are “authorized by law, will not present an undue risk to the public health and safety, and are consistent with the common defense and security.” In addition, “special circumstances” must be present for the NRC to consider granting an exemption. For each exemption request, SMR, LLC will address authorization by law, risk to the public health and safety, the common defense and security, and the special circumstances present. The below discussion represents an exemption that is intended to be requested as part of a future licensing submittal for the SMR-300 design.

1 10 CFR 50, Appendix A, General Design Criteria 17, 33, 34, 35, 38, 41, and 44

1.1 Introduction and Request

1.1.1 Summary

SMR, LLC requests an exemption from the portions of General Design Criterion (GDC 17) that require offsite power, because offsite power is not required for SMR-300 SSCs to perform their safety functions. The SMR-300 design utilizes passive safety systems that do not require offsite electrical power. The safety systems assure that core cooling, containment integrity, and other vital functions are maintained during design basis events. A redundant Class 1E DC power system and a Class 1E 120VAC distribution system provide the necessary power for one-time actuation of valves that support heat transfer to the ultimate heat sink and instrumentation and control safety functions during anticipated operational occurrences and postulated accidents. The SMR-300 design meets the remaining portions of GDC 17.

In addition, SMR, LLC requests exemptions from the portions of GDCs 33, 34, 35, 38, 41, and 44 that require onsite and offsite power to permit system safety functions. Since the SMR-300 does not rely on offsite power to ensure safety functions of SSCs, compliance with these portions of the requirements is unnecessary. The SMR-300 design meets the remaining portions of GDCs 33, 34, 35, 38, 41, and 44.

1.1.2 Regulatory Requirements

10 CFR 50.34(a)(3) requires a construction permit application preliminary safety analysis report to include, in part:

(i) The principal design criteria for the facility. Appendix A, General Design Criteria for Nuclear Power Plants, establishes minimum requirements for the principal design criteria for water-cooled nuclear power plants similar in design and location to plants for which construction permits have previously been issued by the Commission and provides guidance to applicants for construction permits in establishing principal design criteria for other types of nuclear power units;

The **Introduction to 10 CFR 50, Appendix A** states, in part:

Also, there may be water-cooled nuclear power units for which fulfillment of some of the General Design Criteria may not be necessary or appropriate. For plants such as these, departures from the General Design Criteria must be identified and justified.

10 CFR 50, Appendix A General Design Criterion 17 – Electrical Power Systems states:

An onsite electric power system and an offsite electric power system shall be provided to permit functioning of structures, systems, and components important to safety. The safety function for each system (assuming the other system is not functioning) shall be to provide sufficient capacity and capability to assure that (1) specified acceptable fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded as a result of anticipated operational occurrences and (2) the core is cooled and containment integrity and other vital functions are maintained in the event of postulated accidents.

The onsite electric power supplies, including the batteries, and the onsite electric distribution system, shall have sufficient independence, redundancy, and testability to perform their safety functions assuming a single failure.

Electric power from the transmission network to the onsite electric distribution system shall be supplied by two physically independent circuits (not necessarily on separate rights of way) designed and located so as to minimize to the extent practical the likelihood of their simultaneous failure under operating and postulated accident and environmental conditions. A switchyard common to both circuits is acceptable. Each of these circuits shall 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 shall 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 shall 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.

10 CFR 50, Appendix A General Design Criterion 33 – Reactor Coolant Makeup states:

A system to supply reactor coolant makeup for protection against small breaks in the reactor coolant pressure boundary shall be provided. The system safety function shall be to assure that specified acceptable fuel design limits are not exceeded as a result of reactor coolant loss due to leakage from the reactor coolant pressure boundary and rupture of small piping or other small components which are part of the boundary. The system shall be designed to assure that for onsite electric power system operation (assuming offsite power is not available) and for offsite electric power system operation (assuming onsite power is not available) the system safety function can be accomplished using the piping, pumps, and valves used to maintain coolant inventory during normal reactor operation.

10 CFR 50, Appendix A General Design Criterion 34 – Residual Heat Removal states:

A system to remove residual heat shall be provided. The system safety function shall be to transfer fission product decay heat and other residual heat from the reactor core at a rate such that specified acceptable fuel design limits and the design conditions of the reactor coolant pressure boundary are not exceeded.

Suitable redundancy in components and features, and suitable interconnections, leak detection, and isolation capabilities shall be provided to assure that for onsite electric power system operation (assuming offsite power is not available) and for offsite electric power system *operation (assuming onsite power is not available) the system safety function can be accomplished, assuming a single failure.*

10 CFR 50, Appendix A General Design Criterion 35 – Emergency Core Cooling states:

A system to provide abundant emergency core cooling shall be provided. The system safety function shall be to transfer heat from the reactor core following any loss of reactor coolant at a rate such that (1) fuel and clad damage that could interfere with continued effective core cooling is prevented and (2) clad metal-water reaction is limited to negligible amounts.

Suitable redundancy in components and features, and suitable interconnections, leak detection, isolation, and containment capabilities shall be provided to assure that for onsite electric power system operation (assuming offsite power is not available) and for offsite electric power system operation (assuming onsite power is not available) the system safety function can be accomplished, assuming a single failure.

10 CFR 50, Appendix A General Design Criterion 38 – Containment Heat Removal states:

A system to remove heat from the reactor containment shall be provided. The system safety function shall be to reduce rapidly, consistent with the functioning of other associated systems, the containment pressure and temperature following any loss-of-coolant accident and maintain them at acceptably low levels.

Suitable redundancy in components and features, and suitable interconnections, leak detection, isolation, and containment capabilities shall be provided to assure that for onsite electric power system operation (assuming offsite power is not available) and for offsite electric power system operation (assuming onsite power is not available) the system safety function can be accomplished, assuming a single failure.

10 CFR 50, Appendix A General Design Criterion 41 – Containment Atmosphere Cleanup states:

Systems to control fission products, hydrogen, oxygen, and other substances which may be released into the reactor containment shall be provided as necessary to reduce, consistent with the functioning of other associated systems, the concentration and quality of fission products released to the environment following postulated accidents, and to control the concentration of hydrogen or oxygen and other substances in the containment atmosphere following postulated accidents to assure that containment integrity is maintained.

Each system shall have suitable redundancy in components and features, and suitable interconnections, leak detection, isolation, and containment capabilities to assure that for onsite electric power system operation (assuming offsite power is not available) and for offsite electric power system operation (assuming onsite power is not available) its safety function can be accomplished, assuming a single failure.

10 CFR 50, Appendix A General Design Criterion 44 – Cooling Water states:

A system to transfer heat from structures, systems, and components important to safety, to an ultimate heat sink shall be provided. The system safety function shall be to transfer the combined heat load of these structures, systems, and components under normal operating and accident conditions.

Suitable redundancy in components and features, and suitable interconnections, leak detection, and isolation capabilities shall be provided to assure that for onsite electric power system operation (assuming offsite power is not available) and for offsite electric power system operation (assuming onsite power is not available) the system safety function can be accomplished, assuming a single failure.

1.1.3 Exemption Sought

SMR, LLC requests an exemption from the portions of GDC 17 related to the offsite electric power system, including the provision of two physically independent circuits for transmission of AC power from the offsite network to the onsite distribution system.

Similarly, SMR, LLC requests exemptions from the provisions of GDCs 33, 34, 35, 38, 41, and 44 that require onsite and offsite power to permit system safety functions. For each of these GDCs, the exemption is from the phrase “for offsite electric power system operation (assuming onsite power is not available).”

1.1.4 Effect on Regulatory Conformance

The SMR-300 design does not conform to the portions of GDCs 17, 33, 34, 35, 38, 41, and 44 that require an offsite electrical power system to permit system safety functions. The design conforms with the remainder of each GDC and with other requirements associated with electrical systems. Therefore, principal design criteria (PDCs) that remove provisions related to offsite electrical power systems were created. The SMR-300 design conforms with the following PDCs:

Principal Design Criterion 17 – Electrical Power Systems:

A redundant onsite electric power system shall be provided to permit functioning of structures, systems, and components important to safety. The safety function for the redundant system shall be to provide sufficient capacity and capability to assure that (1) specified acceptable fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded as a result of anticipated operational occurrences and (2) the core is cooled and containment integrity and other vital functions are maintained in the event of postulated accidents.

The onsite electric power supplies, including the batteries, and the onsite electric distribution system, shall have sufficient independence, redundancy, and testability to perform their safety functions assuming a single failure.

Provisions shall 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.

Principal Design Criterion 33 – Reactor Coolant Makeup:

A system to supply reactor coolant makeup for protection against small breaks in the reactor coolant pressure boundary shall be provided. The system safety function shall be to assure that specified acceptable fuel design limits are not exceeded as a result of reactor coolant loss due to leakage from the reactor coolant pressure boundary and rupture of small piping or other small components which are part of the boundary. The system shall be designed to assure that for onsite electric power system operation (assuming offsite power is not available) the system *safety function can be accomplished using the piping, pumps, and valves used to maintain coolant inventory during normal reactor operation.*

Principal Design Criterion 34 – Residual Heat Removal:

A system to remove residual heat shall be provided. The system safety function shall be to transfer fission product decay heat and other residual heat from the reactor core at a rate such that specified acceptable fuel design limits and the design conditions of the reactor coolant pressure boundary are not exceeded.

Suitable redundancy in components and features, and suitable interconnections, leak detection, and isolation capabilities shall be provided to assure that for onsite electric power system operation (assuming offsite power is not available) the system safety function can be accomplished, assuming a single failure.

Principal Design Criterion 35 – Emergency Core Cooling:

A system to provide abundant emergency core cooling shall be provided. The system safety function shall be to transfer heat from the reactor core following any loss of reactor coolant at a rate such that (1) fuel and clad damage that could interfere with continued effective core cooling is prevented and (2) clad metal-water reaction is limited to negligible amounts.

Suitable redundancy in components and features, and suitable interconnections, leak detection, isolation, and containment capabilities shall be provided to assure that for onsite electric power system operation (assuming offsite power is not available) the system safety function can be accomplished, assuming a single failure.

Principal Design Criterion 38 – Containment Heat Removal:

A system to remove heat from the reactor containment shall be provided. The system safety function shall be to reduce rapidly, consistent with the functioning of other associated systems, the containment pressure and temperature following any loss-of-coolant accident and maintain them at acceptably low levels.

Suitable redundancy in components and features, and suitable interconnections, leak detection, isolation, and containment capabilities shall be provided to assure that for onsite electric power system operation (assuming offsite power is not available) the system safety function can be accomplished, assuming a single failure.

Principal Design Criterion 41 – Containment Atmosphere Cleanup:

Systems to control fission products, hydrogen, oxygen, and other substances which may be released into the reactor containment shall be provided as necessary to reduce, consistent with the functioning of other associated systems, the concentration and quality of fission products released to the environment following postulated accidents, and to control the concentration of hydrogen or oxygen and other substances in the containment atmosphere following postulated accidents to assure that containment integrity is maintained.

Each system shall have suitable redundancy in components and features, and suitable interconnections, leak detection, isolation, and containment capabilities to assure that for onsite electric power system operation (assuming offsite power is not available) its safety function can be accomplished, assuming a single failure.

Principal Design Criterion 44 – Cooling Water:

A system to transfer heat from structures, systems, and components important to safety, to an ultimate heat sink shall be provided. The system safety function shall be to transfer the combined heat load of these structures, systems, and components under normal operating and accident conditions.

Suitable redundancy in components and features, and suitable interconnections, leak detection, and isolation capabilities shall be provided to assure that for onsite electric power system operation (assuming offsite power is not available) the system safety function can be accomplished, assuming a single failure.

1.2 Technical Justification of Exemption

1.2.1 GDC 17

The underlying purpose of GDC 17 requiring both onsite and offsite power systems is to provide sufficient electrical power capacity and capability to assure that (1) specified acceptable fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded as a result of anticipated operational occurrences and (2) the core is cooled and containment integrity and other vital functions are maintained in the event of postulated accidents. As discussed in Chapter 8 of the SAR, the SMR-300 design provides passive safety systems that only rely on the onsite Class 1E DC power system and Class 1E 120VAC distribution system for these functions during anticipated operational occurrences and postulated accidents. Multiple non-safety related onsite and offsite electric power sources provide additional defense-in-depth in the SMR-300 design, but are not relied upon for safety functions.

During anticipated operational occurrences and postulated accidents, electric power is necessary to actuate safety-related valves via the safety-related instrumentation and control system. After one-time actuation of safety-related valves, core cooling and containment integrity are maintained through natural circulation and convective and conductive heat transfer. The onsite Class 1E DC power system and its associated Class 1E 120VAC distribution system provide the necessary power to safety-related equipment and instrumentation. These onsite electrical systems are designed with sufficient independence, redundancy, and testability to perform their safety functions assuming a single failure. Chapter 6 of the SAR describes the thermal-hydraulic systems that are relied upon for establishing and maintaining safe shutdown, while Chapter 7 of the SAR describes the instrumentation and control system that provides necessary indications and control functions. Chapter 15 of the SAR demonstrates that only these onsite electrical power systems are required for establishing and maintaining safe shutdown to assure that (1) specified acceptable fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded as a result of anticipated operational occurrences and (2) the core is cooled and containment integrity and other vital functions are maintained in the event of postulated accidents.

Although not required to comply with the underlying purpose of GDC 17, the SMR-300 is designed with additional defense-in-depth with reliable non-safety-related offsite and onsite AC power systems that are available for plant functions and auxiliaries. During a loss of offsite power, onsite AC power can be supplied by onsite non-Class 1E standby diesel generators.

Loads and equipment can be manually added to the diesel generators as required. These standby diesel generators are not required for safe shutdown of the plant.

1.2.2 GDCs 33, 34, 35, 38, 41, and 44

The underlying purpose of the power provisions in GDCs 33, 34, 35, 38, 41, and 44 is to ensure there is sufficient electrical power to permit the various safety functions noted in each GDC. As noted for GDC 17, offsite power is not needed to ensure that these safety functions can be performed.

1.3 Regulatory Basis

The requested exemption is consistent with the criteria of 10 CFR 50.12, as discussed below.

1.3.1 10 CFR 50.12(a)(1)

10 CFR 50.12(a)(1) requires that a requested exemption is authorized by law, will not present an undue risk to the public health and safety, and is consistent with the common defense and security.

The requested exemption is authorized by law, as it is not inconsistent with the Atomic Energy Act of 1954, as amended.

The requested exemption does not present an undue risk to the public health and safety, as the SMR-300 design utilizes passive safety systems that do not require offsite electrical power to assure that (1) specified acceptable fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded as a result of anticipated operational occurrences and (2) the core is cooled and containment integrity and other vital functions are maintained in the event of postulated accidents. Postulated accident progression and consequences are not impacted by the requested exemption.

The requested exemption is consistent with the common defense and security, as it does not affect the design, function, or operation of structures or plant equipment that is necessary to maintain the secure status of the plant. The requested exemption does not impact the security power system. The requested exemption has no impact on plant security or safeguards procedures.

1.3.2 10 CFR 50.12(a)(2)

10 CFR 50.12(a)(2) requires that a requested exemption be accompanied by special circumstances.

Special circumstances are present as listed in 10 CFR 50.12(a)(2)(ii); the application of the regulation is not necessary to achieve the underlying purpose of the rule. The underlying purpose of requiring offsite electrical power systems in portions of GDCs 17, 33, 34, 35, 38, 41, and 44 is to ensure that sufficient electrical power to assure that (1) specified acceptable fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded as a result of anticipated operational occurrences and (2) the core is cooled and containment integrity and other vital functions are maintained in the event of postulated accidents. The SMR-300 design achieves this purpose using onsite Class 1E DC power sources, with additional defense in depth provided by non-safety related onsite and offsite AC power sources.