

3.2 Classification of Structures, Systems, and Components

GDC 1 requires that structures, systems, and components (SSC) important to safety be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed. GDC 1 also requires that a quality assurance program be established to provide adequate assurance that these SSC will satisfactorily perform their safety functions, and that appropriate records of the design, fabrication, erection, and testing of these SSC be maintained for the life of the plant. To fulfill these requirements, the U.S. EPR SSC are classified according to nuclear safety function, seismic design category, quality group, quality standards, and applicability of the 10 CFR 50, Appendix B quality assurance program. This section describes the methodology used for classifying the U.S. EPR SSC. Seismic classification is addressed in Section 3.2.1 and quality group classification is addressed in Section 3.2.2.

10 CFR 50.2 defines safety-related SSC as the “structures, systems and components that are relied upon to remain functional during and following design basis events to assure:

1. The integrity of the reactor coolant pressure boundary
2. The capability to shut down the reactor and maintain it in a safe shutdown condition; or
3. The capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposures comparable to the applicable guideline exposures set forth in §50.34(a)(1) or §100.11...”

The U.S. EPR SSC are classified based on their functions and the 10 CFR 50.2 definition of safety-related. An SSC that does not perform a function that addresses one of the three objectives listed above is non-safety-related.

The U.S. EPR safety classification methodology makes a distinction between primary design functions and secondary design functions. A primary design function is a principal function for which an SSC must be included in the plant design. A secondary design function is a function that the SSC must be capable of fulfilling because of the position of that SSC within the plant design. Both primary and secondary design functions can be, but need not be, safety-related.

Safety classification of systems considers only their primary design functions. Thus, systems are safety-related if any one of their primary design functions is safety-related.

Safety classification of structures and components considers both their primary and secondary design functions. Thus, structures and components are safety-related if at least one of their primary or secondary design functions is safety-related.

As a result, application of the U.S. EPR safety classification methodology logically allows both the identification of safety-related systems that include non-safety-related components, and the identification of non-safety-related systems that include safety-related components.

In addition to safety-related and non-safety-related, the U.S. EPR safety classification methodology has a third classification which includes SSC that are by definition non-safety-related, but to which a “significant licensing requirement or commitment” applies. A “significant licensing requirement or commitment” is a practice that is based on an NRC regulation or licensing guidance that applies to SSC that do not meet the 10 CFR 50.2 definition of safety-related. These SSC are classified as supplemented grade.

The U.S. EPR safety classification methodology uses the following designations:

- Safety-related: S.
- Non-safety-related: NS.
- Supplemented Grade: NS-AQ.

U.S. EPR SSC that are classified as safety-related are subject to the quality assurance program requirements of 10 CFR 50, Appendix B. Non-safety-related SSC are not included in the 10 CFR 50, Appendix B quality assurance program. However, those non-safety-related SSC that are classified as supplemented grade will be included in the 10 CFR 50, Appendix B quality assurance program if inclusion is explicitly invoked by the relevant “significant licensing requirement or commitment.” Also see Section 17.4.2 for a description of how quality assurance is applied to risk-significant SSC.

Table 3.2.2-1—Classification Summary lists the safety classification of U.S. EPR SSC.

Classification of fire protection systems in accordance with RG 1.189 is described in Section 9.5.1.

3.2.1 Seismic Classification

GDC 2 requires in part that “structures, systems, and components important to safety shall be designed to withstand the effects of natural phenomena such as earthquakes...without loss of capability to perform their safety functions.” In addition, 10 CFR 50.34(a)(12) requires that—in order to comply with the earthquake provisions of GDC 2—the U.S. EPR comply with the earthquake engineering criteria of 10 CFR 50, Appendix S. 10 CFR 50, Appendix S defines the safe shutdown earthquake (SSE) as the “vibratory ground motion for which certain structures, systems, and components must be designed to remain functional.”

10 CFR 50, Appendix S states “the structures, systems, and components required to withstand the effects of the Safe Shutdown Earthquake Ground Motion or surface deformation are those necessary to assure:

1. The integrity of the reactor coolant pressure boundary;
2. The capability to shut down the reactor and maintain it in a safe shutdown condition; or
3. The capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposures comparable to the guideline exposures of §50.34(a)(1).”

To meet the requirements of both GDC 2 and 10 CFR 50, Appendix S with regard to the design for earthquakes, U.S. EPR SSC are seismically classified in accordance with RG 1.29.

Radioactive waste management SSC are explicitly excluded from the seismic classification requirements of RG 1.29. However, they meet the seismic design criteria specified in RG 1.143 (refer to Sections 11.2, 11.3, and 11.4) and GDC 61 as it relates to the design of radioactive waste systems and other systems that may contain radioactivity. Safety-related instrument sensing lines meet the seismic design requirements specified in RG 1.151.

The seismic classification of U.S. EPR SSC uses the following categories: Seismic Category I, Seismic Category II, radwaste seismic, conventional seismic, and non-seismic.

Table 3.2.2-1 lists the seismic classification of U.S. EPR SSC. A COL applicant that references the U.S. EPR design certification will identify the seismic classification of applicable site-specific SSC that are not identified in Table 3.2.2-1.

The piping and instrumentation diagrams (P&IDs) of U.S. EPR systems indicate the Seismic Category I boundaries when portions of a system are not Seismic Category I. A list of U.S. EPR piping and instrumentation diagrams is provided in Section 1.7.

To address the broader concept of important to safety in the context of seismic classification, only seismically designed SSC are credited in the probabilistic risk assessment-based seismic margin (refer to Section 19.1.5.1.2.4 and Table 19.1-106).

3.2.1.1 Seismic Category I

U.S. EPR SSC that are classified as safety-related are also designed to be capable of performing their safety functions during and following an SSE. Therefore, these safety-related SSC, including their foundations and supports, are classified as Seismic Category I. Additionally, certain SSC explicitly identified in RG 1.29, such as fuel

storage racks in the spent fuel storage structure and Class 1E electrical systems, are classified as Seismic Category I.

Seismic Category I SSC are designed to withstand the seismic loads associated with the SSE, in combination with other designated loads, without loss of function or pressure integrity. SSE seismic design loads are addressed in Section 3.7. The design of Seismic Category I structures is addressed in Section 3.8. The seismic design of mechanical systems and components is addressed in Section 3.9. The seismic qualification of mechanical and electrical equipment, including their supports, is addressed in Section 3.10.

Seismic Category I SSC are subject to the quality assurance program requirements of 10 CFR 50, Appendix B.

3.2.1.2 Seismic Category II

Per RG 1.29, some U.S. EPR SSC that perform no safety-related function could, if they failed under seismic loading, prevent or reduce the functional capability of a Seismic Category I SSC, or cause incapacitating injury to main control room occupants during or following an SSE. These non-safety-related SSC are classified as Seismic Category II.

U.S. EPR SSC classified as Seismic Category II are designed to withstand SSE seismic loads without incurring a structural failure that permits deleterious interaction with any Seismic Category I SSC or that could result in injury to main control room occupants. The seismic design criteria that apply to Seismic Category II SSC are addressed in Section 3.7.

Seismic Category II SSC are subject to the pertinent quality assurance program requirements of 10 CFR 50, Appendix B.

3.2.1.3 Radwaste Seismic

Radioactive waste management SSC that are classified as RW-IIa per RG 1.143 are subject to the relevant seismic design requirements tabulated in that RG. These SSC are designed to withstand seismic loads up to ½ SSE and are seismically categorized as radwaste seismic (RS).

3.2.1.4 Conventional Seismic

Some non-safety-related U.S. EPR SSC do not fall within the criteria for classification as Seismic Category I or II, but may still be subject to seismic design criteria that are incorporated in, or invoked by, an applicable commercial or industry code. These SSC are classified as conventional seismic (CS). SSC that are classified as CS, based solely on applicable commercial or industry codes, are not considered part of the licensing

basis for the U.S. EPR since this classification is not prescribed in NRC regulations or guidance documents.

Some supplemented grade U.S. EPR SSC do not fall within the criteria for classification as Seismic Category I or II, but may be subject to “significant licensing requirements or commitments” that specify consideration of seismic design criteria that are less demanding than either a full or ½ SSE. Those SSC that are classified as RW-IIb or RW-IIc per RG 1.143 are included in this group. These SSC are also seismically categorized as CS.

3.2.1.5 Non-Seismic

The U.S. EPR SSC that do not fall within the RG 1.29 criteria for classification as Seismic Category I or II, do not fall within the RG 1.143 criteria for RW-IIa, RW-IIb, or RW-IIc, and are not subject to any seismic design criteria invoked by the applicable commercial or industrial codes and standards, are classified as non-seismic (NSC).