



Considerations for Including Principal Design Criteria in the Licensing Basis in 10 CFR Part 52

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Considerations for Including Principal Design Criteria in the Licensing Basis executive summary

This white paper describes, from a historical perspective, the principal design criteria (PDC) and the general design criteria (GDC) to which the PDC of the current fleet conform. This white paper also compares the relationship of the PDC to the licensing basis of both the construction permits and operating licenses issued under Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, “Domestic licensing of production and utilization facilities,” and combined licenses issued under 10 CFR Part 52, “Licenses, certifications, and approvals for nuclear power plants.”

Because the GDC have become the *de facto* PDC for the current fleet, the original intent of the GDC is reviewed in this white paper. The GDC were created in response to a recommendation to the U.S. Atomic Energy Commission to make the 10 CFR Part 50 licensing process more predictable for water-cooled nuclear power plants under development at that time, rather than to create new requirements. Because the GDC are based on water-cooled nuclear power plant technology, it was recognized when they were created that the current GDC may not be appropriate as design requirements for other technologies.

The GDC in Appendix A to 10 CFR Part 50 are the minimum requirements for the PDC of water-cooled nuclear power plants, similar in design and location to plants for which construction permits were issued at the time of promulgation, and are to be incorporated by reference in construction permits of water-cooled nuclear power plants. Because of this requirement and reviewing the history of the GDC and PDC, the PDC are meant to be a standard against which to compare the construction of the facility before issuance of the operating license. Under 10 CFR Part 52, inspections, tests, analysis, and acceptance criteria fulfill the same purpose in comparing the construction of a facility to the application before allowing the facility to operate. Under both 10 CFR Part 50 and 10 CFR Part 52, the PDC are incorporated into the Final Safety Analysis Report and therefore are part of the licensing basis of the operating facilities. Under either type of license, changes to the PDC would require U.S. Nuclear Regulatory Commission approval because the changes would not meet the underlying intent of 10 CFR 50.59, “Changes, tests, and approvals,” to be “no more than a minimal increase” under the criteria of 10 CFR 50.59, as stated in the “Comments and Resolution on Proposed Rule Topics,” of the final rule. Therefore, the PDC are already controlled by existing regulations.

1 Introduction

The regulatory framework under Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, “Licenses, certifications, and approvals for nuclear power plants,” has sufficient provisions that serve a similar purpose regarding the principal design criteria (PDC) under the framework of 10 CFR Part 50, “Domestic licensing of production and utilization facilities.” First, to ensure the facility is constructed in conformance with the PDC as described in the application, 10 CFR Part 52 licenses use the inspections, tests, analysis, and acceptance criteria (ITAAC) requirement, which must be met before issuance of the finding under 10 CFR 52.103, “Operating under a combined license,” paragraph (g), and operation of the facility. Additionally, the PDC are included in the final safety analysis (FSAR) of combined license (COL) applications and are subject to the change control requirements of 10 CFR 50.59, “Changes, tests, and experiments.” As discussed in the Statements of Consideration for 10 CFR 50.59 and industry guidance, changes to the PDC would not meet the underlying intent of 10 CFR 50.59 to be “no more than a minimal increase” under the criteria of 10 CFR 50.59 and would require U.S. Nuclear Regulatory Commission (NRC) approval to modify the PDC, under 10 CFR 50.90, “Application for amendment of license, construction permit, or early site permit.” Thus, 10 CFR Part 52 contains sufficient provisions to ensure that the facility is constructed in conformance with the license and to ensure that changes to the PDC are approved beforehand by the NRC.

This white paper provides historical information in Section 2 and how design criteria are to be included within the licensing basis in Section 3.

2 Historical perspective

2.1 Development of the GDC

The original purpose of the general design criteria (GDC) was to aid in predictability of licensing different, large, water-cooled nuclear power plant designs by clarifying existing U.S. Atomic Energy Commission (AEC) requirements [2]. The publishing of the GDC was a direct result of the recommendations of the Mitchell Panel [1][2]:

The AEC should define more precisely and realistically the scope of information to be supplied by the applicant at the construction permit stage.

In accordance with this suggestion, the AEC issued an informal draft of the GDC in November 1965, with a final rule issued in 1971 [3][4].

The GDC were “intended to provide engineering goals rather than precise tests or methodologies by which reactor safety can be fully and satisfactorily gauged.”¹ The GDC “are cast in broad, general terms and constitute the minimum requirements for the principal design criteria of water-cooled nuclear power plants,” while “[t]here are a variety of methods for demonstrating compliance with GDC.”² Indeed, the GDC “were only a regulatory beginning and not the end product, and...there would be a fleshing-out of their broad requirements by future regulations more specific in character.”³

However, while the GDC are broad goals, they were still only considered appropriate for traditional light water reactors (LWRs), similar to those construction permits already issued at the time. The wording in the final rule reflected comments stating great concerns from the industry, regarding the rigidity of the GDC [3]:

It would be a great pity, and unfortunate not only for the development of the industry, but also possibly for the health, safety, and welfare of the public at large, if criteria developed under the influence of BWR [boiling-water reactor] and PWR [pressurized-water reactor] experience to date were to become in any practical effect the rigid standards of the future. **Regardless of all efforts to generalize them, the proposed criteria necessarily will have a water reactor background**, and therefore it should be made emphatically clear in any criteria adopted that AEC, its staff, its hearing officers, and its regulatory system will consciously and deliberately preserve the flexibility that is essential to let them accommodate to [sic] new developments. (emphasis added)

Additionally, the updated language in the final rule reflects that the GDC have always been guidance for reactors that are not water-cooled and were revised to be “requirements” for only water-cooled reactors [4]:

¹ *Nader v. NRC*, 513 F.2d 1045, 1052 (1975).

² Petition for Emergency and Remedial Action, CLI-78-6, 7 NRC 400, 406 (1978).

³ *Nader v. NRC*, 513 F.2d 1045, 1052 (1975).

A proposed Appendix A, “General Design Criteria for Nuclear Power Plant Construction Permits” to 10 CFR Part 50 was published in the Federal Register (32 F.R. 10213) on July 11, 1967. The comments and suggestions received in response to the notice of proposed rule making and subsequent developments in the technology and in the licensing process have been considered in developing the revised criteria which follow.

The revised criteria establish minimum requirements for water-cooled nuclear power plants similar in design and location to plants for which construction permits have been issued by the Commission, whereas the previously proposed criteria would have provided guidance for applicants for construction permits for all types of nuclear power plants.

Ultimately, the predecessor to the NRC, the AEC, saw a benefit in clarifying and standardizing design criteria for water-cooled reactors and encoded these design criteria as the “GDC.” The application of the GDC was refined to water-cooled reactors and as guidance to other, non-water cooled reactor types.

Going forward, it is clear that the PDC for advanced reactors are not required to follow those set forth in 10 CFR Part 50, Appendix A. The regulations in 10 CFR 52.79, “Contents of applications; technical information in final safety analysis report,” paragraph (a)(4), clearly indicate that Appendix A

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 in establishing principal design criteria for other types of nuclear power units. (emphasis added)

In addition, NRC Regulatory Guide (RG) 1.232, “Guidance for Developing Principal Design Criteria for Non-Light-Water Reactors,” Revision 0, states that “[b]ecause the current GDC [in 10 CFR 50, Appendix A] are based on LWR technology, the NRC developed the non-LWR design criteria, included as appendices to this RG, to provide guidance for developing PDC for non-LWR technology.” RG 1.232 further states “that different requirements may need to be adapted for non-LWR designs and that the GDC in 10 CFR 50 Appendix A are not regulatory requirements for non-LWR designs but provide guidance in establishing the PDC for non-LWR designs.”

In sum, the GDC were developed for the current fleet of operating LWR plants. For newer or different technologies, their scope may not be appropriate and must be adjusted to the technology in the application.

2.2 Inclusion of the GDC in license applications

The predominant licensing framework for the AEC, and later, the NRC, has been 10 CFR Part 50. This framework includes a two-step licensing process, where the regulator approves a site for construction of a nuclear power plant and subsequently approves a separate license to operate that facility. Therefore, the precedent for how the GDC have been included in the licensing basis is largely derived and inherited from the 10 CFR Part 50 licensing framework.



Applicants for construction permits for water-cooled nuclear power plants are required to use the GDC as the minimum requirements in developing the PDC that are included in the construction permit applications for their facilities [5]. Additionally, the PDC are intended to be incorporated by reference in the construction permits. Most, if not all, construction permits have a statement in them that the facility will be constructed as described in the application and hearing record in accordance with the principal architectural and engineering criteria set forth therein. Therefore, meeting the facility's PDC are conditions of the use of the construction permit, and these design criteria must be met before the NRC issues an operating license [4][6][7].

The PDC have historically been carried over to the FSAR for the operating license application, and, as many applicants simply quoted the GDC in stating the PDC listed in their FSARs, the GDC have become the *de facto* PDC for the currently licensed LWRs [8][9]. The issued operating licenses state that the facility has been substantially completed in conformance with the construction permit and the application [10]. Though there is no direct tie in the license to the PDC, the PDC are part of the FSAR included in the application for the operating license. Thus, they are part of the licensing basis of the facility, even without being called out specifically in the license. Additionally, since the licensed facility would not be deconstructed and reconstructed after licensing, the PDC are not referenced specifically in the operating license.

3 Inclusion of design criteria in the licensing basis

The PDC play a similar, but different, role in the licensing basis of Part 50 and Part 52 licenses. Because of the two-stage licensing of Part 50, PDC play an important role in the approval of construction of nuclear power plants. In fact, the original title of the GDC, which set the requirements for PDC, was “General Design Criteria for Nuclear Power Plant Construction Permits.” Under Part 52, there are other mechanisms that perform the same function.

Once in the operational phase, PDC perform a similar role under both Part 50 and Part 52. Any changes to PDC under Part 50 operating licenses and Part 52 combined licenses follow the same process and would require NRC approval for changes. The following sections detail how the PDC are treated within the two different licensing frameworks.

3.1 Construction verification

3.1.1 Principal design criteria in Part 50

For Part 50, there are several layers to the relation of the PDC to verification that the construction of the facility is in conformance with the application and construction permit. First, the PDC are incorporated by reference into the construction permit, thereby making them legally binding requirements [4]. Second, inspections are performed by the NRC staff during construction to verify that construction conforms to the PDC. Finally, issuance of an operating license includes a finding that the facility has been constructed in conformance with the application (which includes a statement of the PDC in the associated FSAR) [10].

3.1.2 Principal design criteria in Part 52

Under Part 52, there is an option to issue a license to operate in a single step, unlike Part 50’s construction permit and operating license steps. Though there is no construction permit phase under Part 52 where the staff compares the PDC to the constructed facility, the NRC staff created an analogous step within the Part 52 framework to the Part 50 transition from construction permit to operating license [4]:

Paragraph (b) [of 10 CFR 52.80] requires the Commission to identify the ITAAC [inspections, tests, analysis, and acceptance criteria] within the combined license that the licensee shall perform, and the acceptance criteria that, if met, are necessary and sufficient to provide reasonable assurance that the facility has been constructed and will be operated in conformity with the license, the provisions of the Act, and the Commission’s rules and regulations.

Paragraph (g) [of 10 CFR 52.103] prohibits the licensee from operating the facility until the Commission makes a finding that the acceptance criteria in the combined license are met (except for acceptance criteria that the Commission found were met when the combined license was issued).

As can be seen by the above, similar to meeting the PDC for a construction permit, under Part 52, ITAAC must be met before a facility can be operated. Under Part 50, the facility is inspected against the PDC before an operating license is issued. Once the facility is constructed and the PDC met, the NRC makes a finding in the operating license to this effect. Similarly, under Part 52, facilities are inspected against the ITAAC before a facility is allowed to operate.

Once the facility is constructed and the ITAAC have been met, the NRC makes a finding under 10 CFR 52.103(g) that the ITAAC have been met and the facility will be operated in accordance with the license.

As stated in 10 CFR 52.80, “Contents of applications; additional technical information,” the ITAAC are “necessary and sufficient to provide reasonable assurance that the facility has been constructed” in conformance with the license. Because the ITAAC are necessary and sufficient to provide reasonable assurance that the facility has been constructed in conformance with the license, which was issued based in part on the PDC included in the associated FSAR, it is not necessary to reference the PDC directly in the combined license.

3.2 Operating phase

Though not called out directly in the operating license or combined license, the PDC continue to have a role in the licensing basis during operations, as discussed below.

3.2.1 Part 50

The regulations for content of applications for an operating license under 10 CFR 50.34, “Contents of applications; technical information,” do not mention the principal design criteria for an FSAR, unlike the regulations that clearly ask for PDC for a preliminary safety analysis report (PSAR). Instead, this statement is made:

(b) Final safety analysis report. Each application for an operating license shall include a final safety analysis report. The final safety analysis report shall include information that describes the facility, presents the design bases and the limits on its operation, and presents a safety analysis of the structures, systems, and components and of the facility as a whole, ...

Nevertheless, RG 1.70, “Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (LWR Edition),” Section 3.1, is titled, “Conformance with NRC General Design Criteria.” This suggests that the NRC staff expects the PDC to be carried over from the PSAR to the FSAR and expects the licensing basis for the operating facility to include the PDC. Though this is intuitive because the facility would not be deconstructed and reconstructed to new PDC after issuance of an operating license, the GDC were not intended to guide operation of the facility but to place limits on construction [2][3]. Thus, the inclusion of GDC in the FSAR carries over the high-level design basis from the construction of the facility into the licensing basis of the operating facility.

Given the recent activity related to licensing of non-LWRs, there has been considerable discussion regarding regulatory control of PDC, specifically with respect to change control. The change control process currently established for information within the FSAR continues to be appropriate, as changes to PDC would not pass an evaluation under 10 CFR 50.59, therefore requiring prior NRC approval. This is specifically stated in the Statements of Consideration for the final rule for 10 CFR 50.59 [11]:

Although the final rule allows minimal increases, licensees still must meet applicable regulatory limits and other acceptance criteria to which they are committed (such as are contained in Regulatory Guides and nationally recognized industry consensus standards, e.g., the ASME B&PV Code and IEEE



Standards). Further, departures from the design, fabrication, construction, testing, and performance requirements as outlined in the General Design Criteria (appendix A to part 50) are not compatible with a “no more than minimal increase” standard.

Thus, changes to the PDC as described in the FSAR are already controlled under 10 CFR 50.59 and 10 CFR 50.90.

3.2.2 Part 52

Under 10 CFR 52.79(a)(4), PDC are to be included in applications for a combined license, specifically in the FSAR. After license issuance, any potential change to the FSAR must be evaluated under the change processes of 10 CFR 50.59 and 10 CFR 50.90 under 10 CFR 52.98, “Finality of combined licenses; information requests.” Thus, it follows that the PDC included in the FSAR are controlled in the same manner as they would be under a 10 CFR Part 50 operating license, all through the requirements in 10 CFR 50.59 and 10 CFR 50.90.

As noted above, under 10 CFR 50.59, “departures from the design, fabrication, construction, testing, and performance requirements as outlined in the General Design Criteria (appendix A to part 50) are not compatible with a ‘no more than minimal increase’ standard.”⁴ As a result, for LWRs, departures from the GDC would require approval from the NRC. The same principle would apply to the PDC of an advanced reactor.

Thus, it follows that any change to the PDC would meet the criteria of 10 CFR 50.59 for requiring approval by the NRC.

⁴ See also NEI 96-07, Rev. 1 at 39 (2000).

4 Conclusion

The regulatory framework under 10 CFR Part 52 has sufficient provisions that serve a similar purpose regarding the PDC under the 10 CFR Part 50 framework. First, to ensure the facility is constructed in conformance with the PDC as described in the application, 10 CFR Part 52 licenses use the ITAAC requirement, which must be met before issuance of the 10 CFR 52.103(g) finding and operation of the facility. Additionally, the PDC are included in the FSAR and are subject to the change control requirements of 10 CFR 50.59. As discussed in the Statements of Consideration for 10 CFR 50.59 and industry guidance, changes to the PDC would not pass the “no more than minimal increase” test and would require NRC approval to modify the PDC, under 10 CFR 50.90. Ultimately, the current regulations are sufficient to provide regulatory change control over the PDC within the licensing basis.

5 References

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