NRRC Technical Regulations

Construction and Commissioning of Nuclear Facilities

NRRC-R-08 Rev. 0.1

2024

هيئة الرقابة النووية والإشعاعية
Nuclear and Radiological Regulatory Commission

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Regulation

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Preamble

In accordance with the provisions of the Law of Nuclear and Radiological Control issued by Royal Decree No. (M/82) dated 25/7/1439 AH, and NRRC's Statute issued by the Ministers' Cabinet Resolution No. (334) dated 25/6/1439 AH, the NRRC prepared regulations that ensure control over radiological activities and practices as well as nuclear and radiological facilities.

This regulation has been prepared on the basis of International Atomic Energy Agency (IAEA) standards, international best practices, and in accordance with the Kingdom's international commitments. This regulation has been presented in "the Public Consultation Platform" for the public review, comments, and feedback.

This regulation has been approved by the NRRC's Board of Directors Resolution No. (R/1/1/2022) dated 20/04/2022.

This edition, NRRC-R-08 Rev. 0.1 (2024), of the regulation is revised and takes precedence over the previous publication, NRRC-R-08 (2022). In addition, the changes within this revision are editorial.

Table of Contents

Related Regulations

Chapter 1: Objective, Scope, and Definitions

Section 1: Objective

1. The objective of this regulation is to provide the regulatory requirements, based on international best practices, for the construction and commissioning of nuclear facilities, which will enable the construction and commissioning to be of high safety and quality and consistent with the design and site evaluation requirements of the facility.

Section 2: Scope

2. This regulation shall apply to the construction and commissioning stages of new nuclear facilities and to major modifications and refurbishments of an existing nuclear facility.

3. The requirements of this regulation shall apply as such to a holder of a construction license of a nuclear facility, and to an applicant for a construction license, supplier of the facility, contractors and suppliers of safety significant products, and their subcontractors, as applicable.

4. The regulation establishes the responsibilities of the licensee and suppliers and the prerequisites and management principles governing the construction and commissioning stages. In addition, this regulation establishes the requirements with regard to the transfer of responsibilities from the construction to the commissioning stage and from the commissioning to the operation stage.

5. The regulation specifies the requirements concerning safety culture during the construction and commissioning stages.

6. This regulation is supplemented by the regulation on Licensing and Regulatory Oversight of Nuclear Facilities (NRRC-R-03 Rev. 0.1), the regulation on Leadership and Management for Safety (NRRC-R-04 Rev. 0.1), the regulation on

Design of Nuclear Facilities (NRRC-R-06 Rev. 0.1), and the regulation on Safety Assessment of Nuclear Facilities (NRRC-R-07 Rev. 0.1).

7. The regulation does not cover considerations of nuclear security in the construction and commissioning of a nuclear facility.

Section 3: Definitions

Commissioning

The process where the structures, systems, and components (SSCs) of facilities and activities, after being constructed, are made operational and verified to be in accordance with the design and that they meet the required performance criteria. Commissioning may include both non-nuclear and nuclear testing.

Commissioning Organization

The entity managing commissioning activities.

Competence

The ability to apply knowledge and skills to achieve intended results.

Conformity assessment

A demonstration that specified requirements relating to a product, process, system, person, or body are fulfilled.

Construction

The process of manufacturing and assembling the components of a facility, carrying out the civil works, the installation of components and equipment and the performance of associated tests.

Construction Organization

The organizational entity managing construction activities.

Contractor

Any individual or organization that provides items or renders services in accordance with a contract or a procurement document. A contractor may be a construction organization, technical services organization, consultant responsible for independent review and assessment, or organization responsible for performing inspections.

Design

The process and the results of developing a concept, detailed plans, supporting calculations, and specifications for a facility and its parts.

Design review

The process by which a design is evaluated to ensure compliance with the prescribed requirements.

Inspection system

Comprises all those elements of testing, such as inspection equipment and their software, inspection procedures and personnel that are used to perform concerned examination and may influence the quality and outcome of an inspection.

Item important to safety

A structure, system, or component (i.e., an item) that is part of a safety function and/or whose malfunction or failure could lead to radiation exposure of the site personnel or members of the public.

Operating organization

An organization applying for operating or authorized to operate an authorized facility and responsible for its safety.

Operational limits and conditions

A set of rules setting forth parameter limits, the functional capability and the performance levels of equipment and personnel approved by the regulatory body for safe operation of an authorized facility.

Root cause

The fundamental cause of an initiating event, correction of which will prevent recurrence of the initiating event.

Subcontractor

A person or supplier organization that is not in a direct contractual relationship with the licensee or license applicant.

Supplier

Any person or organization to whom a registrant or licensee delegates duties, totally or partially, in relation to the design, manufacture, production, or construction of a source. Supplier refers to an organization or person manufacturing or providing a product.

Technical Services Organization

An organization that provides expertise and services to support nuclear and radiation safety and all related scientific and technical issues.

Validation

The process of determining whether a product or service is adequate to satisfactorily perform its intended function.

Verification

The process of determining whether the quality or performance of a product or service is as stated, as intended, or as required.

Chapter 2: Construction

Section 4: Prerequisites of Construction

8. At any time, no person shall initiate any related construction activity without obtaining valid authorization or written approval from the NRRC.

9. The applicant shall ensure that the construction of a nuclear facility is not commenced before the construction license has been issued.

10. Manufacturing of components or structures with a long lead time and site preparation activities may be started before the construction license is issued, subject to the NRRC approval.

11. The design of the systems important to the safety of the nuclear facility, described in the Preliminary Safety Analysis Report for the construction license application, shall be completed, verified by safety analyses, and reviewed by the applicant and the NRRC before the construction starts. The design of the systems shall contain sufficiently detailed information, specifications, and supporting calculations to assess and demonstrate that the plant can be constructed, commissioned, operated, and decommissioned in a manner that is acceptably safe throughout its lifetime, including with regard to any site-specific aspects.

12. Tests and analyses needed to verify alternative methods of construction or novel design features of the facility shall be completed before the construction starts. All necessary engineering documents related to nuclear safety to start the construction activities shall be made available to the NRRC.

13. The applicant shall establish and implement an integrated management system for the construction stage before applying for a construction license.

14. The licensee shall establish adequate infrastructure for the on-site construction activities, such as transport arrangements for large components, support systems including electricity, gas, and water supply, and accommodation of the workforce.

Section 5: Responsibilities Licensee and Suppliers during Construction

15. The licensee retains the prime responsibility for safety throughout the lifetime of the facilities and activities, and this responsibility cannot be delegated.

16. The licensee shall specify for its vendor of the facility, contractors, and suppliers the safety and quality requirements for the construction of a nuclear facility in accordance with the NRRC requirements.

17. The licensee shall ensure that the construction activities are conducted in accordance with the safety and quality requirements and shall be able to demonstrate such compliance.

18. The licensee is responsible for the activities of contractors, suppliers and subcontractors whose activities might affect the safety of the facility, and for supervising these activities.

19. The licensee is responsible for establishing and implementing an integrated management system for the construction of a nuclear facility, giving due priority to safety. The responsibilities of the organizations participating in construction activities shall be clearly defined in the management system.

20. The vendor of the facility, contractors, and suppliers are responsible for fulfilling the safety and quality requirements specified for the construction, including the work of their subcontractors.

21. The licensee and the vendor of the facility, contractors and suppliers whose activities might affect the safety of the facility shall have the needed competence, experience, and resources within their organizations to ensure that the facility is constructed in accordance with specified safety and quality requirements and to ensure proper control of supply chains.

Section 6: Management of Construction Activities

22. The licensee shall have an integrated management system in place to implement the management of construction activities. This management system shall be appropriately certified or independently evaluated.

23. The licensee shall ensure that processes and procedures required to manage, control, and implement a construction project of a nuclear facility are defined and described in the licensee's management system for construction. These processes shall take account of internal and external hazards and risks related to the implementation of construction activities according to plans, as well as relevant experience gained in the construction of other similar facilities.

24. As a part of the management system for construction, the licensee shall specify the interfaces and establish clear lines of communication between various organizations participating in the design and construction of the facility.

25. During the construction, the licensee shall monitor and maintain the facility, to protect the plant equipment and to maintain consistency with the Preliminary Safety Analysis Report.

26. To enhance the reliability of construction activities, the latter shall be carefully planned, scheduled, and carried out by competent staff with high quality and in accordance with approved procedures. The overall construction schedule should include at least the activities to be performed, the organizations responsible for implementing various activities, the planned sequential order and duration of the activities, and the resources needed for each activity.

27. The licensee shall ensure that arrangements for work control, modification control, and configuration control are established for construction at an adequate time.

28. Independent safety reviews or verifications of construction activities shall be carried out for defined activities, as required, and their hold points shall be specified by the licensee. The NRRC may define additional hold points.

29. As a part of the management system, the licensee shall establish provisions to ensure compliance with regulatory requirements and the safety and quality of the construction. The regulatory requirements and licensee's requirements shall be brought together into procurement specifications.

30. The licensee shall specify a formal procedure for design modifications implemented during construction, which shall be reviewed, and their impact independently assessed by a designated entity of the licensee organization responsible for the design.

31. The licensee shall establish a configuration management process to control design modifications during construction. Safety-related design modifications during the construction stage shall be approved by the NRRC.

32. The licensee is fully liable for any safety implication activities and shall perform an independent design review of the quality plans of specified structures and components important to safety by independent qualified technical services organizations.

33. The licensee shall ensure that contractors, suppliers, and subcontractors involved in construction activities are informed of the safety and quality requirements for their services and products and of the documentation and reporting requirements and that they have in place and implement quality plans for their products for the verification of the quality of items important to safety.

34. The licensee shall specify the inspections to be performed during manufacturing and installation by qualified technical services organizations. The contractors, suppliers, and subcontractors shall be informed of these inspections.

35. Contractors and suppliers shall not commence their work before being authorized by the licensee.

36. All items important to safety shall be inspected and tested by the manufacturer in accordance with the requirements established in the procurement specifications.

37. After items important to safety have been received on-site, an inspection shall be performed by the licensee to ensure that the specified requirements for the item are fulfilled, and no damage has occurred during the transport to the site prior to the use of the items in construction.

38. The licensee shall establish storages fulfilling the specified requirements on the site to protect items important to safety prior to their installation and shall establish measures for monitoring and control of environmental conditions and for performing housekeeping during construction to preserve installed items.

39. The licensee shall ensure that baseline in-service inspections (pre-service inspections) by means of non-destructive examination methods are performed using a qualified inspection system.

40. The conceptual plan for in-service inspections shall be submitted to the NRRC for approval when applying for a construction license.

41. After all the manufacturing and installation work for the item has been completed, the licensee shall perform an independent conformity assessment of specified items important to safety by independent qualified technical services organizations.

42. A conformity assessment of other structures and components shall be performed by the licensee to verify that the installed item complies with the design and quality requirements.

43. The licensee shall oversee and assess the performance of the organizations responsible for construction activities based on a graded approach.

44. The licensee is responsible for filing an inspection request to a qualified technical services organization in respect of all items for which an inspection during manufacturing or installation is required and for filing an inspection request in respect of all items for which a conformity assessment is required.

45. During the construction, the licensee shall use an effective system for collecting, analyzing, and following up on nonconformances. Nonconformances shall be categorized based on their safety significance, and significant nonconformances shall be reported to the NRRC.

46. The licensee shall make it clear to all individuals engaged in construction activities that they are expected to report nonconformances.

47. The licensee shall investigate safety significant events during the construction, report them immediately to the NRRC, and determine direct causes and root causes of the events and preventive and corrective action plans shall be determined as a part of the investigation. The investigation report shall be approved by the NRRC.

Section 7: Safety Culture during Construction

48. The licensee shall ensure that the NRRC requirements concerning culture for safety are implemented during the construction of a nuclear facility, as stipulated in the Regulation on Leadership and Management for Safety (NRRC-R-04 Rev. 0.1).

49. The senior management of each organization participating in construction activities shall actively demonstrate commitment to safety in all their activities. Safety-oriented decision-making shall be applied in all construction activities.

50. The licensee shall ensure that individuals working in organizations participating in construction activities understand the essential features of the safety significance of their work.

51. Managers at all levels in organizations participating in construction activities shall encourage workers to report any potential safety concerns, which shall be responded to properly.

52. The licensee shall ensure that any unplanned actions are avoided in the construction activities. In unforeseen situations or if the situation is not fully understood, the work shall not be continued before an assessment of the situation is made.

53. The licensee shall ensure that in all organizations participating in construction activities, procedures are in place for reporting deviations, nonconformances, and safety concerns to the management of the organization or to the licensee. Procedures shall be established for reporting safety concerns to the NRRC.

54. The safety culture of the organizations participating in the construction of a nuclear facility shall be adequately monitored by the licensee throughout the construction process.

55. The licensee shall make arrangements to allow regulatory oversight during construction, including such activities as monitoring and direct observation of construction work practices, items and equipment used in construction, and results of measurements and tests.

Section 8: Transfer of Responsibilities

56. The licensee shall ensure that procedures are established to control and coordinate the handover of the completed construction work from one contractor to another and from the construction organization to the commissioning organization. These procedures shall be part of the management system for construction.

57. The procedures shall specify the necessary documentation for the transfer of responsibilities. The documentation shall be reviewed by both parties for completeness and accuracy. Any remaining nonconformances shall be assessed, and the remaining work shall be identified, planned, and scheduled.

Chapter 3: Commissioning

Section 9: Prerequisites of Commissioning

58. At any time, no person shall initiate any related commissioning activity without obtaining valid authorization or written approval from the NRRC.

59. The licensee shall ensure that the commissioning of a system important to safety will not commence before manufacturing and installation of the system and its structures and components is completed and the licensee has verified the readiness for commissioning.

60. The licensee shall ensure that the management system for the commissioning stage is established and implemented before the commencement of commissioning activities. Operating procedures shall be available before the commencement of commissioning.

61. The licensee shall ensure safe handling and storage of the fuel before bringing fresh nuclear fuel to the nuclear power plant site for the first time.

62. The licensee shall not commence the initial fuel loading until all relevant pre-operational tests have been performed and the results approved by the licensee and the NRRC.

63. After fuel loading, the transfer to the next stage of commissioning (subcritical tests, initial criticality tests, low power tests, power ascension tests at several power levels) shall not be commenced until all the tests of the previous stage have been performed and the results have been approved by the licensee and the NRRC.

Section 10: Responsibilities Licensee and Suppliers during Commissioning

64. The licensee retains the prime responsibility for safety throughout the lifetime of the facilities and activities, and this responsibility cannot be delegated.

65. The licensee shall specify the safety and quality requirements for commissioning for its vendor of the facility, contractors, and suppliers in accordance with the NRRC requirements.

66. The licensee shall ensure that the commissioning activities are conducted in accordance with the safety and quality requirements for the commissioning and shall be able to demonstrate such compliance.

67. The licensee is responsible for the activities of contractors, suppliers and subcontractors whose activities might affect the safety of the facility, and for supervising these activities.

68. The licensee is responsible for establishing and implementing a management system for the commissioning of a nuclear facility, giving due priority to safety. The responsibilities of the organizations participating in commissioning activities shall be clearly defined in the management system.

69. The vendor of the facility, contractors, and suppliers are responsible for fulfilling the safety and quality requirements specified for the commissioning, including the work of their subcontractors.

70. The licensee and the vendor of the facility, contractors, and suppliers whose activities might affect the safety of the facility shall have the required competence, experience, and resources within their organizations to ensure that the facility is commissioned in accordance with specified safety and quality requirements.

Section 11: Management of Commissioning Activities

71. During the commissioning, the licensee shall verify that the nuclear facility and its structures, systems, and components, as well as the functions they accomplish, fulfill the safety requirements, including regulatory requirements, as specified in the Safety Analysis Report and detailed design requirements.

72. During the commissioning, the licensee shall verify and validate the procedures for normal operation, including periodic testing and maintenance, of the facility

and its structures, systems, and components. The procedures for anticipated operational occurrences and accident conditions shall be verified and validated to the extent practicable.

73. During the commissioning, the licensee shall ensure that the competence of the operating personnel is adequate for the safe operation of the facility. The operating personnel shall be directly involved in commissioning activities.

74. The licensee shall have in place a management system for implementing the management of commissioning activities. This management system shall be appropriately certified or independently evaluated.

75. The licensee shall ensure that processes and procedures required to manage, control, and implement the commissioning of a nuclear facility are defined and described in the licensee's management system for the commissioning. These processes shall take into account risks related to the implementation of commissioning activities according to plans and relevant experience gained in the commissioning of other similar facilities.

76. As a part of the management system for commissioning, the licensee shall specify the interfaces and establish clear lines of communication between various organizations participating in the design, construction, commissioning, and operation of the facility.

77. The licensee shall ensure that arrangements for work control, modification control and configuration control are in place from the commencement of commissioning.

78. The licensee shall ensure that all the functions of its organization, defined in the management system, are performed at the appropriate stages of the commissioning. These shall include personnel managerial functions, radiation protection, waste management, fire safety, physical protection, and emergency planning.

79. During the commissioning, the licensee shall monitor and maintain the facility, following the normal procedures for the operation of the facility, to maintain consistency with the Safety Analysis Report.

80. To enhance the reliability of commissioning activities, they shall be carefully planned, scheduled, and carried out by competent staff with high quality and in accordance with approved procedures. The overall commissioning schedule should include, at least, the activities to be performed, the organizations responsible for implementing various activities, the planned sequential order and duration of the activities and the resources needed for each activity.

81. Independent safety reviews or verifications of commissioning activities shall be carried out for defined activities, as necessary, and its hold points shall be specified by the licensee. The NRRC may define additional hold points.

82. The licensee shall use a formal procedure for design modifications implemented during commissioning, which have to be reviewed and their impact independently assessed by a designated entity of the licensee organization responsible for the design.

83. The licensee shall establish a configuration management process to control design modifications during commissioning. Safety-related design modifications during the commissioning stage shall be approved by the NRRC.

84. During the commissioning, the licensee shall use an effective system for collecting, analyzing, and following up on nonconformances. Nonconformances shall be categorized based on their safety significance, and significant nonconformances shall be reported to the NRRC.

85. The licensee shall make it clear to all individuals engaged in commissioning activities that they are expected to report nonconformances.

86. The licensee shall investigate safety significant events during the commissioning, report them immediately to the NRRC, and determine direct causes and root

causes of events and preventive and corrective action plans shall be determined as a part of the investigation. The investigation report shall be approved by the NRRC.

Section 12: Commissioning Program

87. The licensee shall establish and implement, subject to the NRRC approval, a commissioning program in the framework of the management system for commissioning. The program shall specify the responsibilities for implementing and reporting the various parts of the program.

88. The commissioning stages, test objectives, and acceptance criteria of the tests shall be specified in the commissioning program so that it is auditable.

89. The commissioning program shall include all the tests necessary to demonstrate that the facility, as built, meets the safety requirements, including regulatory requirements, as specified in the Safety Analysis Report and detailed design requirements.

90. The commissioning program shall demonstrate that the facility can be safely operated in accordance with the operational limits and conditions of the facility. The licensee shall review the operational limits and conditions on the basis of the results of the commissioning tests.

91. The commissioning program shall be sufficiently comprehensive and provide reference data to characterize the structures, systems, and components of the nuclear facility. Such reference data shall be retained to ensure the safety of the facility during the operation and for subsequent safety reviews.

92. The licensee shall ensure that no such commissioning tests are performed that might place the facility in an unanalyzed condition or otherwise jeopardize its safety.

93. After fuel loading at a nuclear power plant, a safety review shall be carried out by the licensee before the commencement of each test.

94. If it is not considered reasonably practical to fully test the functionality of a structure, system, or component important to safety for all operating or accident conditions, the licensee shall ensure that additional compensatory measures, such as off-site testing, safety assessments, and third-party reviews, are used. The compensatory measures and their justification shall be approved by the NRRC.

95. A test procedure shall be drawn up for each test of the commissioning program. Safety-related commissioning test procedures shall be submitted to the NRRC for review before performing the tests.

96. A report shall be drawn up for the review of the test results for each test of the commissioning program, and a summary report shall be drawn up for each stage of the commissioning. Safety-related commissioning test reports and summary test reports for each stage shall be approved by the NRRC before entering the next stage.

97. On the basis of the review, a judgment shall be made on whether the commissioning program can proceed to the next stage. Judgments shall also be made on whether the succeeding stages will be modified as a consequence of the test results, or because some tests in the stage had not been undertaken, or some tests had been undertaken but had not been completed.

Section 13: Safety Culture during Commissioning

98. The licensee shall ensure that the NRRC's requirements concerning culture for safety are implemented during the commissioning of a nuclear facility, as stipulated in the Regulation on Leadership and Management for Safety (NRRC-R-04 Rev. 0.1).

99. The senior management of each organization participating in commissioning activities shall actively demonstrate commitment to safety in all their activities. Safety-oriented decision-making shall be applied in all commissioning activities.

100. The licensee shall ensure that individuals working in organizations participating in commissioning activities understand the essential features of the safety significance of their work.

101. Managers at all levels in organizations participating in commissioning activities shall encourage workers to report any potential safety concerns, which shall be responded to properly.

102. The licensee shall ensure that any unplanned actions are avoided in the commissioning activities. In unforeseen situations or if the situation is not fully understood, the activity shall not be continued before an assessment of the situation is made.

103. The licensee shall ensure that in all organizations participating in the commissioning activities, procedures are in place for reporting deviations, nonconformances, and safety concerns to the management of the organization or the licensee. Procedures shall be established for reporting safety concerns to the NRRC.

104. The safety culture of the organizations participating in the commissioning of a nuclear facility shall be adequately monitored by the licensee throughout the commissioning process.

Section 14: Transfer of Responsibilities

105. The licensee shall ensure that procedures are established to control and coordinate the handover of responsibilities from the commissioning organization to the operating organization. These procedures shall be a part of the management system for commissioning.

106. The procedures shall specify the necessary documentation for the transfer. The documentation shall be reviewed by both parties for completeness and accuracy. Records presenting the commissioning results and the configuration of the facility shall be transferred.

107. The responsibility for the systems needed for the safe storage of the fresh nuclear fuel shall be transferred to the operating organization before nuclear fuel is brought to the site. The responsibility for all systems shall be transferred to the operating organization before the initial fuel loading.

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