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PART II

Statutory Notifications (S. R. O.)

GOVERNMENT OF PAKISTAN

PAKISTAN NUCLEAR REGULATORY AUTHORITY

NOTIFICATION

Islamabad, the 1st February, 2020

S.R.O. 861(I)/2020.—In exercise of the powers conferred by Section 16(2)(a) read with Section 56 of the Pakistan Nuclear Regulatory Authority Ordinance, 2001, the Pakistan Nuclear Regulatory Authority is pleased to make and promulgate the following regulations:

1. **Short Title, Extent, Applicability and Commencement.**—(1) These regulations may be called the “Regulations for the Safe Management of Spent Nuclear Fuel - (PAK/918)”.

(2) These regulations extend to the whole of Pakistan.

(3) These regulations shall be applicable to the activities related to safe management of spent fuel.

(1885)

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(4) These regulations shall come into force at once.

2. **Definitions.**—In these regulations, unless there is anything repugnant in the subject or context,

- (a) “*applicant*” means a person who has applied to the Authority for a license or for an authorization;
- (b) “*cask*” means a shielded container used for the dry storage of spent fuel;
- (c) “*certificate holder*” means a person holding a valid design approval certificate of the cask;
- (d) “*confinement*” means prevention or control of releases of radioactive material to the environment in operation or in accidents;
- (e) “*design certification*” means a process for approval of design of the cask;
- (f) “*dry storage*” means storage in a gaseous medium, such as air or an inert gas;
- (g) “*dual purpose cask*” means a shielded container used for the dry storage as well as transport of radioactive materials such as spent fuel;
- (h) “*facility*” means spent fuel storage facility;
- (i) “*item important to safety*” means an item that is part of a safety group and whose malfunction or failure could lead to radiation exposure of the workers or the public;
- (j) “*licensee*” means the holder of a valid license issued by the Authority;
- (k) “*management system*” means a set of interrelated or interacting elements (a system) for establishing policies and objectives and enabling the objectives to be achieved in an efficient and effective manner;
- (l) “*residual heat*” means the heat originating from radioactive decay;
- (m) “*spent fuel*” means nuclear fuel removed from a reactor following irradiation that is no longer usable in its present form;

- (n) “*spent fuel management*” means all activities that relate to the handling and storage of spent fuel, excluding off-site transport;
- (o) “*structures, systems and components*” means a general term encompassing all of the elements (items) of a facility or activity that contribute to protection and safety, except human factors; and
- (p) “*wet storage*” means storage in water or in another liquid.

3. **Scope.**—These regulations shall cover all aspects of the safe management of spent fuel in dry as well as wet storage. These regulations also cover design certification process for cask. However, handling and storage of the spent fuel as a part of the operational activities of a nuclear reactor, as described in Regulations on the Safety of Nuclear Power Plants Operation - (PAK/913), are not covered under these regulations.

4. **Interpretation.**—The decision of Chairman PNRA regarding the interpretation of any word or phrase of these regulations shall be final and binding.

5. **General Responsibilities.**—(1) The applicant or licensee, as the case may be, shall be responsible for the safe management of spent fuel.

(2) For spent fuel storage facilities, the applicant or licensee, as the case may be, shall follow the authorization and licensing process as prescribed in Regulations for Licensing of Nuclear Installations in Pakistan - (PAK/909). Whereas, for design certification of the cask, the applicant or licensee, as the case may be, shall comply with the design certification process for cask given in Schedule I of these regulations.

(3) The applicant or licensee, as the case may be, shall establish necessary qualification and experience criteria for all staff involved in activities that may affect safety. The applicant or licensee, as the case may be, shall additionally ensure that the qualifications and training of contractors is adequate for the activities to be performed and that adequate control and supervision is in place.

(4) The licensee shall adequately consider the human and organizational factors and human-machine interfaces throughout the design of the facility or cask, as the case may be.

(5) The licensee or certificate holder, as the case may be, shall ensure that the construction or manufacturing of the facility or cask is in accordance with the approved design.

(6) The licensee shall prepare and put in place a management system approved by the Authority, covering all activities in relation with these regulations. The management system shall be an integral part of every activity, which may affect safety.

(7) The licensee shall establish and maintain safety culture by means of an effective management system and a demonstrated commitment to safety on the part of its management.

(8) The applicant or licensee, as the case may be, shall obtain, evaluate and utilize the available experience feedback from other national and international organizations and facilities.

(9) The application for acquiring an authorization or license, as the case may be, shall be accompanied by such fee as prescribed by Regulations on Licensing Fee by Pakistan Nuclear Regulatory Authority - (PAK/900).

(10) The licensee shall comply with the requirements of radiation protection as specified in Regulations on Radiation Protection - (PAK/904) while managing the spent fuel.

(11) The licensee shall fulfill the requirements of Regulations on Radioactive Waste Management - (PAK/915) while managing radioactive waste generated during management of spent fuel.

(12) The applicant or licensee, as the case may be, shall ensure that design of dual purpose cask satisfies the requirements of these regulations in addition to the requirements of Regulations for the Safe Transport of Radioactive Material - (PAK/916).

(13) The licensee shall establish and implement emergency preparedness and response measures commensurate with the hazards associated with the handling and storage of spent fuel in accordance with Regulations on Management of a Nuclear or Radiological Emergency - (PAK/914).

(14) The licensee shall take all necessary measures to ensure physical protection of spent fuel as prescribed in Regulations on Physical Protection of Nuclear Material and Nuclear Installations - (PAK/925).

(15) The licensee shall take necessary measures to comply with all aspects of decommissioning of the facility or cask, as the case may be, in accordance with Regulations on Decommissioning of Facilities Using Radioactive Material - (PAK/930).

(16) The applicant or licensee, as the case may be, shall be subject to enforcement actions under the provisions of Pakistan Nuclear Regulatory Authority Enforcement Regulations - (PAK/950) in case of any non-compliance with the requirements of these regulations.

SPECIFIC REQUIREMENTS FOR SPENT FUEL STORAGE FACILITIES

6. **General.**—(1) The licensee shall establish limits and acceptance criteria for the facility by taking into account storage conditions, compatibility with the safety analysis of the facility, suitability for handling and retrieval of spent fuel.

(2) The licensee shall ensure that spent fuel is uniquely identified and marked, under an established marking system, for the entire storage period.

(3) The licensee shall ensure safe handling of spent fuel.

(4) The licensee shall ensure that the cask manufactured in accordance with the certified design is used for transportation and storage of the spent fuel.

(5) The licensee shall submit design and Safety Analysis Report (SAR) modifications, important to safety including facility configuration and the operational limits and conditions, to the Authority for approval before implementation.

7. **Design.**—(1) The licensee shall use following hierarchy of design measures, to the extent practicable, in protecting the workers, the public and the environment against potential hazards:

(a) Selection of the process to eliminate the hazard;

(b) Passive design features;

(c) Active design features; and

(d) Administrative controls.

(2) The facility shall be designed to:

(a) Maintain spent fuel in a subcritical condition;

(b) Provide sufficient radiation shielding and confinement;

(c) Provide adequate heat removal capacity;

- (d) Facilitate decontamination to the extent practicable; and
 - (e) Facilitate the retrieval of spent fuel from the storage.
- (3) The facility shall be designed to ensure safety for the expected operating lifetime, under both normal and possible accident conditions, until its removal from regulatory control.
- (4) Operational limits and conditions shall be developed to ensure that the facility is operated in accordance with the design intent.
- (5) The SAR shall clearly describe the assumptions and basis for the operational limits and conditions.
- (6) The design of the facility shall ensure availability and accessibility of control rooms and panels, important to safety, during routine and emergency operations.
- (7) All structures, systems and components important to safety for the facility shall be identified and classified on the basis of their safety function and safety significance.
- (8) The design of the facility shall control and limit the consequences of failures and deviations from normal operation that exceed the capability of safety systems.
- (9) Appropriate margins shall be provided in the design for all structures, systems and components important to safety so as to take into account relevant wear-out mechanisms and potential age related degradation, in order to ensure the capability of the structure, system or component to perform the necessary safety function throughout its design life.
- (10) Provision shall be made for monitoring, testing, sampling and inspection to assess aging mechanisms predicted at the design stage and to identify unanticipated behavior or degradation that may occur in service.
- (11) The design of the facility shall provide suitable measures to limit possible radiological impacts on the workers, the public and the environment, including the impacts from discharges or uncontrolled radioactive releases.
- (12) The concept of defence in depth shall be applied at the facility for prevention and mitigation of accidents. The degree of application of each level of defence in depth shall commensurate with the potential hazards associated with the spent fuel.

(13) The design of the facility shall consider redundancy and diversity of the safety related structures, systems and components.

(14) Structures, systems and components important to safety, shall be designed, taking into account the site specific natural phenomena such as earthquakes, hurricanes, floods, fires etc., and for human-induced external events.

(15) Structures, systems and components important to safety shall either be capable of performing their safety functions in spite of loss of support systems, or shall be designed to fail to safe configuration.

(16) The design of the facility shall provide adequate accessibility to facilitate inspection; testing and maintenance of structures, systems and components; and monitoring for radiation and contamination.

(17) If an item important to safety cannot be designed to be capable of being tested, inspected or monitored to the extent desirable, a robust technical justification shall be provided that incorporates the following approach:

- (a) Other proven alternatives and indirect methods; and
- (b) Conservative safety margins shall be applied or other appropriate measures shall be taken to compensate for possible unanticipated failures.

(18) In design of the facility, not only the facility itself but its interfaces with other facilities that may affect its safety shall also be considered.

(19) Cooling systems, including any support features, shall have adequate capacity, availability and reliability to remove heat generated from radioactive decay and chemical reactions.

8. **Handling Equipment.**—(1) The equipment and systems for handling of spent fuel shall be designed to:

- (a) Prevent damage to the fuel;
- (b) Prevent dropping of the fuel and the casks;
- (c) Facilitate decontamination of the facility;
- (d) Prevent undue stresses on spent fuel; and

- (e) Facilitate maintenance and future decommissioning of fuel handling and storage facilities.
- (2) The cranes for carrying the cask shall meet single-failure criteria.
- (3) The design of handling equipment shall provide for automatic stop of the Fuel Handling Equipment (FHE) in the event of earthquake with intensity values higher than those set in the design.
- (4) The FHE shall have interlocks which restrict:
 - (a) Lifting the spent fuel higher than the water level to ensure radiation protection of the personnel;
 - (b) Shaking of FHE during spent fuel handling; and
 - (c) Contact of the FHE with structural elements of the spent fuel pool.
- 9. **Aging Management.**—(1) The licensee shall develop and implement aging management program for its facility.
 - (2) The licensee shall take into account aging and wear out effects in all normal operating conditions of the facility.
- 10. **Financial Resources.**—The licensee shall allocate adequate financial resources to fulfill its prime responsibility for safety and to implement these foregoing safety requirements.
- 11. **Event Notification.**—(1) The licensee shall notify the Authority as soon as possible but not later than twelve (12) hours after the discovery of any event having impact on safety of the spent fuel.
 - (2) The licensee shall:
 - (a) Within seventy two (72) hours, submit a preliminary report to the Authority; and
 - (b) Within sixty (60) days, submit a detailed report to the Authority on the causes of the event, its circumstances and consequences, and on the corrective actions taken or to be taken.

12. **Records and Reports.**—(1) The licensee shall ensure that records and reports important to safety are maintained throughout the lifetime of the facility.

(2) The licensee shall maintain up to date inventory of spent fuel on yearly basis or on such shorter intervals in such format as specified by the Authority.

(3) The licensee shall submit to the Authority an annual report, as specified by the Authority, describing inventory and all necessary details relevant to the safe management of spent fuel.

13. **Additional Requirements for Wet Storage Facility.**—(1) The facility for wet storage shall be designed and built to withstand the maximum potential earthquake stresses for the region where the facility is sited or situated.

(2) The design of the facility shall include means for the following:

(a) Controlling the temperature, water chemistry and radiological composition of water in which spent fuel is handled or stored;

(b) Monitoring and controlling the water level in the fuel storage pool and means for detecting leakage;

(c) Preventing the uncovering of fuel assemblies in the pool; and

(d) Ensuring sufficient filtered ventilation of the facility.

(3) The feed water system of the pools shall be designed with the capacity higher than the system for water purification.

(4) The design of the facility shall minimize operator intervention during normal operation and accident conditions.

(5) The facility shall maintain at least minimum water levels in the fuel storage pool necessary for radiation shielding.

(6) Backup system for filling the pool from a reliable water source shall be provided and the capacity of the backup system for filling shall be higher than the maximum pool leakage rate.

(7) The instrumentation and control system of the facility shall ensure on-line monitoring of the level, temperature and specific activity of the pool water.

(8) The licensee shall make necessary arrangements for measurement of concentration of homogenous neutron absorbers.

(9) The operators shall be provided with clear displays and alarms for those parameters that are important to safety.

(10) The equipment for underwater fuel handling shall not cause mechanical damages to the cladding of the pools from:

- (a) The existing equipment at the facility; and
- (b) Initiating events like falling of casks and assemblies during handling of spent fuel or other heavy objects.

SPECIFIC REQUIREMENTS FOR CASK

14. **General.**—(1) The applicant shall be responsible to comply with the applicable national laws, regulations and technical standards related to cask.

(2) The applicant shall establish design criteria for all relevant parameters of the cask and submit to the Authority for approval.

(3) The cask shall be conspicuously and durably marked with the following:

- (a) Design approval certificate number;
- (b) A unique identification number;
- (c) Date of manufacturing; and
- (d) Maximum laden weight.

15. **Design.**—(1) The cask shall be designed to:

- (a) Maintain spent fuel in a subcritical condition;
- (b) Provide sufficient radiation shielding and confinement;
- (c) Provide redundant sealing of confinement systems;
- (d) Provide adequate heat removal;
- (e) Facilitate decontamination to the extent practicable; and
- (f) Facilitate the retrieval of spent fuel from storage.

(2) The cask shall be designed to ensure safety of the fuel throughout the operating lifetime of the cask, under both normal and possible accident conditions.

(3) The limits and conditions shall be developed to ensure that the cask is operated in accordance with the design assumptions and intent.

(4) The SAR of the cask shall describe the assumptions and basis for the operational limits and conditions.

(5) All items important to safety for a cask shall be identified and classified on the basis of their safety function and safety significance.

(6) Appropriate margins shall be provided in the design of all items important to safety so as to take into account relevant wear out mechanisms and potential age related degradation, in order to ensure the capability of the item important to safety to perform necessary safety function throughout its design life.

(7) Provision shall be made for monitoring, testing, sampling and inspection to assess aging mechanisms predicted at the design stage and to identify unanticipated behavior or degradation that may occur in service.

(8) The design of the cask shall provide suitable measures to limit possible radiological impacts on the workers, the public and the environment.

(9) The concept of defence in depth shall be applied at the cask for the prevention and mitigation of accidents. The degree of application of each level of defence in depth shall be commensurate with the potential hazards associated with the spent fuel.

(10) Items important to safety shall be designed taking into account the site specific natural phenomena such as earthquakes, hurricanes, floods, fires etc., and for human-induced external events.

(11) The design of the cask shall provide adequate accessibility to facilitate inspection; testing and maintenance of items important to safety; and monitoring for radiation and contamination.

(12) If an item important to safety cannot be designed to be capable of being tested, inspected or monitored to the extent desirable, a robust technical justification shall be provided that incorporates the following approach:

- (a) Other proven alternatives or indirect methods, as the case may be; and

- (b) Conservative safety margins shall be applied or other appropriate precautions shall be taken to compensate for possible unanticipated failures.

(13) The design of the cask shall be such as to ensure that the consequences of credible failures of equipment or systems, both within and outside the facility, shall not exceed the limits.

(14) The cask used for storage of damaged fuel shall be designed to withstand the temperatures and pressures resulting from the residual heat of the spent fuel and from chemical reactions.

16. **Records and Reports.**—The certificate holder shall submit a written report to the Authority within thirty (30) days of discovery of a design or fabrication deficiency for any cask which has been delivered to a licensee, when the design or fabrication deficiency affects the ability of items important to safety to perform their intended safety function. Records of such reports shall be maintained and updated.

Schedule I

Design Certification Process for the Cask

(Refer Regulation 5(2))

The design certification process for the cask shall be as follows:

1. **Letter of Intent.**—The applicant shall notify in writing to the Chairman of his intention to design a cask as early as possible.

2. **Finalization of Applicable Codes and Standards.**—The applicant shall submit the list of codes and standards to be followed for design of the cask to the Authority for approval.

3. **Submission of Application for Design Approval Certificate.**—The applicant shall submit an application to the Authority, for obtaining a design approval certificate for the cask, along with the following documents in accordance with the approved codes and standards:

- (1) Safety Analysis Report
- (2) Management System Manual
- (3) Aging Management Program

(4) Surveillance and Testing Program

4. Provisional Acceptance of Design and Authorization for Manufacturing of Prototype Cask.—Following shall be the sequence of steps:

(1) Based on satisfactory review of documents mentioned in Section 3 of this Schedule, the design may provisionally be accepted by the Authority.

(2) The applicant shall ensure that the prototype cask is manufactured from licensed cask manufacturer only.

(3) The applicant shall submit the quality plan (Q-plan) to the Authority for the manufacturing of prototype cask revealing all the applicable tests required for qualification of the cask and selection of inspection control points by the Authority.

(4) Qualification of each test shall be a prerequisite to proceed for the next test.

(5) After completion of tests performed on the cask, the applicant shall submit test completion report, along with updated documents mentioned in Section 3 of this Schedule, to the Authority.

(6) In case of any modification in the design prior to the issuance of design approval certificate, the applicant shall submit a design modification case to the Authority for approval.

5. Issuance of Certificate.—Upon acceptance of the updated submissions and resolution of all safety issues, the Authority may issue a design approval certificate for the cask for such purpose, for such period, and with such terms and conditions as may be specified by the Authority in the certificate. The certificate may not be issued for more than twenty (20) years at once.

6. Amendment in Certificate.—(1) The certificate holder shall submit an application for the amendment in the design approval certificate to the Authority along with the relevant documents and applicable amendment fee as prescribed in Regulations on Licensing Fee by Pakistan Nuclear Regulatory Authority - (PAK/900).

(2) Upon approval of the submissions, the Authority may issue the amended design approval certificate.

7. **Revalidation of Certificate.**—(1) The certificate holder or a licensee using the cask, as the case may be, shall apply for the revalidation of design approval certificate of the cask six (6) months prior to expiry of the certificate along with the updated or revised documents, as the case may be, as mentioned in Section 3 of this Schedule.

(2) Upon approval of these documents, the certificate may be revalidated by the Authority for a period of up to twenty (20) years.

[Ref: PNRA-PPD-02(18)/15.]

MOHAMMAD SALEEM ZAFAR,
Member (Corporate).