

# NRRC Specific Regulations

## Uranium Exploration, Mining, and Milling

**NRRC-R-01-SR06**

**2024**



هيئة الرقابة النووية والإشعاعية  
Nuclear and Radiological Regulatory Commission

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## **Specific Regulation**

Uranium Exploration, Mining, and Milling

2024

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## Preamble

In accordance with the provisions of the Notification on and Authorization of Facilities and Activities with Radiation Sources Regulation (NRRC-R-02) approved by the NRRC's Board of Directors in resolution No. (R/1/1/2022), dated 20 April 2022, in chapter (5), section (16), article (36), and the provisions of the Licensing and Regulatory Oversight of Nuclear Facilities Regulation (NRRC-R-03) approved by the NRRC's Board of Directors in resolution No. (R/1/1/2022), dated 20 April 2022, in chapter (3), section (5), article (13), this specific regulation provides detailed requirements for the uranium exploration, mining, and milling activities and their relevant facilities.

This specific regulation has been prepared on the basis of the International Atomic Energy Agency (IAEA) standards, international best practices, and the experiences of similar international regulatory bodies, and in accordance with the Kingdom's relevant international commitments, and it has been approved by the NRRC's CEO resolution No. 2126, dated 12/6/2024.

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## **Chapter 1: Objective, Scope, and Definitions**

### **Section 1: Objective**

1. The objective of this Specific Regulation is to provide the regulatory requirements considering safety, security and safeguards for uranium exploration, mining, and milling activities and facilities for the purpose of protection of workers, members of the public and the environment from harmful effects of radiation exposures of these activities and facilities.

### **Section 2: Scope**

2. This Specific Regulation stipulates the requirements for notification and authorization for uranium exploration, uranium mining, and milling from conventional and unconventional Sources of Uranium.
3. This Specific regulation provides the requirements for uranium exploration, mining, and milling concerning the management system, radiation protection, operating procedures, security, accountancy and control, emergency preparedness, and radioactive waste management.

### **Section 3: Definitions**

#### ***Construction***

Construction means the installation of wells (e.g., drilling) associated with radiological operations (e.g., production, injection, or monitoring well networks associated with in-situ recovery or other facilities), excavation or the installation of foundations, or in-place assembly, erection, fabrication,

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or testing for any structure, system, or component of a facility or activity subject to the regulations in this part that are related to radiological safety or security.

### ***Core storage facility***

Storage that contains exploration core and other related samples from exploration, drilling, test pits, and test mining.

### ***Uranium exploration***

Prospecting for uranium [mineral] deposits by drilling, digging, excavation, adits, shafts or pits or other method to obtain samples of geological material to conduct assays, geological, geophysical, or geochemical analysis, to determine the presence of such deposits, their extent, quantity, quality, and mining viability.

### ***Long-lived radionuclides in airborne dust (LLRD)***

Uranium ore contains all elements of the uranium-238 ( $^{238}\text{U}$ ) and uranium-235 ( $^{235}\text{U}$ ) decay chains. From the perspective of internal exposure to LLRD, 238U, uranium-234 ( $^{234}\text{U}$ ), thorium-230 ( $^{230}\text{Th}$ ), radium-226 ( $^{226}\text{Ra}$ ), and polonium-210 ( $^{210}\text{Po}$ ) are the most significant radionuclides.

### ***Long-Term management plan***

A component of the decommissioning plan that identifies the activities required to ensure that a disposal facility is functioning properly after decommissioning. Activities would include environmental monitoring, geotechnical monitoring, inspections, contingency response actions, the Long-Term Management plan period, and other necessary information.



***Mill***

A facility at which ore is processed and treated to recover uranium concentrate, including any ore residue and water treatment system associated with the facility.

***Mine***

A location from which useful minerals or ores are extracted, whether from the surface or subsurface, or from seawater or natural water bodies from which evaporites are recovered.

***Ore concentrate***

An extracted product that contains uranium that could result from the physical or chemical separation of uranium from ore. This is also referred to as yellowcake and is considered a nuclear material.

***Performance condition***

A performance condition is an operational, safety, security, or radiological health characteristic that is assessed to determine if a facility is functioning properly.

***Performance level***

A performance level is a numeric value that is assigned to a performance condition that is measured, calculated, or monitored to determine if a specific performance condition indicates a proper functioning facility.

***Process(ing)***

Treating ore by mechanical, chemical, or other means to extract and produce an ore concentrate from ore.

### *Process hazard analysis*

A process hazard analysis is a data and information analysis strategy designed to identify particular threats to public and occupational health and safety and the manner in which these threats can be controlled and/or mitigated.

### *Radiological environmental impact assessment*

Assessment of the expected radiological impacts of facilities and activities on the environment for the purposes of protection of the public and protection of the environment against radiation risks.

### *Radon progeny*

The radioactive decay products of radon-222 ( $^{222}\text{Rn}$ ) of greatest significance to human health are as follows: bismuth-214 ( $^{214}\text{Bi}$ ), lead-214 ( $^{214}\text{Pb}$ ), polonium-214 ( $^{214}\text{Po}$ ) and polonium-218 ( $^{218}\text{Po}$ ).

**Note:** These radionuclides are generated when radon gas undergoes radioactive decay.  $^{218}\text{Po}$  and  $^{214}\text{Po}$  emit alpha particles and are responsible for the bulk of the dose to the respiratory tract resulting from inhaled radon. All four of these short-lived radon progenies have half-lives of less than 30 minutes. Also known as radon decay products.

### *Waste rock*

Waste rock means a naturally occurring material that is mined as part of the process to reach ore and has minimal or no economic value at the time the material is mined.

### ***Workplace***

A workplace is any area within a uranium mine or mill where a worker could reasonably be expected to be in the course of performing work.

### ***Unconventional Sources of Uranium***

Unconventional sources of uranium are ores, that contain other mineral resources that are the primary mining and processing targets.

### ***Uranium milling***

The process of extracting or concentration uranium from uranium ore or other uranium-bearing materials resulting in a uranium concentrate or other product that is packaged for further refining.

## **Chapter 2: General Principles**

### **Section 4: General Requirements**

4. No person shall commence any activity of mining, or milling to which this Specific Regulation applies without prior authorization by the NRRC.
5. Any person intending to conduct any activity under Article 2 of this Specific Regulation shall notify of such intention in writing to the NRRC. Notifications shall be prepared and submitted in accordance with the Regulation on Notification on and Authorization of Facilities and Activities with Radiation Sources (NRRC-R-02).
6. The authorized person shall grant the NRRC access to all licensed activities and facilities under this Specific Regulation for the purposes of inspections.

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7. The applicant shall submit information required by the NRRC for the purpose of this Specific Regulation.

### **Chapter 3: Regulatory Control**

#### **Section 5: Uranium Exploration Notification**

8. For uranium exploration activity, the NRRC shall be notified before commencing the exploration activity.
9. Considering the Regulation on Notification on and Authorization of Facilities and Activities with Radiation Sources (NRRC-R-02), the applicant shall proceed further for authorization if the risk associated with the activity or practice with a radiation source cannot be neglected in terms of radiation safety or security of radioactive material or is a subject to safeguards requirements.
10. For the purpose of the notification for uranium exploration, the applicant shall submit the following information to the NRRC:
  - a. A description of the type of uranium exploration activity to be conducted.
  - b. A map of the proposed area and the adjacent area surrounding with the information on natural springs, lakes, ponds, reservoirs, water pipelines, earthen dams, private and public water wells, buildings, and the tentative exploration site.
  - c. The approximate date upon which the uranium exploration activity will commence..

- d. The prospective assessment of potential presence of radioactive materials and plan for the implementation of radiation protection program and safety program in accordance with the requirements of the Regulation on Radiation Safety (NRRC-R-01).
- e. A description of any potential radioactive waste generation including its quantity, physicochemical properties, origin, and its handling with an appropriate disposal methodology.
- f. A proposal of an appropriate core storage facility and a description of samples preparation and radiation monitoring activities..
- g. Any other information required by the NRRC for the implementation of the requirements under this Specific Regulation.

### **Section 6: Mining Authorization**

- 11. For uranium mining activity, the following licenses are required:
  - a. A license for mining activity before commencing excavation or earthmoving works on the site.
  - b. A decommissioning license before commencing decommissioning activities.
- 12. When applying for a license for uranium mining activity, the applicant shall submit the following information to the NRRC:
  - a. A description of the proposed design of the mine facility installations or structures.

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- b. The mine master plan and the location of the mine site, a surface plan which indicates the boundaries of the mining activity, and the area where the activity to be licensed is proposed to be undertaken.
  - c. A description of the location of the mine including the topographic maps and relevant meteorological data.
  - d. A description of the geography, geology, ore deposit, mineralogy, geotechnical and seismic conditions, meteorology, and hydrological conditions for the site and surrounding region.
  - e. A radiological environmental impact assessment, including a radiological baseline characteristics study of the site and the surrounding area.
  - f. A description of all proposed laboratory facilities.
  - g. Contingency plans for construction and the measures to control the movement of water in existing waterways, if any.
  - h. A description of the radiation protection, and environmental monitoring programs.
  - i. Management system manual describing the management of quality and safety during the site preparation and operation phases.
  - j. The proposed commissioning plan for the components, systems, and equipment to be installed at the mine.
  - k. The amount of uranium ore that will be mined, including a description of the proposed methods for carrying on the activity, such as installations, excavations and/or underground activities.



- l. Preliminary plan for emergency arrangements.
  - m. The anticipated uranium mining schedule.
  - n. Anticipated quantities, categories, and classes of radioactive waste, predisposal management locations, proposed conditioning and treatment methods, and program and schedule for their removal and disposal. The types of radioactive waste streams shall be specified and include radioactive waste, other types of radioactive waste, recyclable material, and radioactive material that does not meet clearance levels.
  - o. A description of the proposed decommissioning plan consistent with the applicable requirements of the specific regulation on Decommissioning of of Radiation Facilities (NRRC-R-01-SR15).
13. When applying for a decommissioning license for a uranium mining activity, the applicant shall submit the following information to the NRRC:
- a. A final decommissioning plan consistent with the applicable requirements of the specific Regulation regulation on Decommissioning of of Radiation Facilities (NRRC-R-01-SR15).
  - b. A description of and the proposed schedule for the decommissioning work, and the rationale for the schedule.
  - c. A description of the land, buildings, structures, components, systems, equipment utilized for the storage of management of ore, and radioactive waste that will be affected by the decommissioning activity.

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- d. The proposed measures, methods, and programs for carrying on the decommissioning.
  - e. Management system manual describing the management of quality and safety during the decommissioning phase.
  - f. A description of the planned final site configuration upon completion of the decommissioning work.
  - g. A final radiological site survey plan incorporating appropriate clearance levels.
  - h. A radioactive waste management plan.
  - i. Long-Term Management Plan.
  - j. An update of the radiological environmental impact assessment and a program for radiation monitoring and surveillance in the environment of the facility.
  - k. Security arrangements considering the planned decommissioning activities.
  - l. Plan for emergency arrangements.
14. The authorized person shall comply with the applicable requirements in Chapter 4 of this specific regulation for each stage of the uranium mining licensing application.



**Section 7: Milling Authorization**

15. For a uranium milling activity and/or facility, the following licenses are required:
- a. A site license before commencing excavation or earthmoving works on the site.
  - b. A construction license before commencing the construction of the facility.
  - c. An operating license before commencing the operation of the facility.
  - d. A decommissioning license before commencing decommissioning activities.
16. When applying for a milling site license for a uranium milling activity and/or facility, the applicant shall submit the following information to the NRRC:
- a. A description of the proposed milling facility including the layout, boundaries of the mill, planned structures, controlled areas, and radioactive waste management.
  - b. A radiological environmental impact assessment, including a radiological baseline study on the site and surrounding area.

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- c. Site evaluation process and the results of the investigations, and a description of the preparatory work to be done at the site and in the surrounding area. The following shall be included:
- i. Description of the mill methods, including the installations, their purpose and capacity, and any excavations.
  - ii. Description and analysis of the geography, geology, ore deposit, mineralogy, geotechnical and seismic conditions, meteorology, and hydrological conditions for the site and surrounding region.
  - iii. Description of any activity that may have an impact on the development of the mill, including any past mining-related activity at the site before the date of submission of the application to the NRRC.
- d. Initial emergency preparedness plan.
- e. An initial security plan.
17. When applying for a construction license for a uranium milling activity and/or facility, the applicant shall submit the following information to the NRRC:
- a. A description of the design and the maintenance program for every locker/change room, eating and common employee assembly area.
  - b. The proposed construction program, including its schedule.
  - c. Preliminary plan for emergency arrangements.

- d. Management system manual describing the management of quality and safety during the construction phase.
  - e. A description of all proposed laboratory facilities.
  - f. A description of the proposed design and construction of the waste management systems, including the measures to monitor its construction, and the construction schedule.
  - g. The proposed commissioning plan for the components, systems, and equipment to be installed at the mill.
  - h. Contingency plans for construction and the measures to control the movement of water in existing waterways.
  - i. A preliminary security plan.
  - j. Proposed plan for the decommissioning of the mill consistent with the applicable requirements of the Regulation on Decommissioning of Nuclear Facilities (NRRC-R-10).
18. When applying for an operating license for a uranium milling activity and/or facility, the applicant shall submit the following information to the NRRC:
- a. A program for radiation monitoring in the environment of the milling facility.
  - b. Results of a process-hazard analysis, and a description of how those results have been addressed.
  - c. A description of the structures, components, systems, and equipment at the mill, including any changes to their design and their

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- design operating conditions as a result of the commissioning.
- d. Programs for maintenance and aging management.
  - e. The proposed operating schedule.
  - f. The proposed measures, strategy, methods, and procedures for extracting, handling, storing, loading, and transporting (in accordance with the Regulation on Safe Transport of Radioactive Materials (NRRC-R-15)) ore and ore concentrates, both solid and liquid.
  - g. Management system manual during the operating phase.
  - h. The daily and annual design capacity of the mill, and the expected recovery and composition of mill feed, concentrates and tailings.
  - i. Operational Limits and Conditions, which shall at least define the limits for the process quantities that affect the safety of the facility in various operating states.
  - j. A plan for emergency arrangements.
  - k. A description of the proposed operation of the radioactive waste predisposal and disposal facilities.
  - l. Occupational radiation protection program, including arrangements for designation of areas, standard operating procedures, monitoring of workers and the workplace, the health surveillance program, and provision and maintenance of personal protective equipment.



- m. Updated decommissioning plan consistent with the applicable requirements of the Regulation on Decommissioning of Nuclear Facilities (NRRC-R-10).
  - n. A plan for security arrangements, including security plans, cyber security plans and contingency plans.
19. When applying for a decommissioning license for a uranium milling activity and/or facility, the applicant shall submit the following information to the NRRC:
- a. A final decommissioning plan in accordance with the Regulation on Decommissioning of Nuclear Facilities (NRRC-R-10).
  - b. Management system manual during the decommissioning phase.
  - c. The proposed measures, methods, and programs to implement the decommissioning plan.
  - d. The land, buildings, structures, components, systems, equipment, radioactive material, and hazardous substances that will be affected by the decommissioning.
  - e. A description of and the proposed schedule for the decommissioning work, including the proposed starting date and the expected completion date of the decommissioning work and the rationale for the schedule.
  - f. A program for radiation monitoring in the environment of the milling facility incorporating appropriate clearance levels to be used.

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- g. A declaration that the decommissioning clearance levels shall be achieved.
  - h. A description of the planned final site configuration upon completion of the decommissioning work.
  - i. The quantities or volumes of all radioactive waste expected during the decommissioning activities, including a plan for the management of the expected waste.
  - j. A Long-Term Management plan and proposed measures, strategy, methods, and procedures for the radioactive materials on site (e.g., uranium tailings, waste rock, residues, and sludges, contaminated equipment) that cannot be released from the site.
  - k. A description and justification of proposed restrictions on future use of the site, if it is anticipated that this shall be necessary.
  - l. A plan for emergency arrangements.
  - m. A final security plan considering the planned decommissioning.
20. The authorized person shall comply with the applicable requirements in Chapter 4 of this specific regulation for each stage of the uranium milling licensing application.

### **Section 8: Long-Term Management**

21. When applying for a decommissioning license for a uranium milling or mining activity, the applicant shall submit a Long-Term Management plan description. Information required by the Long-Term Management plan includes the following:

- a. Expected Results of the decommissioning process.
  - b. Results of environmental monitoring programs.
  - c. Demonstration that the clearance levels have been met.
  - d. Proposed post-decommissioning monitoring, inspection, and maintenance activities.
22. Applicants shall propose a Long-Term Management plan period. This Long-Term Management plan period shall be approved by the NRRC.
23. Decommissioning of a mine or mill shall not be deemed complete until the clearance levels approved by the NRRC have been achieved.

#### **Section 9: Unconventional Sources of Uranium**

24. Persons who mine and mill unconventional sources of uranium and who produce ore concentrates shall obtain the proper NRRC's authorization as per this specific regulation.
25. Only those facilities and/or activities that solely involve nuclear material (ore concentrates) and radioactive waste shall be subject to the provisions of this Specific Regulation.

### **Chapter 4: Obligations of Authorized Person**

#### **Section 10: Management System**

26. The authorized person shall comply with the management system requirements defined in the Regulation on Leadership and Management for Safety (NRRC-R-04).

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27. Performance specifications shall include specific performance conditions and performance levels.
  28. The authorized person shall investigate and promptly document causes, and corrective actions related to any defect due to design or malfunction discovered in equipment or working procedures which is likely to significantly endanger the safety and security activities and facilities.

### **Section 11: Radiation Protection**

29. The authorized persons shall comply with the radiation protection requirements defined in the Regulation on Radiation Safety (NRRC-R-01).
30. For the purpose of keeping a record of radiological doses to workers employed in Controlled Areas, the authorized person shall monitor and document the magnitude of internal inhalation exposures to airborne radon progeny and long-lived radioactive dust (LLRD), as well as external exposure to gamma radiation.
31. The authorized person shall minimize or prevent inhalation and/or ingestion intakes with appropriate procedures for contamination control, personal protective equipment, and proper industrial hygiene.
32. Any known or suspected accidental inhalation or ingestion event shall be evaluated to estimate and document intakes for use in the calculation of annual internal dose to affected workers.





33. The authorized person shall provide every worker who is to enter a controlled area with a direct-reading dosimeter and/or cumulative dose personal dosimeter.
34. The authorized person shall document the dose data for each worker.
35. The authorized person shall define dose constraints and discharge limits to be approved by the NRRC to ensure adequate levels of radiation protection to workers, members of the public, and the environment.
36. The authorized person shall make every effort to inform persons living in the vicinity of the mine or mill of the general nature and characteristics of the anticipated effects of the activity to be licensed on the environment and the health and safety of persons and measures being taken to ensure that facilities are designed, constructed, and operated to keep exposures to ionizing radiation and discharges of radioactive materials as low as reasonably achievable (ALARA).
37. The authorized person shall ensure that all workers are, upon commencing work, properly instructed in the radiation protection aspects of their work and in the precautions necessary to control their radiation exposure below the limits and as low as reasonably achievable (ALARA), to avoid radiation incidents and accidents and that reinstruction of workers is undertaken at appropriate intervals, at a minimum of annually.
38. The authorized person shall prepare, maintain, and ensure appropriate ventilation and dust control methods and equipment for controlling air quality, including a maintenance program.



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39. The authorized person shall ensure the use of respiratory protection when required to keep the internal inhalation exposures below the limits.
  40. Before deploying respirators, each worker shall be medically cleared to wear a respirator, and procedures for respirator use, care and maintenance, identification of potential leakage following use, and proper storage shall have been prepared.
  41. The authorized person shall ensure the availability and visibility of appropriate signage at all entrances to all controlled areas. The authorized person shall designate the area as a controlled area and indicate the dose rate of gamma radiation in any designated radiation area continuously.
  42. The authorized person shall notify the NRRC promptly of any changes in operation, or operating conditions or other matters which are likely to significantly increase radiation exposure to workers, members of the public or the environment.

## **Section 12: Operating Procedures**

43. The authorized person shall establish, implement, and maintain written operating procedures for the licensed activity in accordance with the applicable requirements defined in the Regulation on Operations of Nuclear Facilities (NRRC-R-09).

44. The authorized persons shall comply with the Operational Limits and Conditions (OLCs) requirements defined in the Regulation on Operations of Nuclear Facilities (NRRC-R-09).
45. Operational Limits and Conditions (OLCs) shall have the following characteristics:
  - a. Operational Limits and Conditions (OLCs) are designed to provide early warning of an imminent safety or security concern. If exceeded, corrective actions shall be taken to identify causes and prevent recurrence.
  - b. Operational Limits and Conditions (OLCs) are set at measurable engineering values, concentrations, or radiological doses that the applicant considers appropriate and have been approved by the NRRC.
46. Operational Limits and Conditions (OLCs) shall include the following:
  - a. A description by the applicant or authorized person of any action that the applicant shall take if an operational limit is reached.
  - b. Reporting procedures that shall be followed if an operational limit is reached.

### **Section 13: Radioactive Waste Management**

47. The authorized person shall ensure compliance with the applicable requirements of Regulation on Management of Radioactive Waste (NRRC-R-16).

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48. The authorized person shall develop and implement measures to control the spread of any radioactive contamination.
  49. The authorized person shall ensure that radioactive waste is managed by means of the best practicable technology and that exposures to ionizing radiation resulting from the management and disposition of radioactive waste are as low as reasonably achievable (ALARA).

#### **Section 14: Security**

50. The authorized person shall ensure compliance with the applicable requirements defined in the Regulation on Nuclear Security (NRRC-R-11) and the Regulation on Security of Radioactive Materials (NRRC-R-17) and the security plan approved by the NRRC.
51. The security plan shall include processes to maintain security based on the threat and risk assessment of the products associated with uranium mining and milling. It shall include a detection, delay response system and measures to mitigate the effects of a nuclear security event that could result in loss or releases of radioactive material impacting health and safety of persons or the environment.
52. As the uranium concentration within a process increases, the authorized person shall enhance nuclear security measures to protect the uranium in process, storage, and transit using the concept of a “graded approach” as defined in the Regulation on Nuclear Security (NRRC-R-11).



**Section 15: Accountancy, Control, and Non-Proliferation**

53. The authorized person shall establish and maintain a system of accounting and control of nuclear material (NMAC) in accordance with the Regulation on Nuclear Material Accountancy and Control (NRRC-R-12).
54. The authorized person shall provide the NRRC with an annual declaration, containing information specifying the location, operational status and estimated annual production capacity of uranium mines and milling.
55. Prior to any import, export or shipment of nuclear material including ore and ore concentrate, the authorized person shall submit an application of permit of such activity to the NRRC.
56. After any imports and exports of nuclear materials including ore and ore concentrate have been successfully accepted by the receiving party, the authorized person shall notify the NRRC.
57. For nuclear-related items, the authorized person shall ensure compliance with the applicable requirements of the Regulation on Authorization and Regulatory Control of Nuclear-Related Items (NRRC-R-18).

**Section 16: Incidents, Accidents and Emergency Preparedness**

58. The authorized person shall ensure compliance with the applicable requirements of the Regulation on Nuclear Facilities Emergency Preparedness and Response (NRRC-R-14).

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59. The authorized person is responsible to remediate.
  60. If the authorized person experiences a release from a mining or milling operation, the NRRC shall be notified.
  61. The mitigation of a release and its consequences shall commence as soon as possible. Any delay in the mitigation of a release must be reported to the NRRC and a mitigation schedule must be submitted and approved by the NRRC. The release mitigation shall be deemed complete when the defect is brought under control and approved by the NRRC.





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*King Fahd National Library Cataloging-in-Publication Data*

L.D. no. 1446/334

ISBN: 978-603-05-0627-9







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