

**INTEGRATED
REGULATORY
REVIEW SERVICE (IRRS)
MISSION
TO
The Hashemite Kingdom of Jordan**

Amman, Jordan

14 to 25 June 2014

DEPARTMENT OF NUCLEAR SAFETY AND SECURITY



Integrated
Regulatory
Review Service
IRRS



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INTEGRATED REGULATORY REVIEW SERVICE (IRRS)
REPORT TO
THE HASHEMITE KINGDOM OF JORDAN

Mission date: *14 to 25 June 2014*

Regulatory body: *Energy and Minerals Regulatory Commission (EMRC)*

Location: *Amman, Jordan*

Regulated facilities and activities: *Radiation sources in industrial and medical facilities, research facilities, transport, emergency preparedness and response, medical exposure, occupational exposure*

Organized by: *International Atomic Energy Agency*

IRRS REVIEW TEAM

| | |
|---------------------------|------------------------------------|
| LOY John | Team Leader (United Arab Emirates) |
| VLAHOV Nikolay | Deputy Team Leader (Bulgaria) |
| BSAT Hassan | Reviewer (Lebanon) |
| CEYHAN Mehmet | Reviewer (Turkey) |
| FASSI FEHRI Majid | Reviewer (Canada) |
| EL-MONGY Sayed Ali Hassan | Reviewer (Egypt) |
| FENNELL Stephen | Reviewer (Ireland) |
| HUNT John | Reviewer (Brazil) |
| JACKSON Terry | Reviewer (USA) |
| NIZAMSKA Marina | Reviewer (Bulgaria) |
| ÖHLÉN Elisabeth | Reviewer (Sweden) |
| RUEL Delphine | Reviewer (France) |
| GAN PekYen | Observer (Malaysia) |
| SHIMA Masakazu | Observer (Japan) |
| MANSOUX Hilaire | IAEA Team Coordinator |
| JONES Geoffrey | IAEA Deputy Team Coordinator |
| SALINAS Rodrigo | IAEA Review Area Facilitator |
| SWOBODA Zumi | IAEA Administrative Assistant |

The number of recommendations, suggestions and good practices is in no way a measure of the status of the regulatory body. Comparisons of such numbers between IRRS reports from different countries should not be attempted.

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EXECUTIVE SUMMARY

At the request of the Government of The Hashemite Kingdom of Jordan, an international team of senior safety experts met representatives of the Energy and Minerals Regulatory Commission (EMRC)¹ from 14 to 25 June 2014 to conduct an Integrated Regulatory Review Service (IRRS) mission. The purpose of the peer review was to review the Jordanian regulatory framework for nuclear and radiation safety.

The review compared the Jordanian regulatory framework for nuclear and radiation safety against the IAEA safety standards as the international benchmark for safety. The mission was also used to exchange information and experience between the IRRS review team members and the Jordanian counterparts in the areas covered by the IRRS.

The IRRS review team consisted of 12 senior regulatory experts from 11 IAEA Member States, 2 observers, 3 IAEA staff members and 1 IAEA administrative assistant. The IRRS review team carried out the review in the following areas: responsibilities and functions of the government; the global nuclear safety regime; responsibilities and functions of the regulatory body; the management system of the regulatory body; the activities of the regulatory body including the authorization, review and assessment, inspection and enforcement processes; development and content of regulations and guides; emergency preparedness and response; occupational radiation protection, patient protection, transport and the tailored module for countries embarking on nuclear power.

In addition, policy issues were discussed, including independence of the regulatory body and capacity building for current and future activities of the regulatory body.

The IRRS review addressed all facilities and activities regulated by EMRC.

The mission included observations of regulatory activities and interviews and discussions with EMRC staff, EMRC commissioners, representatives from the Jordan Atomic Energy Commission (JAEC) and the Health and Environment Ministries, to help assess the effectiveness of the regulatory system. Visits were also performed to King Hussein Cancer Centre, the Jordan Research and Training Reactor (JRTR), the Gamma Irradiator, the Interim Waste Storage Facility, the Jordan Subcritical Assembly (JSA), Jordan University for Science & Technology (JUST). The IRRS team members observed the working practices during inspections carried out by EMRC, including discussions with the licensee personnel and management.

EMRC provided the IRRS review team with advanced reference material and documentation including the results of the self-assessment in all areas within the scope of the mission. Throughout the mission, the IRRS review team was extended full cooperation in regulatory, technical, and policy issues by all parties; in particular, the staff of EMRC provided the fullest practicable assistance and demonstrated extensive openness and transparency.

¹ At the time of the request, and throughout the preparation of the mission, the national organization in charge of regulatory oversight for nuclear and radiation safety was the Jordan Nuclear Regulatory Commission (JNRC). JNRC was merged in EMRC in April 2014. EMRC is the merging of three different regulatory organisations within the Ministry of Energy. This report systematically addresses EMRC, and leaves to the context of each section if it is the whole organization or the divisions involved in the nuclear and radiation safety regulatory activities.

The IRRS review team made the following general observations:

- The nuclear and radiation safety regulatory body in Jordan is a relatively young organization that was already facing large challenges in terms of its regulatory workload, building its management system and recruiting and retaining the numbers of staff required and improving their training. It now also faces the challenge of operating as a part of a new body that has merged it with other regulators with quite different objectives, while it is also preparing to regulate the establishment of a nuclear power programme.
- The new EMRC structure and the revision of the relevant law represent important opportunities to strengthen Jordan's nuclear and radiation safety regulatory infrastructure.
- While the Government has shown its commitment to nuclear and radiation safety through its enactment of the law and by becoming a party to international conventions, there would be value in demonstrating that commitment through adoption of a formal national policy and strategy for safety. Such a policy could show also the Government's commitment to the independence of regulatory decision-making in this area by further defining the role of the Minister of Energy vis a vis EMRC.

The IRRS review team identified a number of good practices and made recommendations and suggestions that indicate where improvements are necessary or desirable to continue enhancing the effectiveness of regulatory functions in line with the IAEA Safety Standards.

The good practices identified by the IRRS review team are the following:

- Jordan is contributing to and making good use of the global nuclear safety regime;
- EMRC is promoting safety culture, including through inventive ways;
- Orphan and disused radioactive sources are transferred for safe storage to a radioactive waste storage facility;
- EMRC has a resident inspector at the construction site of the JRTR.

The IRRS review team identified certain issues warranting attention or in need of improvement and believes that consideration of these would enhance the overall performance of the regulatory system:

- The government should ensure that EMRC is provided with adequate human resources with the necessary competence to effectively regulate nuclear and radiation risks in the country;
- EMRC should continue working on its human resources development planning and establish its internal systematic training programme for current and new staff. As a part of the human resource planning, the Government and EMRC should identify and implement innovative approaches to attract and retain highly qualified staff;
- EMRC should continue to improve its integrated management system, particularly to define, document and implement the core regulatory processes and functions;
- EMRC should more effectively use a graded approach based upon radiation risks associated with facilities and activities in its processes for licensing and review and assessment and in formulating its inspection programme to allow it to focus on higher priority areas;
- The Government and EMRC should complete the regulatory framework as soon as possible by issuing the regulations and instructions that have been in draft for some time. EMRC should also develop guides to support regulation, particularly relating to control of medical and occupational exposures;

- The Government should ensure that formal coordination arrangements are established between EMRC and other Government agencies including the Ministries of Health, Interior, Environment and Labour;
- In further developing the legal and regulatory framework for nuclear and radiation safety, the Government and EMRC should also include the specific requirements for a nuclear power programme.

The IRRS review team findings are summarized in Appendix V. The IRRS review team findings related to the tailored module for countries embarking on nuclear power are given in Appendix VI.

An IAEA press release was issued at the end of the IRRS mission.

I. INTRODUCTION

At the request of the Government of The Hashemite Kingdom of Jordan, an international team of senior safety experts met representatives of the Energy and Minerals Regulatory Commission (EMRC) from 14 to 25 June 2014 to conduct an Integrated Regulatory Review Service (IRRS) mission. The purpose of the peer review was to review the Jordanian regulatory framework for nuclear and radiation safety. The review mission was formally requested by the Government of Jordan in October 2012. An IRRS preparatory mission was conducted, 11-12 December 2013, at Jordan Nuclear Regulatory Commission (JNRC) Headquarters in Amman to discuss the purpose, objectives, scope and detailed preparations of the review in connection with the facilities and activities regulated by JNRC and selected safety aspects. Since the IRRS preparatory mission, JNRC has been discontinued and its rights and assets were devolved to EMRC in April 2014.

The IRRS review team consisted of 12 senior regulatory experts from 11 IAEA Member States, 2 observers, 3 IAEA staff members and 1 IAEA administrative assistant. The IRRS review team carried out the review in the following areas: responsibilities and functions of the government; the global nuclear safety regime; responsibilities and functions of the regulatory body; the management system of the regulatory body; the activities of the regulatory body including the authorization, review and assessment, inspection and enforcement processes; development and content of regulations and guides; emergency preparedness and response; occupational radiation protection, patient protection, transport and the tailored module for countries embarking on nuclear power.

EMRC conducted a self-assessment in preparation for the mission but did not prepare a preliminary action plan. The results of EMRC's self-assessment and supporting documentation were provided to the IRRS review team as advance reference material for the mission. During the mission the IRRS review team performed a systematic review of all topics by reviewing the advance reference material, conducting interviews with management and staff from EMRC and performed direct observation of EMRC working practices during inspections. Meetings with the Ministry of Health and Ministry of Environment were organized and discussions were held with EMRC Board of Commissioners and also with representatives of the Jordan Atomic Energy Commission (JAEC).

All through the mission the IRRS team received excellent support and cooperation from EMRC.

II. OBJECTIVE AND SCOPE

The purpose of this IRRS mission was to conduct a review of Jordan's nuclear and radiation safety regulatory framework and activities to review its effectiveness and to exchange information and experience in the areas covered by the IRRS. The IRRS review scope included all facilities and activities regulated by EMRC. The review was carried out by comparison of existing arrangements against the IAEA safety standards.

It is expected that the IRRS mission will facilitate regulatory improvements in Jordan and other Member States from the knowledge gained and experiences shared between EMRC and IRRS reviewers and through the evaluation of the effectiveness of the Jordanian regulatory framework for nuclear and radiation safety and its good practices.

The key objectives of this mission were to enhance nuclear and radiation safety, and emergency preparedness and response:

- Providing Jordan and EMRC, through completion of the IRRS questionnaire, with an opportunity for self-assessment of its activities against IAEA safety standards;
- Providing Jordan and EMRC with a review of its regulatory programme and policy issues relating to nuclear and radiation safety, and emergency preparedness and response;
- Providing Jordan and EMRC with an objective evaluation of its nuclear safety, and emergency preparedness and response regulatory activities with respect to IAEA safety standards;
- Contributing to the harmonization of regulatory approaches among IAEA Member States;
- Promoting the sharing of experience and exchange of lessons learned;
- Providing reviewers from IAEA Member States and the IAEA staff with opportunities to broaden their experience and knowledge of their own fields;
- Providing key EMRC staff with an opportunity to discuss their practices with reviewers who have experience with different practices in the same field;
- Providing Jordan and EMRC with recommendations and suggestions for improvement; and
- Providing other States with information regarding good practices identified in the course of the review.

III. BASIS FOR THE REVIEW

A) PREPARATORY WORK AND IAEA REVIEW TEAM

At the request of the Government of The Hashemite Kingdom of Jordan, an IRRS preparatory meeting was conducted from 11 to 12 December 2013. The IRRS preparatory meeting was carried out by the appointed Team Leader Mr John Loy, Deputy Team Leader Mr Nikolay Vlakhov and the IRRS IAEA Team representatives, Mr Hilaire Mansoux, Team Coordinator and Mr Geoffrey Jones, Deputy Team Coordinator.

The IRRS preparatory mission team had discussions regarding regulatory programmes and policy issues with the senior management of JNRC represented by Dr. Majd Hawwari, JNRC Chairman, other senior management and staff. The discussions resulted in agreement that the regulatory functions covering the following facilities and activities were to be reviewed by the IRRS mission:

- Research reactor;
- Waste facilities;
- Radiation sources facilities;
- Transport;
- Patient protection;
- Occupational radiation protection;
- Selected policy issues.

JNRC Directors made presentations on the national context, the current status of JNRC and the self-assessment results to date.

IAEA staff presented the IRRS principles, process and methodology. This was followed by a discussion on the tentative work plan for the implementation of the IRRS in Jordan in June 2014.

The proposed IRRS review team composition (senior regulators from Member States to be involved in the review) was discussed and the size of the IRRS review team was tentatively confirmed. Logistics including meeting and work space, counterparts and Liaison Officer identification, proposed site visits, lodging and transportation arrangements were also addressed.

The JNRC Liaison Officer for the preparatory meeting and the IRRS mission was Mr. Tamer Kasht.

JNRC provided IAEA (and the review team) with the advance reference material for the review at the end of April 2014, including the self-assessment results. In preparation for the mission, the IAEA review team members conducted a review of the advance reference material and provided their initial review comments to the IAEA Team Coordinator prior to the commencement of the IRRS mission.

B) REFERENCE FOR THE REVIEW

The most relevant IAEA safety standards and the Code of Conduct on the Safety and Security of Radioactive Sources were used as review criteria. A more complete list of IAEA publications used as the reference for this mission is given in Appendix VII.

C) CONDUCT OF THE REVIEW

An opening IRRS Review team meeting was conducted on Saturday, 14 June, 2014 in Amman by the IRRS Team Leader and the IRRS IAEA Team Coordinator to discuss the general overview, the focus areas and specific issues of the mission, to clarify the basis for the review and the background, context and objectives of the IRRS and to agree on the methodology for the review and the evaluation among all reviewers. They also presented the agenda for the mission.

The Liaison Officer was present at the opening IRRS review team meeting, in accordance with the IRRS guidelines, and presented logistical arrangements planned for the mission.

The reviewers also reported their first impressions of the advance reference material.

The IRRS entrance meeting was held on Sunday, 15 June 2014, with the participation of EMRC senior management and staff. Opening remarks were made by EMRC Chairman H.E. Eng. Farouq Al-Hyari, and IRRS Team Leader Mr John Loy. JAEC Chairman H.E. Dr. Khaled Toukan and EMRC Commissioner H.E. Dr Majd Hawwari gave an overview of the Jordan context and EMRC activities.

During the mission, a review was conducted for all the review areas with the objective of providing Jordan and EMRC with recommendations and suggestions for improvement as well as identifying good practices. The review was conducted through meetings, interviews and discussions, visits to facilities and direct observations regarding the national practices and activities.

The IRRS review team performed its activities based on the mission programme given in Appendix II.

The IRRS exit meeting was held on Wednesday, 25 June 2014. The opening remarks at the exit meeting were presented by EMRC Commissioner Dr. Majd Hawwari and EMRC Chairman Eng. Farouq Al-Hyar, and were followed by the presentation of the results of the mission by the IRRS Team Leader Mr John Loy. Closing remarks were made by Mr Denis Flory, IAEA, Deputy Director General, Department of Nuclear Safety and Security.

An IAEA press release was issued at the end of the exit meeting.

1. RESPONSIBILITIES AND FUNCTIONS OF THE GOVERNMENT

1.1. NATIONAL POLICY AND STRATEGY FOR SAFETY

The IRRS team was advised that the Government of Jordan regards the national policy and strategy for safety as being established through laws, particularly the law establishing the regulatory body, regulations and instructions. It affirms its commitment to safety by becoming a party to most of the relevant international conventions, including the Convention on Nuclear Safety.

The internationally accepted fundamental safety objective and most of the fundamental safety principles as stated in the IAEA SF-1 are incorporated in the Regulation on Safe Use of Nuclear Energy No (43) of 2014. However, the IRRS team could not find a standalone comprehensive national policy document outlining Jordan's commitment to the Fundamental Safety Principles and a strategy for their implementation, including a commitment to the provisions of human and financial resources, the scope of legal provisions, and the promotion of leadership and management for safety, including safety culture.

The IRRS team noted that Law No (43) of 2007, "Radiation Protection and Nuclear Safety and Security Law," included as an objective of the regulatory body the "formulation of the general policy in the field of radiation protection, and nuclear safety and security, and submit it to the cabinet for endorsement." The IRRS team understands that a similar provision is included in the draft of the new law.

The IRRS team acknowledged the dedication of the Government of Jordan to demonstrate its commitments by real actions, but has concluded that the establishment of a comprehensive national policy and strategy for safety would be beneficial, especially for a country considering embarking on a nuclear power programme. Such a policy and strategy could be developed through implementing the provision in the law mentioned above. Attention should be paid to the application of a graded approach by the government and by the regulatory body. Additional discussion regarding an integrated nuclear power programme is provided in Section 11.2.1 of this report.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
|---|---|
| | Observation: Jordan demonstrates its commitment to safety through its legal and regulatory framework and by being a party to international conventions but no national policy document exists that represents the Jordanian national policy and strategy for safety. |
| (1) | BASIS: GSR Part 1, Requirement 1 states that <i>"The government shall establish a national policy and strategy for safety, the implementation of which shall be subject to a graded approach in accordance with national circumstances and with the radiation risks associated with facilities and activities, to achieve the fundamental safety objective and to apply the fundamental safety principles established in the Safety Fundamentals."</i> |
| (2) | BASIS: GSR Part 1, para. 2.3 states that <i>"National policy and strategy for safety shall express a long term commitment to safety. The national policy shall be promulgated as a statement of the government's intent. The strategy shall set out the mechanisms for implementing the national policy."</i> |
| R1 | Recommendation: The Government should establish and publish a national policy and strategy for safety on the basis of consideration of a formulation of the policy prepared by EMRC. |

1.2. ESTABLISHMENT OF A FRAMEWORK FOR SAFETY

Law No (43) of 2007 established the regulatory body and defined its main functions, provided the basis for inspection of facilities and activities and for the enforcement of regulations. Law No. (17) of 2014 discontinued the JNRC and named EMRC as its successor organization. Law No (43) of 2007 continued in effect in other respects and will form the basis of a new law being drafted.

The IRRS team review of Law No (43) of 2007 identified that some important prerequisites for the establishment of an effective safety framework are missing from the law and are recommended to be covered by the new law. In particular, the law should clearly assign prime responsibility for safety to the licence holder or operator. This is an important principle, one of the Safety Fundamentals, and needs to be established definitively in the law. The IRRS team is also of the view that the powers of inspectors to enter licensee premises should be clearly established.

One main legal document that supports an effective governmental, legal and regulatory framework for safety is the Regulation on the Safe Use of Nuclear Energy No (43) of 2014, which specifies some of the fundamental safety principles. No equivalent basic radiation protection regulation has, however, yet been completed.

Law No (43) of 2007 provided for the Cabinet to issue regulations, including a number of technical regulations that are vital to nuclear safety. EMRC drafted the following regulations of those required by the 2007 law:

- Regulation on the Safe Use of Nuclear Energy (2014);
- Regulation on the Basis and Conditions for Granting Licenses and Permits for the Radiation Work (2013);
- Regulation on the Fees for Licenses and Permits for the Radiation Work (2013);
- Regulation of Radiation Protection (draft);
- Regulation on the Management and Treatment of Radioactive Waste and Spent Fuel (draft);
- Regulation on the Transport of Radioactive Materials (draft);
- Regulation on the Extracting, Mining and Processing of the Nuclear Materials (draft).

Several regulations have been in draft form for a number of years; others have been submitted to the Government, but not as yet issued. There will be many demands placed on the regulatory system in the future; this work from the past should be completed as soon as possible.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

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| | Observation: Several elements for an effective governmental and legal framework for safety are missing from the existing law. |
| (1) | BASIS: GSR Part 1 para. 2.5 states that <i>“The government shall promulgate laws and statutes to make provision for an effective governmental, legal and regulatory framework for safety. This framework for safety shall set out the following:</i> <i>(5) Provision for the involvement of interested parties and for their input to decision making;</i> <i>(6) Provision for assigning legal responsibility for safety to the persons or organizations responsible for the facilities and activities, and for ensuring the continuity of responsibility where activities are carried out by several persons or organizations successively;</i> <i>(11) Provision for appeals against decisions of the regulatory body;</i> <i>(12) Provision for preparedness for, and response to, a nuclear or radiological emergency;</i> <i>(17) The criteria for release from regulatory control;”</i> |

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

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| R2 | <p>Recommendation: The government should ensure that the proposed new law addresses the following issues in accordance with GSR Part 1:</p> <ul style="list-style-type: none"> – Assigning prime responsibility for safety to the operator – Provision for appeals against decisions of the regulatory body – Provision for preparedness for, and response to, a nuclear or radiological emergency – Criteria for release from regulatory control – Clear powers for inspectors – Involvement of interested parties and for their input to decision making <p>Note: This Recommendation also covers issues raised in sections 1.3, 1.4, 3.6, 5.2, 7.1.3, 8.1, 11.2.3.</p> |
| | <p>Observation: A number of regulations and instructions have been in draft form for the last few years without being issued.</p> |
| (1) | <p>BASIS: GSR Part 1, Requirement 2 states that <i>“The government shall establish and maintain an appropriate governmental, legal and regulatory framework for safety within which responsibilities are clearly allocated”</i>.</p> |
| R3 | <p>Recommendation: The government should, working with EMRC and as a matter of urgency, complete the regulations and instructions that are currently in a draft form and ensure that the remainder of the regulatory framework is established as soon as possible.</p> <p>Note: This Recommendation also covers issues raised in sections 3.6, 9.1.1, 9.2, 9.3, 9.4, 9.5, 11.2.4, 11.2.19.</p> |

1.3. ESTABLISHMENT OF A REGULATORY BODY AND ITS INDEPENDENCE

Until April 2014, the regulatory authority for nuclear and radiation safety was the JNRC, established by the Law No. (43) of 2007. By Law No. (17) of 2014 (the restructuring law), published in the Official Gazette on 30 April 2014, the government of Jordan implemented a major administrative reform, which included joining of a number of state authorities under a common management, depending on the area they are involved. JNRC, as a body under the Ministry of Energy, was combined with the regulatory functions of the Natural Resources Authority and the Electricity Regulatory Commission to form the new regulatory authority, the EMRC. In legal terms, the Electricity Regulatory Commission was re-named to be EMRC and a letter from the Prime Minister to the Minister of Energy, conferred the powers of the previous regulators, including the JNRC, on the Chief Executive Officer (CEO) of EMRC.

The restructuring law makes clear that, while the role of the JNRC is now taken up by the new EMRC, the regulatory provisions of Law No (43) of 2007 continues to apply, as do the regulations and instructions issued under that Law.

The new Commission is made up of a CEO and four other Commissioners. The former head of the JNRC has been appointed as a Commissioner.

A new law, the Energy and Minerals law, is currently being drafted. The IRRS team’s recommendations for matters to be covered by the new law are set out in Recommendation 2.

As a result of the restructuring, the nuclear and radiation safety regulator in Jordan is now included as part of a regulatory body that is also concerned with very different issues, such as regulation of the generation and distribution and retail price of electricity and the regulation of mining. This is an approach that is novel in the experience of the IRRS team. It is not at all clear how the new

Commission will function, particularly in areas of potentially overlapping jurisdiction, including the nuclear and safety regulation of nuclear power plants, regulation of uranium mining, and that of ensuring reliable electricity supply, where the balancing of the interests of stakeholders required as a part of electricity and mining regulation could clash with the overriding commitment to nuclear and radiation safety demanded of that regulation. On the other hand, it may assist the nuclear and radiation safety regulator to be a part of a larger body in terms of influence in the government and access to management support and resources.

There remains the issue of the reporting line for the regulatory body being to the Minister of Energy (the draft of the new law in English translation refers to the Commission being ‘attached’ to the Minister). It is the proper role of the Minister to promote and support the energy sector, with nuclear power having been determined to be a part of the energy mix. The Minister is responsible for recommending the appointment of Commissioners to the Cabinet. This “attachment” to the Minister of Energy was also the case with the JNRC. Had that arrangement remained in place at the time of the Mission, the IRRS team, working on the basis of Requirement 4 of GSR Part 1, would very likely have made a recommendation to urge that the JNRC be attached to another Minister. The IRRS team accepts that this is unlikely to be an option for EMRC, given its other energy and minerals sector roles.

EMRC counterparts and other interlocutors, notably during the policy discussion on the issue of independence, assured the IRRS team that the Minister for Energy had no role in regulatory decision-making and that the reporting line was only for accountability to the Parliament. It was also pointed out that the Ministry did not own or operate projects in the energy sector and that promotion of nuclear energy was the role of JAEC. While accepting these assurances, nonetheless the IRRS team is of the view that the issue of the potential for undue influence that might compromise safety needs to be clarified further. As Jordan proceeds with the development of nuclear energy, this issue is likely to rise in significance in the international perspective of the Jordan nuclear programme.

The making of the policy and strategy for safety may represent an opportunity to clarify the independence of EMRC.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| | Observation: The nuclear and radiation safety regulator is now included in an organization with other roles that could conflict with its overall mission to ensure nuclear safety. In addition, EMRC is attached to a Ministry, whose role includes promotion of the energy sector, including nuclear energy. |
| (1) | BASIS: GSR Part 1, Requirement 4 states that <i>“The government shall ensure that the regulatory body is effectively independent in its safety related decision making and that it has functional separation from entities having responsibilities or interests that could unduly influence its decision making.”</i> |
| R4 | Recommendation: The Government, in the law and in its policy and strategy for safety, and EMRC, in its internal procedures, should clarify the role and authority of each separate regulatory function of EMRC so that all regulatory judgements and decisions have sound technical basis and are free from undue influences on its regulatory decision-making. Note: This Recommendation also covers issues raised in sections 3.1, 3.2, 11.2.3. |

1.4. COMPLIANCE WITH REGULATIONS AND RESPONSIBILITY FOR SAFETY

As noted in Recommendation 2 above, the new law should explicitly allocate the responsibility for safety as lying with the person or organization responsible for a facility or activity. It appears to the IRRS team that the Law No (43) of 2007 allows for the regulatory body to ensure that the

responsibility for safety covers all stages in the lifetime of a facility and activity and enables the control of transfer of responsibility. The law is clear that compliance with regulations is binding on licensees.

1.5. COORDINATION OF AUTHORITIES WITH RESPONSIBILITIES FOR SAFETY WITHIN THE REGULATORY FRAMEWORK

Law No (43) of 2007 provided for broad objectives for the regulatory body aimed to be achieved “in coordination with relevant authorities.” The power to licence persons to establish, operate or manage nuclear facilities and to conduct activities with radioactive sources or to use ionizing radiation for work lies with EMRC; there are no other government agencies having direct overlapping responsibilities for licensing of facilities and activities applying ionizing radiation.

There are a number of government agencies whose responsibilities necessarily impinge on the role of EMRC. The most significant of these include the Ministry of Health (MoH), which operates government hospitals and clinics and regulates the private health sector; the Ministry of Environment that oversees environmental impact assessment and environmental monitoring; the Ministry of Labour that oversees conventional industrial safety; and a number of agencies involved in emergency response activities. Both the Ministry of Health and the Ministry of Environment were represented on the Board of the JNRC; but this no longer applies with EMRC. The responsibility of EMRC for border monitoring also brings it into contact with border control agencies.

The IRRS team was advised that a formal agreement was reached between EMRC and the Ministry of Environment for the division of responsibilities in connection with the environmental impact assessment for the research reactor. The IRRS team was not made aware of any such formal agreement with the Ministry of Health concerning the latter’s role in inspection and oversight of health facilities, including radiology, radiotherapy and nuclear medicine.

The necessary coordination can be achieved through reaching a memorandum of understanding between agencies, and other possibilities such as standing or ad-hoc committees.

The issues concerning relations with agencies involved with emergency response are discussed in Section 10 of this report.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| | Observation: EMRC does not have a comprehensive process for co-ordination with other government agencies with responsibilities that impinge upon nuclear and radiation safety. |
| (1) | BASIS: GSR Part 1 para. 2.18 states that <i>“The government shall ensure that there is appropriate coordination of and liaison between the various authorities concerned in areas such as: (1) safety of workers and the public; (2) protection of the environment; (3) applications of radiation in medicine, industry and research; (4) emergency preparedness and response; ETC</i> |
| R5 | Recommendation: The government should ensure that formal coordination arrangements are established between EMRC and other government agencies including the Ministries of Health, Interior, Environment, and Labour. Note: This Recommendation also covers issues raised in sections 7.1.1, 12.1. |

1.6. SYSTEM FOR PROTECTIVE ACTIONS TO REDUCE UNREGULATED RADIATION RISKS

Article (4) of Law No (43) of 2007 gave the former JNRC the responsibility of achieving protection of the environment, human health and property from hazards of contamination and exposure to ionizing radiation in accordance with the provisions of the law. This general aim, which must be exercised in coordination and cooperation with relevant authorities, gives EMRC (assuming it remains

in the new law), the basis for dealing with unregulated radiation risks. Such risks may arise from an accident, a discontinued practice or from inadequate control of contaminated material or natural radioactivity.

On the basis of results of previously conducted radon surveys, it appears that the ventilation of homes in Jordan means that there is not likely to be high levels of radon, unless certain active building materials were used. The IRRS team was advised of a case whereby JNRC intervened to assist in dealing with a situation where bricks were being constructed from active tailings from a formerly mined phosphate deposit.

It is inevitable that these circumstances will need to be treated on a case-by-case basis and the IRRS team see little value in establishing a formal regulatory process. Nonetheless, there may be value in the country adopting some guidelines, which may establish some broad objectives to achieve optimization of protective actions in such cases.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| | Observation: JNRC in the past has acted on a case-by-case basis to deal with existing exposure situations. |
| (1) | BASIS: GSR Part 1, Requirement 9 states that <i>“The government shall establish an effective system for protective actions to reduce undue radiation risks associated with unregulated sources (of natural or artificial origin) and contamination from past activities or events, consistent with the principles of justification and optimization.”</i> |
| S1 | Suggestion: The government should consider establishing national processes and guidance for protective actions to reduce the risk from unregulated sources. |

1.7. PROVISIONS FOR DECOMMISSIONING AND MANAGEMENT OF RADIOACTIVE WASTE AND SPENT FUEL

The IRRS team was provided with a copy of the draft national radioactive waste and spent fuel strategy as a part of the Advance Reference Material. The significant chapter headings in this draft are:

- International and National Radioactive Waste Management Principles;
- International Obligations and Applicable National Legislation;
- Responsibilities – the government, JAEC, the JNRC, generators and operators;
- Provision of Resources – including a commitment to establish a fund for decommissioning and radioactive waste and spent fuel disposal;
- Safety and Security Objectives;
- Waste Minimization;
- Export/Import of Radioactive Waste;
- Management of Spent Nuclear Fuel;
- Management of Radioactive Waste: disused sealed radioactive sources and other forms of radioactive waste;
- Naturally Occurring Radioactive Material;
- Public participation and information;
- Implementing the policy.

In the view of the IRRS team, the draft policy is an excellent document that would represent a good practice once adopted by the government.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| | Observation: A draft national policy on radioactive waste and spent fuel management has been developed, which still awaits approval by the government. |
| (1) | BASIS: GSR Part 1, Requirement 10, para. 2.28. states that <i>“Decommissioning of facilities and the safe management and disposal of radioactive waste shall constitute essential elements of the governmental policy and the corresponding strategy over the lifetime of facilities and the duration of activities [3, 7]. The strategy shall include appropriate interim targets and end states. Radioactive waste generated in facilities and activities necessitates special consideration because of the various organizations concerned and the long timescales that may be involved. The government shall enforce continuity of responsibility between successive authorized parties.”</i> |
| S2 | Suggestion: The government should consider timely adoption of the draft national policy on management of spent fuel and radioactive waste and support for its effective implementation. Note: This Suggestion also covers issues raised in section 11.2.13. |

1.8. COMPETENCE FOR SAFETY

The government has established through regulation requirements for the necessary competences for the operation and regulation of facilities and activities. It also supports and finances the educational system and organizes administrative training.

This regulation on qualification specifies requirements for the system of selection and qualification of personnel. All licensees and individuals are required to maintain and enhance their knowledge and improve their skills. To obtain an authorization, applicants must prove that they possess the required number of staff with the necessary competence and skills to ensure safety of the facility or activity. This is verified during the authorization process.

Concerning nuclear power, the system of training and qualification in the country relies mostly on educating young experts abroad and actively using their knowledge and skills after they return to Jordan. Some measures have also been taken locally, such as the creation of university courses and faculty regarding nuclear sciences and engineering. One example is the establishment of a Nuclear Engineering Department at the Jordan University for Science and Technology (JUST). This is considered a step forward in Jordan's efforts to develop its nuclear infrastructure and to introduce nuclear power as part of its energy mix.

Concerning EMRC, the IRRS team identified that the regulatory authority has an insufficient number of staff (see 3.3) to effectively fulfil its regulatory functions for protection of the public and the environment. In addition, EMRC employees should be appropriately trained to perform regulatory inspections and conduct safety assessments. The IRRS team is aware that hiring and training staff is a time and financially consuming process.

Concerning research and development, Jordan is establishing facilities to support a nuclear research programme. The Jordan Centre for Nuclear Research includes a 5 MW multi-purpose research reactor under construction. The Centre for Nuclear Research is also planned to include a radio-isotope production facility, a cold neutron source research facility, a radioactive waste facility for the research reactor, and an education and training building. The JSA is designed to fulfil the training needs of students and is equipped to perform all of the fundamental experiments required for a typical nuclear engineering university program. The IRRS team considers that these research and development activities are satisfactory for the current state of the nuclear power programme.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| | Observation: EMRC does not possess sufficient staff with the necessary competencies to perform all its regulatory functions. |
| (1) | BASIS: GSR Part 1, Requirement 18, states that <i>“The regulatory body shall employ a sufficient number of qualified and competent staff, commensurate with the nature and the number of facilities and activities to be regulated, to perform its functions and to discharge its responsibilities.”</i> |
| R6 | Recommendation: The government should ensure that EMRC is provided with adequate human resources with the necessary competence to effectively regulate nuclear and radiation risks in the country. Note: This Recommendation also covers issues raised in sections 6.1.2, 11.2.9. |

1.9. PROVISION OF TECHNICAL SERVICES

Various technical services relating to occupational radiation protection and safety are available in Jordan. External dosimetry services are offered by JAEC, the Jordan Royal Scientific Society and by one additional private company. A secondary standards dosimetry laboratory for calibrating gamma and X-Ray dose rate survey equipment is operated by JAEC.

EMRC operates a number of environmental monitoring stations and has a radiochemistry laboratory, and is the national organization in charge of border monitoring of radiation sources.

There is at present no arrangement to ensure internal dosimetry monitoring in Jordan. Internal dosimetry arrangements need to be available to determine fully doses received by workers in certain operations in nuclear facilities where there may be inhaled or ingested contamination. In the first instance, Jordan could make arrangements for such dosimetry needs with other countries pending development of its own facilities. More information to justify the following suggestion is given in Chapter 12 of this report.

Technical services to support present facilities and activities are available in Jordan. Future facilities and activities will require internal dosimetry services to be arranged.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| | Observation: Technical services to support present facilities and activities are available in Jordan. Future facilities and activities will require internal dosimetry services to be arranged. |
| (1) | BASIS: GRS Part 1 Requirement 13, states that <i>“The government shall make provision, where necessary, for technical services in relation to safety, such as services for personal dosimetry, environmental monitoring and the calibration of equipment.”</i> |
| S3 | Suggestion: The Government should consider establishing internal dosimetry arrangements in a timely manner. Note: This Suggestion also covers issues raised in section 12.2. |

1.10. SUMMARY

The Government of Jordan has very recently made significant changes to the nuclear and radiation safety regulator by merging it into the EMRC and is preparing a new energy and minerals law that will, inter alia, cover the regulation of nuclear and radiation safety. While the IRRS team finds the new regulatory structure to be novel and requiring further definition to ensure technically sound and

independent regulatory decision-making, its formation and the development of the new law offer the opportunity to strengthen the role of the regulatory body and establish an improved regulatory framework. These actions should be accompanied by the development and issuance of a national policy and strategy for safety.

The regulatory framework needs to be completed - it cannot continue to operate on the basis of drafts. Coordination with relevant Government agencies should be strengthened. The government needs to ensure that EMRC is provided with sufficient human resources with the needed competencies to support its nuclear and radiation safety regulatory activities.

2. GLOBAL NUCLEAR SAFETY REGIME

2.1. INTERNATIONAL OBLIGATIONS AND ARRANGEMENTS FOR INTERNATIONAL COOPERATION

Jordan has ratified a number of international instruments related to nuclear safety and radiological protection:

- Convention on Early Notification of a Nuclear Accident;
- Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency;
- Convention on Nuclear Safety;
- Vienna Convention on Civil Liability for Nuclear Damage and protocol amending it;
- Revised Supplementary Agreement Concerning the Provision of Technical Assistance by the IAEA (RSA); and
- Co-operative Agreement for Arab States in Asia for Research Development and Training Related to Nuclear Science and Technology (ARASIA).

Jordan is not yet a contracting party to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, but EMRC is leading a national committee established by the Cabinet to work toward this objective.

Since the ratification by Jordan of the Convention on Nuclear Safety, two review meetings have taken place in 2011 and 2014. Jordan has not participated in these meetings as required by the Convention. In 2011, Jordan did not prepare a national report to report on the implementation of its obligations on the convention. In 2014, Jordan prepared a report but submitted it very late. As a result, Jordan could not benefit from the peer-review process that is the central feature of this mechanism.

Jordan has made a political commitment to work toward the principles of the Code of Conduct on the Safety and Security of Radioactive Sources, but has yet to commit to the Guidance on Import and Export of Radioactive Sources.

With regards to international cooperation, Jordan has several bilateral agreements and cooperation programmes with the European Union, France, the Republic of Korea, Russian Federation, and the United States of America.

Jordan is taking full benefit from and contributing to the technical cooperation programme of the IAEA, particularly in the field of nuclear and radiation safety. EMRC hosted many regional workshops.

EMRC staff are familiar with IAEA safety standards, which are actively used in the establishment of country safety requirements and standards. Jordan, through EMRC staff, is member of the four IAEA Safety Standards Committees — the Nuclear Safety Standards Committee (NUSSC), the Radiation Safety Standards Committee (RASSC), the Transport Safety Standards Committee (TRANSSC) and the Waste Safety Standards Committee (WASSC).

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| | Observation: Jordan is benefitting from and contributing to international cooperation in nuclear safety and radiation protection in a substantial way. |
| (1) | BASIS: GSR Part 1, Requirement 14, states that <i>“The government shall fulfil its respective international obligations, participate in the relevant international arrangements, including international peer reviews, and promote international cooperation to enhance safety globally.”</i> |
| GP1 | Good Practice: Jordan is participating in several international forums and actively using various international cooperation programs to strengthen its nuclear and radiation safety infrastructure. |

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| | Observation: Jordan is a party to the safety related Conventions, with the exception of the Joint Convention, its participation in the Convention on Nuclear Safety has been limited. |
| | BASIS: GSR Part 1, Requirement 14, states that <i>“The government shall fulfil its respective international obligations, participate in the relevant international arrangements, including international peer reviews, and promote international cooperation to enhance safety globally.”</i> |
| R7 | Recommendation: The government should become a contracting party to the Joint Convention and should demonstrate that respective international obligations are fulfilled by participation in its relevant international arrangements. Note: This Recommendation also covers issues raised in section 11.2.2. |

2.2. SHARING OF OPERATING EXPERIENCE AND REGULATORY EXPERIENCE

Jordan has appointed a national officer for the International Nuclear and Radiological Events Scale (INES) and participates in international exchanges of information on radiation events and incidents. It also takes part in a number of international activities intended to exchange regulatory experience. Lessons learned from the experience of other countries were used to prepare the country’s safety regulations and instructions. Starting a research reactor program, Jordan could largely benefit from some of the existing IAEA instruments for sharing of operating experience (e.g. Incident Reporting System (IRS) for research reactors and IRS for NPP when the nuclear programme is launched).

Improvements based on operating and regulatory experience are implemented on a case-by-case basis and are not subject to a systematic approach. Since feedback from experience is a fundamental way of enhancing safety and improving the regulatory control, the IRRS team believes that EMRC would benefit from more active involvement in the process of exchanging experience.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| | Observation: EMRC has not made arrangements for Jordan to be actively involved in sharing operating and regulatory experience. |
| (1) | BASIS: GSR Part 1, Requirement 15, para. 3.4, states that <i>“The regulatory body shall establish and maintain a means for receiving information from other States and from authorized parties, as well as a means for making available to others lessons learned from operating experience and regulatory experience.”</i> |
| S4 | Suggestion: EMRC should consider establishing processes for identifying and sharing lessons learnt from operating experience and regulatory experience. |

2.3.SUMMARY

Jordan has ratified most of the international instruments related to nuclear and radiation safety, except the Join Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. However, Jordan did not actively participated to the review meeting under the Convention on Nuclear Safety in 2011 and 2014. As a result, Jordan could not benefit from the peer-review process that is the central feature of this mechanism.

Jordan has established an extensive international cooperation programme, including bilateral agreements and cooperation programmes with the European Union, France, the Republic of Korea, Russian Federation, and the United States of America. Jordan is taking full benefit from and

contributing to the technical cooperation programme of the IAEA, particularly in the field of nuclear and radiation safety. For example, EMRC hosted many regional workshops and training courses.

EMRC staff are familiar with IAEA safety standards and actively use them in the establishment of country safety requirements and standards. EMRC takes part in the four IAEA Safety Standards Committees.

Jordan is a member of INES and takes benefit from international activities intended to exchange regulatory experience. To benefit from more active involvement in the process of exchanging experience, EMRC should not only receive information on lessons learnt but also provide such to the international community.

3. RESPONSIBILITIES AND FUNCTIONS OF THE REGULATORY BODY

3.1. ORGANIZATIONAL STRUCTURE OF THE REGULATORY BODY AND ALLOCATION OF RESOURCES

EMRC organizational structure resulted from the restructuring mandated by Law No. (17) of 2014. A Chief Executive Officer supported by a Board of Commissioners manages the authority. There is a total of five commissioners, including the chairman. The previous Director General of JNRC was appointed as a Commissioner. The organization represents a unique combination of an electricity grid regulator, mines regulator and the nuclear and radiation safety regulator. Decision making in this context is discussed in Section 1.3 of the report.

The organizational structure (see Appendix IX) includes four directorates from the former JNRC; namely Nuclear Safety and Security Directorate (NSSD), Radiation Protection and Control Directorate (RPCD), Border Control Directorate (BCD) and Supportive Technical Services Directorate (STSD). As the proposed structure appears to result from an assembly of former directorates of the three merged organizations, the IRRS team was not able to judge the effectiveness of the structure and the communications and interactions between separate directorates. A systematic assessment of EMRC arrangements for discharging its current and future regulatory functions is essential for the effective operation of the Commission. This should be done by making use of graded approach to support EMRC in establishing its new organization and resources accordingly.

The IRRS team was advised that a Strategic Planning Committee has been recently established by the CEO of EMRC that is considering the organization structure and allocation of resources.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| | Observation: The systematic assessment of the EMRC structure and allocation of resources among divisions has just commenced |
| (1) | BASIS: GSR Part 1, Requirement 16, para. 4.5 states that <i>“The regulatory body has the responsibility for structuring its organization and managing its available resources so as to fulfil its statutory obligations effectively. The regulatory body shall allocate resources commensurate with the radiation risks associated with facilities and activities, in accordance with a graded approach. Thus, for the lowest associated radiation risks, it may be appropriate for the regulatory body to exempt a particular activity from some or all aspects of regulatory control; for the highest associated radiation risks, it may be appropriate for the regulatory body to carry out a detailed scrutiny in relation to any proposed facility or activity before it is authorized, and also subsequent to its authorization.”</i> |
| S5 | Suggestion: EMRC should consider finalizing the systematic assessment of its organizational needs for its current and future nuclear and radiation safety regulatory functions and establish its new organization and resources accordingly. Note: This Suggestion also covers issues raised in section 10.1. |

3.2. EFFECTIVE INDEPENDENCE IN THE PERFORMANCE OF REGULATORY ACTIVITIES

Due to the very recent reorganization, it was not possible for the IRRS team to assess its impact on the effective independence of EMRC in terms of regulatory decision making. However during the meeting with the ERMC Commissioners, the IRRS team pointed out the potential challenges that EMRC may face in the near future, specifically with regards to its multiple and possibly conflicting mandates. Recommendation 4 in Section 1.3 includes actions for EMRC to ensure effective independence, as explained in the IAEA standards.

It could be valuable for EMRC to develop a statement setting out its regulatory values and emphasising the independence of its regulatory decision-making. These values might be reflected in a statement of expectations of its employees to ensure that the value of independent regulatory decision-making becomes part of the culture of the new organization.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| | Observation: EMRC is formed from three regulatory bodies that may not have consistent regulatory culture with respect to independence. |
| (1) | BASIS: GSR Part 1, Requirement 17, states that <i>“The regulatory body shall perform its functions in a manner that does not compromise its effective independence.”</i> |
| S6 | Suggestion: EMRC should consider developing a statement describing its regulatory values, emphasising its independence in regulatory decision-making and promulgating a statement of expectations for its employees. |

3.3. STAFFING AND COMPETENCE OF THE REGULATORY BODY

Before merging with EMRC, the total number of JNRC staff was 158 with 16 staff in the RPCD and 25 staff in the NSSD.

At the time of the mission, the RPCD has a total number of 9 employees (4 staff responsible for performing inspections, 3 staff responsible for licensing and 2 administrative support staff). NSSD has 19 staff. The IRRS team considers that the number of technical staff is insufficient for the amount of work to be done. Special attention should be paid to the RPCD, where seven inspectors are responsible for inspecting 426 sites and issuing licenses every 2 years for each single source and all radiation workers. The review and revision of authorization and inspection programmes can contribute to improve the situation (see Chapter 5 for details), but more staff are needed.

Based on specific justification, the Prime Minister has agreed on an exemption from the general rule and EMRC has been allowed to increase the number of staff by 20 (10 in BCD, 5 in RPCD and 5 in NSSD).

EMRC is employing young staff directly after they finish university. These staff are trained by EMRC, mainly through international cooperation programmes. Once they are trained, they may find higher paying jobs and leave the organization. For example, last year 7 staff left RPCD and 6 staff left NSSD. This partly explains the current number of vacant posts. The IRRS team was advised that the average experience of NSSD staff is about 3 years. This rate of loss of competent staff is unacceptably high and needs to be addressed. These specific challenges faced by EMRC on attracting and retaining highly qualified and trained staff are largely due to inadequate salary levels. The hiring system was ineffective to provide such hiring and retention capacity to EMRC as it prevents EMRC from establishing competitive salaries as compared to private industry and foreign regulatory bodies. The government and EMRC have to establish strategies and mechanisms to attract and retain high quality trained personnel in EMRC. This element is highly critical for having adequate competency to implement EMRC’s regulatory functions.

The recent increase of staff dealing with nuclear safety issues is positive, with regards to the nuclear programme. However, a significant increase in staff and contractors will be needed as this programme progresses. The IRRS team was provided with an assessment of EMRC needs in terms of staffing. A national Human Resource Development Plan has been developed as part of the nuclear power programme, and it partly addresses EMRC needs. Section 11.2.9 of this report provides additional discussion on the human resources needs for the nuclear power programme.

A systematic training programme that addresses training needs of inspectors and experts of EMRC does not exist. Such a programme is necessary and should also include the verification of adequate knowledge and abilities of inspectors before they are allowed to work as inspectors and ensure that suitable proficiency is maintained. The effectiveness of the programme should be verified periodically.

During the policy issue discussion on capacity building, the IRRS team was informed that a Strategic Planning Committee was recently established. The committee has to formulate strategic plan for EMRC for the coming three years. The strategic plan will address among others the current status and needs for the next three years (budget, human resource allocation, capacity building). A Human Resource Department, part of the Administrative Directorate will be responsible for the coordination of training and education activities.

IRRS team experts shared their views and experiences on a systematic approach to training and provided examples on establishment of a competency based training programme in their respective organizations. Experts also recommended that special attention be paid to knowledge management and preservation within the regulatory body, this will help to prevent loss of knowledge and information due to retirement or turnover of staff.

EMRC counterparts acknowledged that currently EMRC does not have a systematic way to manage and preserve knowledge and information; therefore they considered the recommendations provided by the experts very useful and to be incorporated in the human resource development plan of EMRC.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| | <p>Observation: Before merging in EMRC, JNRC lacked a fully developed human resources plan covering recruitment, rotation of staff and a training program based upon a competency framework.</p> |
| (1) | <p>BASIS: GSR Part 1, Requirement 18, Para. 4.11, states that <i>“A human resources plan shall be developed...;”</i></p> <p>Para. 4.12 states that <i>“The human resources plan for the regulatory body shall cover recruitment and, where relevant, rotation of staff in order to obtain staff with appropriate competence and skills, and shall include a strategy to compensate for the departure of qualified staff; and”</i></p> <p>Para. 4.13 states that <i>“A process shall be established to develop and maintain the necessary competence and skills of staff of the regulatory body...”</i></p> |
| R8 | <p>Recommendation: EMRC should develop, as a matter of urgency, a human resources plan to support its nuclear and radiological regulatory decision-making and establish its internal systematic training programme for current and new inspectors and assessors.</p> <p>Note: This Recommendation also covers issues raised in sections 7.1.1, 7.1.3, 11.2.9, 11.2.12.</p> |
| R9 | <p>Recommendation: The government and EMRC should identify and implement innovative approaches to attract and retain highly qualified staff at EMRC to support its nuclear and radiation safety regulatory functions.</p> |

3.4. LIAISON WITH ADVISORY BODIES AND SUPPORT ORGANIZATIONS

Jordan, as a small country, is not in a position to establish and maintain a large regulatory authority or to establish its own technical support organization (TSO) that has competence in any specific technical area of regulatory concern. As the national regulatory authority on nuclear and radiation safety, EMRC has the responsibility to review and assess, authorize and inspect all radiation and nuclear-related activities in the country.

The IRRS team acknowledges the fact that during the last few years, EMRC has relied upon the capabilities of its own permanent staff to carry out its regulatory reviews and assessments, which have been increasing. However, the regulatory authority is still not self-sufficient to do its own comprehensive review and assessment for significant projects or to judge on the adequacy of the

assessment work done by external contractors. This is especially true for large projects, such as the construction of a research reactor and a potential nuclear power plant.

EMRC does not have standing advisory bodies and it obtains external technical or expert advice from foreign TSOs. On specific regulatory issues EMRC establishes expert committees to gather experts from different organizations to reach consensus on important topics. Some of the committees are established on a specific topic and are disbanded on completion of the task. Two permanent national committees have been established, namely:

- a. National Committee for Radiological and Nuclear Emergency;
- b. National Committee for Nuclear Security.

Jordan is commended for its efforts to establish a network of expert organizations inside the country, including university departments on nuclear and medical physics in the University of Jordan and Al Balqa Applied University, radiation measurement and research laboratories at JAEC and at the Royal Scientific Society, geology and seismology centres, security centres, etc. These organisations are probably not self-sufficient to judge the safety of a new nuclear power plant design, but could be seen as a good basis for the further establishment of competence in nuclear and radiation safety. In addition, they could provide technical assistance, independent analyses and nuclear safety research.

Occasionally, EMRC had used independent advisors to the board, e.g. seismic evaluation of the JRTR. However, as EMRC bears all the responsibility for making regulatory decisions, the IRRS team identified that the establishment of an advisory body (one or more) to EMRC could provide the Commission with greater confidence in the technical basis of the decisions it takes. The advisory bodies may be composed of experts from scientific institutes, universities, and other competent organisations that will assist EMRC by expert advices on the technical and scientific aspects of nuclear safety and radiation protection. As discussed in Section 11.2.7 of this report, availability of advisory bodies would be particularly important for the nuclear power programme.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| | Observation: Currently no advisory bodies on nuclear or radiation safety for EMRC have been established for EMRC. |
| (1) | BASIS: GSR Part 1, Requirement 20, para. 4.18. states that <i>“The regulatory body may decide to give formal status to the processes by which it is provided with expert opinion and advice. If the establishment of advisory bodies, whether on a temporary or a permanent basis, is considered necessary, it is essential that such bodies provide independent advice, whether technical or non-technical in nature.”</i> |
| S7 | Suggestion: EMRC should consider the use of one or more technical advisory bodies of experts to support its decision making on important nuclear and radiation safety issues. Note: This Suggestion also covers issues raised in section 11.2.7. |

3.5. LIAISON BETWEEN THE REGULATORY BODY AND AUTHORIZED PARTIES

EMRC has established both formal and informal mechanisms for communication with authorized parties and has ensured possibilities for professional and constructive liaison. The IRRS team received positive feedback from these stakeholders. The formal and most frequently used mechanisms are through correspondence between EMRC and authorized parties and inspections on the authorized activities and organizations. It is also a practice to invite authorized parties to meetings, or the authorized parties can request a meeting for clarification of the requirements. For some issues of mutual interest (e.g. regulations) EMRC forms joint working committees to reach consensus on

specific safety issues. Meetings with stakeholders highlighted the frank and open communication of EMRC with the authorized parties.

3.6. STABILITY AND CONSISTENCY OF REGULATORY CONTROL

The legal framework is being modified because of the merging of three regulatory authorities as a result of Law No. (17) of 2014. A new draft law on Energy and Minerals is prepared with a planned date of promulgation in October 2014. Until the adoption of the new law, nuclear and radiation safety in the country is regulated under the Law No (43) of 2007. However, that law does not provide for some of the fundamental safety principles such as: assigning the prime responsibility for safety to the licensee, providing an appeal mechanism against regulatory decisions, involvement of interested parties in decision making, etc. Recommendation 2 in Section 1.2 of the report addresses this issue.

A number of safety-related regulations and instructions have been drafted. Draft regulations are made publically available by the Legislative and Opinion Bureau of the Cabinet, which also performs a consistency check of the draft with the existing laws and regulations.

EMRC has not established a management system process to draft regulations, instructions or regulatory guides. The IRRS team opinion is that draft regulations and instructions need to be finalised and issued in order to achieve consistency of regulatory requirements and criteria. Recommendation 3 in Section 1.2 of the report addresses this issue.

The IRRS team acknowledges EMRC commitment to proactively use IAEA safety standards as a reference when drafting regulations. It commends the fact that all drafts have been sent for external review.

EMRC has established some of the processes, principles and criteria, most of which are in draft form. However a significant number of the core regulatory processes are still missing. Several recommendations were given in this respect, which timely and properly implemented will provide EMRC with improved stability and consistency in the regulatory control, will minimize the risk of inconsistency by EMRC staff, and will enable it to justify its decisions in front of its main stakeholders or when being challenged.

The IRRS team was not able to fully assess the stability and consistency of the regulatory body since it is in a process of transition and large portions of the regulatory framework have not yet been finalized.

3.7. SAFETY RELATED RECORDS

The IRRS team discussed with EMRC staff the arrangements of managing safety-related records with respect to licensing, safety assessments, inspection results, inventory of radiation sources, etc. EMRC is lacking internal procedures on records keeping and archives (see chapters 4, 5 and 12). Many of the documents are stored by their producers in hard copy or in electronic form with no central archive being established. This current arrangement increases the risk losing documentation and corporate knowledge. Several activities on establishing a systematic approach to document handling have been initiated, including the installation of an electronic document and record control system, which is still in an early stage of development.

EMRC needs to undertake urgent actions to establish its processes and ensure that safety-related documents and records are properly archived and stored, and they are readable, complete, identifiable, and easily retrievable.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| | Observation: EMRC arrangements for managing safety related records are inadequate. |
| | BASIS: GSR Part 1, Requirement 35, states that <i>“The regulatory body shall make provision for establishing, maintain and retrieving adequate records relating to the safety of facilities and activities.”</i> |

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

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| (1) | <p>BASIS: GS-R-3, Para. 4.63, states that <i>“The regulatory body shall make provision for establishing and maintaining the following main registers and inventories:</i></p> <ul style="list-style-type: none"> – <i>Registers of sealed radioactive sources and radiation generators;</i> – <i>Records of occupational doses;</i> – <i>Records relating to the safety of facilities and activities;</i> – <i>Records that might be necessary for the shutdown and decommissioning (or closure) of facilities;</i> – <i>Records of events, including non-routine releases of radioactive material to the environment;</i> – <i>Inventories of radioactive waste and of spent fuel.</i> |
| R10 | <p>Recommendation: EMRC should take prompt actions to establish effective arrangements to manage safety-related documents and records, so as to ensure that they are available, identifiable and easily retrievable.</p> <p>Note: This Recommendation also covers issues raised in sections 4.4, 5.2, 7.1.2.</p> |

3.8. COMMUNICATION AND CONSULTATION WITH INTERESTED PARTIES

EMRC does not have an information policy that establishes its principles for communicating with interested parties and the public. However, there are many arrangements that contribute to the exchange of information and consultation. EMRC and JAEC have joint committees to discuss draft of regulations and instructions. They also have frequent informal communication. Through the normal licensing and inspection activities, EMRC has frequent interactions with source users, but does not organise additional meetings with professional bodies.

EMRC has a website, which has not been updated lately. There is a plan, currently on hold due to the reorganization, to upgrade the website and to make more use of it for providing information to the public on EMRC activities. Furthermore, EMRC prepares an annual report, which is sent to the Prime Minister, but is not used for public information. EMRC has contacted journalists from the official Jordan News Agency (Petra), where frequent media reports were published about the processes of JNRC and related activities and decisions, such as the issuance of the construction permit for the JRTR research reactor, workshops and events that were coordinated by JNRC.

EMRC has not yet taken action to communicate, with the interested parties in the vicinities of the research reactor and the selected site for the future nuclear power plant.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

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| | <p>Observation: EMRC does communicate information and activities to interested parties, including the public, but not in a systematic and formalized way.</p> |
| (1) | <p>BASIS: GSR Part 1, Requirement 36, states that <i>“The regulatory body shall promote the establishment of appropriate means of informing and consulting interested parties and the public about the possible radiation risks associated with facilities and activities, and about the processes and decisions of the regulatory body.</i></p> |
| S8 | <p>Suggestion: EMRC should consider developing further, and formalizing in a policy, its information and consultation strategy with interested parties.</p> |

3.9. SUMMARY

EMRC organizational structure includes four directorates from the former JNRC, two of them being dedicated to regulatory activities. NSSD and RPCD Directorates are employing mostly young staff directly after they finish university, who are dedicated and committed to their work. These staff are actively trained by EMRC, mainly through international cooperation programmes.

A national Human Resource Development Plan has been developed as part of the nuclear power programme, and recent increase of staff dealing with nuclear safety issues is considered positive by the IRRS team. To ensure that nuclear and radiation safety regulatory functions are effectively fulfilled, EMRC should be able to attract and retain highly qualified staff and should establish an internal systematic training programme for current and new inspectors and assessors.

EMRC has established both formal and informal mechanisms for communication with authorized parties and has ensured possibilities for professional and constructive liaison. EMRC is commended for its efforts to establish a network of expert organizations inside the country. However, EMRC should consider the use of technical advisory bodies to support its decision making on important nuclear and radiation safety issues.

4. MANAGEMENT SYSTEM OF THE REGULATORY BODY

4.1. IMPLEMENTATION AND DOCUMENTATION OF THE MANAGEMENT SYSTEM

EMRC has recently developed an integrated management system, which is documented in the Quality Management System Manual. The IRRS team acknowledges the work done so far and supports many of the actions that EMRC is planning to implement for improving its management system. The IRRS team consider that the further development of the integrated management system of EMRC is of great importance in order to ensure that safety is not compromised.

The manual contains a quality policy which, among other things, states the commitment to continual improvement. The safety culture is mentioned in the management manual; however the IRRS team considers that the paramount importance of safety could be more explicitly stated in the policy. Individual values, institutional values and behavioural expectations are common for the whole governmental sector in Jordan regulated by the Civil Service Bureau. Every employee has to sign a code of conduct which contains objectives, individual behavioural responsibilities, expectations to handling possible conflicts of interest etc.

The requirements for managing the organization referred in GS-R-3 are not specifically addressed in the management system manual although the law regulating the responsibilities as well as the mission and vision of the organization are published on the public web-site. The IRRS team could not observe any systematic actions in place to provide adequate confidence that all the requirements are satisfied. The IRRS team considers that an overview of the requirements could be documented in the manual and also a description of the planned and systematic actions needed to assess the fulfilment of the requirements.

The description of the core regulatory and supporting processes of EMRC needs to be further clarified and developed in the manual. Some of the processes are also missing in the manual, for instance the one related to Emergency Preparedness and Response. When doing this, EMRC should decide if the nuclear and radiation safety activities of EMRC should deserve a dedicated integrated management system or if these activities will be included in an overall organization system; taken into account both administrative and technical aspects related to nuclear and radiation safety. Moreover, the complexities and interactions of the core processes are not clear and need to be clarified. This could be achieved by developing an overall process map generic for the entire organization describing the regulatory processes, as well as the interactions of the processes.

It was confirmed that the different technical directorates of EMRC, in some cases, have documented procedures specific for their area of responsibility and types of licence holders. Only a few procedures are in place, mainly in NNSD (e.g. procedures for conducting inspections and authorizations including flow-charts showing the sequence of the processes).

In NNSD, several training sessions about the key aspects of safety culture have been conducted as a means of promoting safety culture. So called "safety messages" are distributed to all staff on a daily basis. The messages are based on documented worldwide events (in the nuclear field) in the past and the feedback on the events. This action as well as the perception and knowledge of safety culture among staff are planned to be followed up using a survey. The plan is also to send the survey to JAEC and to conduct specific inspections regarding the safety culture within JAEC.

When developing the management system EMRC has been focusing so far on the priorities set by the government and the top management. Therefore efforts have been put to develop and implement the specific authorization and inspection processes for the research reactor and the application for the nuclear power plant reactors. In this way EMRC has applied a graded approach in the application of the requirements.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

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| | <p>Observation: The requirements for managing the organization are not brought together in a coherent manner and the core processes are not clearly defined, documented and developed.</p> |
| (1) | <p>BASIS: GSR Part 1, Requirement 19 states that <i>“The regulatory body shall establish, implement, and assess and improve a management system that is aligned with its safety goals and contributes to their achievement.”</i></p> |
| (2) | <p>BASIS: GS-R-3, para. 2.1 states that <i>“A management system shall be established, implemented, assessed and continually improved. It shall be aligned with the goals of the organization and shall contribute to their achievement. The main aim of the management system shall be to achieve and enhance safety by:</i></p> <ul style="list-style-type: none"> - <i>Bringing together in a coherent manner all the requirements for managing the organization.</i> - <i>Describing the planned and systematic actions necessary to provide adequate confidence that all these requirements are satisfied;</i> - <i>Ensuring that health, environmental, security, quality and economic requirements are not considered separately from safety requirements, to help preclude their possible impact on safety.”</i> |
| (3) | <p>BASIS: GS-R-3 para. 2.8 states that <i>“The documentation of the management system shall include the following:-</i> <i>A description of the processes and supporting information that explain how work is to be prepared, reviewed, carried out recorded, assessed and improved.</i></p> |
| (4) | <p>GS-R-3 para. 5.1 states that <i>“The processes of the management system that are needed to achieve the goals, provide the means to meet all the requirements and deliver the products of the organization shall be identified, and their development shall be planned, implemented, assessed and continually improved.”</i></p> |
| (5) | <p>GS-R-3 para. 5.6 states that <i>“For each process a designated individual shall be given the authority and responsibility for:</i></p> <ul style="list-style-type: none"> - <i>Developing and documenting the process and maintaining the necessary supporting documentation;</i> - <i>Ensuring that the process, including any subsequent changes to it, is aligned with the goals, strategies, plans and objectives of the organization.</i> |
| R11 | <p>Recommendation: EMRC should proceed further with the establishment and implementation of the integrated management system according to the requirements in GS-R-3 with the aim to achieve and enhance safety. Special attention should be paid to:</p> <ul style="list-style-type: none"> - defining, documenting, and implementing the core regulatory processes; - bringing all the requirements for managing the organization together in a coherent way; - assigning authority and responsibility for the regulatory processes to designated individuals; - assessing and continually improving the processes of the management system. <p>Note: This Recommendation also covers issues raised in sections 4.5, 10.4.</p> |
| (1) | <p>BASIS: GS-R-3 para. 2.5 states that <i>“The management system shall be used to promote and support a strong safety culture by:</i></p> <ul style="list-style-type: none"> - <i>Ensuring a common understanding of the key aspects of safety culture within the organization;....”</i> |

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

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| GP2 | Good practice: The regulatory body is promoting safety culture in an inventive and constructive way by sending daily safety messages to all staff. Training sessions are held on safety culture and a survey is planned. This contributes to a common understanding of the key aspects of safety culture across the organization. |
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4.2. MANAGEMENT RESPONSIBILITY

The IRRS team considered that management commitment is demonstrated explicitly in the quality policy which is signed by the Commissioner who, together with the board of directors, authorizes and endorses the management system. The director of each directorate is responsible for the coordination, development, implementation and maintenance of their respective directorate. The IRRS team underlines the importance of clarifying the responsibilities for the integrated management system within the new EMRC organization, as mentioned in the previous section.

The work to develop the management system was done by forming a group consisting of two members of the staff from both technical and administrative directorates respectively. The work, that was limited in time, was led by the industrial engineer of the NSSD. This person is normally responsible for the QA aspects of nuclear installations and this work was only part of this person's duties. The group met at several occasions during the last year to develop the management system manual. The IRRS team can conclude that the managers are committed to the development and improvement of the management system; however there is a need to determine the amount of resources necessary for further development. The IRRS team observed that there was no individual appointed to coordinate further the development and improvement of the management system and the IRRS team underlined the importance to have such arrangements in place.

Even though the IRRS team could not find any evidence of formal management review meetings yet, the board of directors has monthly documented meetings where they discuss strategic planning and follow up on previous decisions and plans. The directors create annual work plans which are being followed up during monthly meetings in each directorate.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

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| | Observation: There is no appointed individual to coordinate further development and improvement of the management system. |
| (1) | BASIS: GS-R-3 para. 3.13 states that <i>“An individual reporting directly to senior management shall have specific responsibility and authority for:</i> - <i>Coordinating the development and implementation of the management system, and its assessments and continual improvement.- ...”</i> |
| R12 | Recommendation: EMRC should appoint an individual reporting directly to senior management with the responsibility and authority to coordinate the development and implementation of the management system. |

4.3. RESOURCE MANAGEMENT

Most of the human resource procedures are required from the Civil Service Bureau and are valid across the entire governmental authorities. According to the governmental requirements a task has been initiated to create job descriptions for each position describing the qualifications needed for the specific position. The descriptions also include the responsibilities and behavioural expectations of the employee. The IRRS team was told that this work will be completed during 2014 and formally agreed.

Another procedure in place, from the time of JNRC, provides for an annual assessment of results and achievements to be filled in by each employee. Among other things, this assessment reports on attended training courses, formal remarks on employee behaviour, acknowledgements given by the top management. This is then evaluated and scored by the managers and signed by the Chairman and subsequently sent to the Civil Service Bureau.

Infrastructure of the working environment

The Civil Service Bureau is regulating the working environment and there are many governmental procedures to be followed. Within EMRC, it is the manager's responsibility to identify and manage human and physical factors needed to achieve the objectives of the commission.

4.4.PROCESS IMPLEMENTATION

Document and records control

The IRRS team could not confirm that there was an established generic procedure for the control of documents, products and records. A central unit of EMRC, called the Diwan unit, is however responsible for maintaining all formal incoming and outgoing hard copy documents. The Diwan unit then archives the cover letters of documents. The merge of JNRC with other organizations under EMRC has led to a temporary separation of the office buildings. The IRRS team observed, as an example, that the official safety documents for JRTR, including inspection communication, requests for information, as well as the safety evaluation report and the preliminary safety analysis report are kept in two different places and are not officially archived. Only the cover letter was officially registered electronically by the Diwan unit.

EMRC has planned further actions to strengthen the infrastructure, by establishing an electronic documents and records control system, starting with the NSSD. The managers and staff of each directorate are responsible for handling their respective documents and records, including personal back up routines. Currently, records and documents are kept in the offices of EMRC staff only, both in hard copies as well as electronically on the hard drives of the individual computers. No local network is available with one exception: all staff in the RPCD is connected to a small local network. EMRC has developed a few databases for keeping track of personal and institutional licenses, radioactive sources and doses etc. For the database of licenses, there is a routine to back it up. The IRRS team strongly underlines the importance of EMRC to make provision for establishing, maintaining and retrieving adequate records; especially those that are related to the safety of facilities and activities and the IRRS team also strongly advises EMRC to promptly implement and improve procedures for control of documents and records to cover all directorates in order to fill the requirements stated in GS-R-3 for document, product and record control. Recommendation 10 in Section 3.7 addresses this topic.

The archiving of documents and records is not satisfactorily meeting the requirements of GS-R-3; the retention times of documents and records should be established to be consistent with statutory requirements. The environment for storing documents and records is not meeting the standards and requirements related to security, fire protection.

Purchasing

The purchasing process in EMRC is based on the governmental process of purchasing. Based on predefined criteria specific committees assess the suppliers of services for more than 1000 JD. The international cooperation unit of the former JNRC coordinated the agreements with international organizations to provide technical support services. This unit was also keeping all records related to this kind of outside services.

Communication

The right to have any formal communication, internally and externally, is pointed out in the different job descriptions that recently have been developed for every position and individual within the organization. EMRC frequently publishes press releases about important decisions and has contact with the press/media on a regular basis. The public could contact EMRC via a form on the web-site

and the Commissioner in charge of nuclear and radiation safety started to use social media to interact with the public. There are plans to publish executive summaries of inspection reports and enforcement actions on the external web-site; however this is not yet in place.

Managing organizational change

There is no formal process for managing organizational changes within EMRC; however it is planned to include this in the next revision of the management system manual.

4.5. MEASUREMENT, ASSESSMENT AND IMPROVEMENT

Management system reviews have not formally been conducted yet; however the Board of Directors has monthly meetings where decisions about changing of plans and actions for improvement are made. One input to these meetings could be the manager’s self-assessments about the achievements done; however there are no specific guidelines for self-assessments.

There is an internal audit unit within EMRC in charge of independent assessments, but focussing only on auditing financial and some administrative matters. It is confirmed that this unit has neither the capacity nor the knowledge to monitor the quality of the technical work and the regulatory processes related to safety.

As identified by EMRC in the ARM there is a lack of systematic measures in place to evaluate and improve the management system and there are no formal arrangements in place for the management of non-conformances or for the improvement of the management system. This issue is addressed in Recommendation 11.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| | Observation: EMRC Internal audit unit responsibility does not cover regulatory processes and technical matters. |
| (1) | BASIS: GS-R-3 para. 6.3 states that <i>“Independent assessments shall be conducted regularly on behalf of senior management:</i> <ul style="list-style-type: none"> - <i>To evaluate the effectiveness of processes in meeting and fulfilling goals, strategies, plans and objectives;</i> - <i>To determine the adequacy of work performance and leadership;</i> - <i>To evaluate the organization’s safety culture;</i> - <i>To monitor product quality;</i> - <i>To identify opportunities for improvement.”</i> |
| (2) | BASIS: GS-R-3 para. 6.4 states that <i>“An organizational unit shall be established with the responsibility for conducting independent assessments. This unit shall have sufficient authority to discharge its responsibilities.”</i> |
| S9 | Suggestion: EMRC should consider extending the authority and capacity of the internal audit unit to cover the responsibility of independent assessments of regulatory processes and technical matters related to safety. |

4.6. SUMMARY

The integrated management system of EMRC has recently been developed and documented in the Quality Management System Manual. The IRRS team acknowledges the work done so far and supports many of the actions that EMRC are planning to implement and improve its management system. All core regulatory and supporting processes of EMRC as well as the complexities and interactions of the processes need to be further clarified and developed.

Special attention should be given to the importance of having provisions for establishing, maintaining and retrieving adequate records; especially those that are related to the safety of facilities. EMRC should promptly implement and improve procedures for control of documents and records to cover all

directorates in order to fulfil the requirements stated in GS-R-3 for document, product and record control.

Systematic measures are not yet in place to evaluate and improve the management system including formal arrangements for the management of non-conformances. The internal audit unit does not have the authority and knowledge of making independent assessments of regulatory processes and technical matters related to safety.

5. AUTHORIZATION

5.1. GENERIC ISSUES

According to article 14 of the law No (43) of 2007 any operation involving the possession or the use of a radiation source has to be authorized. EMRC has been given the responsibility for granting licences and permits for radiation institutions, nuclear facilities, and workers in the radiation and nuclear fields.

The interviews conducted by the IRRS team about radiation sources and research reactors authorization practices show that the current authorization practices and requirements are not in accordance with a graded approach. More installation specific information and justification for this recommendation are provided in sections 5.2 and 5.3.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| | Observation: The present licensing practices of EMRC do not fully reflect the different levels of radiation risks associated with the various types of facilities and activities. |
| (1) | BASIS: GSR Part 1, Requirement 24, para.4.33 states that <i>“Prior to the granting of an authorization, the applicant shall be required to submit a safety assessment, which shall be reviewed and assessed by the regulatory body in accordance with clearly specified procedures. The extent of the regulatory control applied shall be commensurate with the radiation risks associated with facilities and activities, in accordance with a graded approach.”</i> |
| R13 | Recommendation: EMRC should further formalize the application of a graded approach in the authorization process based on the radiation risks associated with facilities and activities. Note: This Recommendation also covers issues raised in section 5.3. |

Up to now EMRC has developed only limited guidance for applicants to assist them when applying for a licence. The EMRC website has a dedicated page which provides application forms and sets out the list of documents that must be submitted by the applicant in support of different licence application types, but there is no guidance available on the format or content of these documents. In addition, no guidance has been provided for future research reactor applicants setting out the content and format requirements for the Safety Analysis Report.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| | Observation: No adequate guidance has been developed on the contents of the documents supporting the licence application for radiation sources activities and research reactors. |
| (1) | BASIS: GSR Part 1 Requirement 24, para. 4.34 states that <i>“The regulatory body shall issue guidance on the format and content of the documents to be submitted by the applicant in support of an application for an Authorization.”</i> |
| R14 | Recommendation: EMRC should develop adequate guidance on the format and content of the documents to be submitted by the applicant in support of its licence application. Note: This Recommendation also covers issues raised in section 5.3. |

5.2. AUTHORIZATION OF RADIATION SOURCES FACILITIES AND ACTIVITIES

Regulation No 8 of 2013 on the “Basis and conditions for granting licences and permits for the radiation work”, contains provisions regarding the licensing of sites, facilities and practices, as well as personal licences. The information that must be submitted in support of a licence application, as set out in this regulation, is the same for all practice and activities, with the exception of the Radiation Protection Officer (RPO) qualifications.

EMRC has published an instruction on the categorization of radiation institutions (n°1/2013) that defines the criteria for the categorization of the institutions practicing radiation work as either large, medium or small according to the nature of the activities being performed and the associated risks. This instruction also defines which sources and devices are exempted from licensing. However, for these sources and devices EMRC performs a registration process. The IRRS team considers this represents a deviation from the definition of exemption according to GSR Part 3, which defines the general criteria for exemption.

Applicants must pay a licensing fee, as set out in the Regulation on the “Fees for licences and permits for the radiation work” (n°9/2013), before the licence can be issued.

In addition to holding a licence for the site and the facility, all medical and industrial practices subject to licensing must obtain an individual radiation practice licence for each source or device used, with the exception of nuclear medicine departments and the waste store, where the radiation practice licence is given to the facility.

Veterinary facilities using X-ray equipment are presently not licensed with the exception of the JUST which has four veterinary X-ray units.

The import or export of sources in Jordan requires a permit. This permit can only be issued to a licensed user.

All the workers in the radiation field should have a personal licence or a personal permit delivered by EMRC.

Radiation practice and personal licences are issued for a period of two years, regardless of the nature of the activity or associated risks. Site and facility licences are valid indefinitely unless there is a change

The RPCD issues the licences for medical and industrial practices. All licences include a set of common conditions and additional specific conditions can be added when needed. Prior to a licence (site, facility, or radiation practice) being issued, EMRC must first carry out an inspection of the facility regardless of the nature of the activity or associated risks.

The time-frame for the application of a new licence or the renewal of a licence is not defined. As a consequence, late applications for renewals can result in facilities going on working unlicensed pending an inspection being carried out and the renewal application processed.

There is no process in place which allows the authorized party to appeal against a regulatory decision relating to an authorization. Recommendation 2 in section 1.2 addresses this issue.

A documented procedure has not been developed that describes the authorization process and practices as well as record-maintaining requirements. This is also discussed in chapter 4 and addressed in Recommendation 10 in section 3.7.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

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| | Observation: Some facilities are currently unlicensed (veterinary facilities). No time-frame is defined for the renewal application; therefore the renewal process has resulted in facilities operating without a valid licence while they wait for the renewal inspection. |
| (1) | BASIS: GSR Part 1, Requirement 23 states that “ <i>Authorization by the regulatory body,</i> |

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| | <i>including specification of the conditions necessary for safety, shall be a prerequisite for all those facilities and activities that are not either explicitly exempted or approved by means of a notification process.”</i> |
| (2) | BASIS: GSR Part 1, Requirement 23, para. 4.37 states that <i>“Any subsequent amendment, renewal, suspension or revocation of the authorization for a facility or an activity shall be undertaken in accordance with a clearly specified and established procedure, and shall make provision for the timely submission of applications for the renewal or amendment of the authorization”</i> |
| R15 | Recommendation: EMRC should ensure that all facilities and activities that require a licence according to Law No (43) of 2007 are licensed and that the licensing renewal process is revised and formalized so that it does not result in facilities operating without a valid license. Note: This Recommendation also covers issues raised in section 7.1.1. |
| | Observation: The issuing of personal licenses to all workers and of individual licenses to each device as well as the registration of exempted sources represents an administrative burden for EMRC and may not add any additional value to the radiation protection framework. |
| (1) | BASIS: GSR Part 1, Requirement 16, para. 4.5 states that <i>“the regulatory body shall allocate resources commensurate with the radiation risks associated with facilities and activities, in accordance with a graded approach.”</i> |
| S10 | Suggestion: In order to free resources to be directed to higher priority activities, EMRC should consider amending its practices of issuing personal licenses to all workers and individual licenses to each device and source, as well as the registration of exempted sources. |

A tailor-made SQL database for all licensed sources, devices, facilities and personnel has been developed in house by the RPCD. The database is installed on a computer and is backed up frequently on to the same hard disk. A back-up of the database is sent by e-mail every month to the inspector who developed the database. The database is password protected and inspectors are able to access it remotely.

The sustainability of this database is not ensured as it relies on the competencies of a single inspector. Recommendation 10 about record and data keeping in general is provided in section 3.7 and this issue is further considered in section 4.4.

RPCD maintains an excel sheet recording all imported and exported sources and devices, licensed or exempted. EMRC has also recently acquired the Radiation Sources Database (RASOD) from the US Nuclear Regulatory Commission and has started filling it in for all licensed and exempted sources and devices: the data is now complete for Amman region and remains to be completed for other regions. It is unclear whether the excel sheet will be maintained when RASOD is complete. EMRC formerly used the IAEA Regulatory Authority Information System (RAIS) database and is now considering the possibility to use it again.

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| | Observation: EMRC presently maintains three separate databases (RASOD, bespoke SQL licence database, excel sheet) for its register of sources and devices |
| (1) | BASIS : The code of conduct on the safety and security of radioactive sources para. 11 states that <i>“Every State should establish a national register of radioactive sources. This register should, as a minimum, include Category 1 and 2 radioactive sources</i> |

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| | <i>as described in Annex 1 to this Code. The information contained in that register should be appropriately protected.”</i> |
| S11 | Suggestion: EMRC should consider rationalizing the number of databases for sources to ensure that there is a single official comprehensive register of sources and devices in Jordan. |

5.3. AUTHORIZATION OF RESEARCH REACTORS

Licensing of research reactors is performed by the NSSD. EMRC licensing requirements are covered under the draft “Instruction on the Procedure for Issuing Licenses and Permits for Nuclear Facilities and Associated Activities”. Although this instruction was developed for all the Nuclear Facilities, it does not contain information regarding the application of a graded approach for Research Reactors. Updating and publishing this document will allow EMRC to have a clear licensing procedure and criteria for authorization. Recommendation 13 addresses this issues.

Currently, EMRC has a draft “Instruction on the Format and Content of Safety Analysis Report for Nuclear Facilities”, which defines the mandatory content of the Safety Analysis Report for a Nuclear Facility. Although it mentions that the information may be applicable to other facilities, other than Nuclear Power Plants, there are several aspects missing. For example, in order to make it applicable to Research Reactors, items such as a graded approach and coverage of experimental use of the facility should be added. Updating and publishing the instructions will allow EMRC to have clear criteria for assessing the licensees’ submissions, as well as clear criteria for the licensee to comply with. Recommendation 14 addresses this issue.

5.4. AUTHORIZATION OF RADIOACTIVE WASTE MANAGEMENT FACILITIES

Jordan has a radioactive waste storage facility operated by, and located at, JAEC. The facility has a site licence and a facility licence in place, however the radiation practice licence expired on 14th February 2012 has not been renewed. EMRC inspectors advised that they were awaiting the enactment of the Regulation on the Safe Use of Nuclear Energy which came into force on April 2014 so that the licence could be renewed under the new Regulation.

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| | Observation: The radioactive waste storage facility operated by JAEC is unlicensed following the expiry of its radiation practice licence in February 2012 |
| (1) | BASIS GSR Part 1 requirement 23 states that “ <i>Authorization by the regulatory body, including specification of the conditions necessary for safety, shall be a prerequisite for all those facilities and activities that are not either explicitly exempted or approved by means of a notification process.</i> ” |
| R16 | Recommendation: EMRC should immediately rectify the licensing status of the radioactive waste facility at JAEC. |

The facility accepts the transfer of disused radioactive sources from licensees in Jordan, where it is not possible to return them to the original supplier, as well as orphan sources that might be discovered. In the case of sources being transferred from a licensee to the facility the licensee must pay a fee to the waste facility.

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| | Observation: The radioactive waste storage facility operated by JAEC accepts disused radioactive sources from licensees in Jordan, when it is not possible to return them to the original supplier, as well as orphan sources that might be discovered. |
| (1) | BASIS: Code of Conduct para. 20 states that <i>“Every State should ensure that the regulatory body established by its legislation has the authority to (p) ensure that radioactive sources are stored in facilities appropriate for the purpose of such storage.”</i> |
| (2) | BASIS: Code of Conduct para. 22 states that <i>“Every State should ensure that its regulatory body: (a) ensures that arrangements are made for the safe management and secure protection of radioactive sources, including financial provisions where appropriate, once they have become disused (b) is prepared, or has established provisions, to recover and restore appropriate control over orphan sources, and to deal with radiological emergencies and has established appropriate response plans and measures.”</i> |
| GP3 | Good practice: Orphan sources and disused sources are transferred for safe storage to a radioactive waste storage facility. |

There is an arrangement in place between the waste facility and EMRC that a hard copy of the source inventory is forwarded to the regulatory body once a year. EMRC is therefore not aware of the current inventory at the waste facility at any given time. This inventory is kept in hard copy at EMRC premises and the source details are not entered into any database or electronic system.

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| | Observation: The radioactive waste storage facility operated by JAEC does not promptly alert EMRC to new sources transferred to the facility, but instead sends a hard copy of its inventory once a year. |
| (1) | BASIS: Code of Conduct para. 22 <i>“Every State should ensure that its regulatory body...maintains appropriate records..... of the transfer and disposal of the radioactive sources on termination of the authorizations. These records should be properly secured against unauthorized access or alteration, and back-up copies should be made”</i> |
| S12 | Suggestion: EMRC should consider ensuring that the radioactive waste facility at JAEC promptly notifies it of new sources transferred to it and that these records should be appropriately stored. |

5.5. AUTHORIZATION OF TRANSPORT

A licence for transport is required according to the Law No (43) of 2007 and to the regulation number 8 /2013 Article 16. This licence is valid for two years.

EMRC has adopted a requirement list to authorize the transport companies but this list does not include the emergency procedure that must be submitted by the applicant to EMRC in case of an emergency.

The licence issued does not set conditions for the amount of radioactive material that must be loaded in a single shipment (depending on the available shielding for the transport vehicle); there is also no identification of the types of radionuclides that will be transported by these companies. These instructions should be submitted by the licensee to EMRC as a part of their radiation protection program

Before issuing the licence EMRC requires that all radiation workers, including transportation workers, acquire personal dosimeters.

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| | Observation: The information to be submitted to EMRC in support of transport licence applications does not include the identification of the types and activities of radionuclides that will be transported. |
| (1) | BASIS: IAEA Safety Guide TS-G-1.3 paragraph 6.2. states that <i>“For the assessment and evaluation of transport related radiation doses, the package type, the package category, the exposure time, the dose rate, the frequency of operation, the transport volume, the use of overpacks or freight containers, the necessity of in-transit storage, the use of different modes of transport or conveyances and stowing within the conveyance should all be considered. Specific handling procedures (e.g. for small packages or packages that are remotely handled) should be taken into account.”</i> |
| S13 | Suggestion: EMRC should consider revising its requirements related to transport licence application so that they include all the relevant information mentioned in TS-G-1.3. |

5.6. SUMMARY

The authorization requirements for ionizing radiation sources, research reactors and transport are established by the legal and regulatory framework. EMRC has devoted significant resources to developing an internal database supporting the licensing process and has licensed most of the radiation sources activities. However, EMRC should ensure that all facilities that require a licence are indeed licensed and that the licensing renewal process is revised and formalized so that it does not result in facilities operating without a valid license.

Besides, the present licensing practices of EMRC do not fully reflect the different levels of radiation risks associated with the various types of facilities and activities. EMRC should further formalize the application of a graded approach, based on the radiation risks associated with facilities and activities, for the authorization process. Guidance on the contents of the licence applications should also be further developed.

EMRC currently delivers personal licenses to every worker and issues one radiation practice licence for each source or device, which represents a significant workload. In order to free resources to be directed to higher priority activities, the IRRS team suggested that EMRC should consider amending these practices as they represent an administrative burden for EMRC while they may not add any additional value to the radiation protection framework.

Concerning orphan sources and disused sources, the fact that they can be transferred for safe storage to a radioactive waste storage facility was identified as a good practice.

6. REVIEW AND ASSESSMENT

6.1. GENERIC ISSUES

NSSD has performed the review and assessment of the safety assessments submitted for the JSA and the JRTR. With respect to the review and assessment of the JRTR, NSSD adopted, in practice, the review system used by the Korean Institute of Nuclear Safety (KINS). NSSD has used a different process for the JSA but without formalizing the review and assessment process. NSSD did not, so far, document the practice used to review and assess the applicant or licensees applications. Developing a systematic review and assessment process will allow NSSD to achieve consistency, completeness and adequacy of their review and assessment of the applicants' submissions.

RPCD has a dedicated licensing section which reviews and assesses initial licence applications. There is a degree of graded approach to the assessment process as, for large institutions, EMRC sets up a technical committee to consider the licence application. The committee is composed of the director of RPCD and several inspectors. This committee assesses the licence application and issues a recommendation to the Commissioner responsible for nuclear and radiation safety as to whether the licence can be granted. The IRRS team felt that the review of routine licence applications focussed more on ensuring that the required documents had been submitted rather than reviewing or challenging the assumptions and principles that had been used in the safety assessments. There should be a document review and assessment procedures with clear criteria, sufficient depth and complete scope. There is no requirement that any modification that might significantly affect the safety of a facility or activity shall be subject to a review and assessment by the regulatory body (for instance, significant increase in the workload). There is no assessment performed periodically throughout the lifetime of the facility or the duration of the activity, to determine whether radiation risks are as low as reasonably achievable; the renewal of a licence only requires the sending of an official request and the realization of an inspection.

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| | Observation: EMRC does not have a formalized systematic process to review and assess received submissions |
| (1) | BASIS: GSR Part 1 requirement 25 states that <i>“The regulatory body shall review and assess relevant information — whether submitted by the authorized party or the vendor, compiled by the regulatory body, or obtained from elsewhere — to determine whether facilities and activities comply with regulatory requirements and the conditions specified in the authorization. This review and assessment of information shall be performed prior to authorization and again over the lifetime of the facility or the duration of the activity, as specified in regulations promulgated by the regulatory body or in the authorization.”</i> |
| (2) | BASIS: GSR Part 1 requirement 26 states that <i>“Review and assessment of a facility or an activity shall be commensurate with the radiation risks associated with the facility or activity, in accordance with a graded approach.”</i> |
| R17 | Recommendation: EMRC should develop a formal process for review and assessment of safety related applications, taking into account a graded approach. |

6.1.1. MANAGEMENT OF REVIEW AND ASSESSMENT

The review and assessment process should establish the responsibilities of the people involved in the assessment and review of the licensees' submissions. This include the responsibility of the assessors/reviewers, the project managers and the management. The process may include, but it is not limited to, the following responsibilities:

- acknowledgement of the receipt of the applicants submissions and verification of their completeness,
- planning of the review and assessment based on the priorities of the various submissions,

- definition of the purpose, the scope and the depth, and identification of the criteria of the review and assessment,
- assignment of the review and assessment tasks,
- conducting and performing the review and assessment of the submissions,
- tracking of the review and assessment progress,
- integration of the review and assessment results,
- verification of the review and assessment results, and
- approval of the review and assessment results, in terms of recommendations and regulatory decisions.

The process should also capture the quality assurance aspect, the documentation of the results and the feedback to update and improve the processes based on the lessons learned from the review and assessment, as well as to capture any new relevant information, such as regulations or guidance.

6.1.2. ORGANIZATION AND TECHNICAL RESOURCES FOR REVIEW AND ASSESSMENT

The process for the organization of a comprehensive review and assessment should ensure that there are enough resources dedicated to review and assessment of the applicants' submissions. Furthermore, EMRC staff assigned for the review and assessment should be competent and trained to conduct reviews and assessments, as already mentioned in Chapter 1 under Recommendation 6 for the establishment of a training programme.

6.1.3. BASES FOR REVIEW AND ASSESSMENT

Currently, EMRC has limited number of regulations and guidance, in particular regarding the regulations of Research Reactors. Therefore, the ability of EMRC to perform review and assessment of licensees' applications against criteria defined in regulations and clarified in guidance documents is missing. EMRC should develop review and assessment processes that capture published regulations and update the processes to capture any new regulations and guidance documents once published.

6.1.4. PERFORMANCE OF REVIEW AND ASSESSMENT

Given that there is no internal process for review and assessment of the applicants' submissions, the consistency of the review and assessment is missing. The development of the process for the review and assessment of the applications should include methods to verify the comprehensiveness as well as the quality of the safety assessments submitted by the licensees. The processes should also include the aspect related to the communication with the applicant in case there is a need for further information or clarification. Finally, arrangements for inspections should be captured in the processes for the situations where there is a need to confirm that the facilities or activities are as documented in the submissions.

6.2. REVIEW AND ASSESSMENT FOR RESEARCH REACTORS

During the interviews, it was confirmed that EMRC technical staff have difficulties in conducting internal independent verification, particularly when it comes to using safety analysis computer codes, due to a lack of training and limited access to safety analysis computer codes. The lack of training is already mentioned in Chapter 1, but it is worth highlighting its importance in this section as it limits the ability of EMRC to conduct internal independent verifications. On a number of occasions, EMRC has requested technical support from KINS and contracted Advanced Systems Technology and Management Inc. (AdSTM) as a TSO for licensing JRTR, and requested the vendor, the consortium of Korea Atomic Energy Research Institute and DAEWOO E&C, to perform additional and further safety analysis for JRTR. Similar difficulties were encountered during the licensing of the JSA. Similarly, obtaining the necessary computer codes for safety analysis would help EMRC staff to verify the licensees' submissions.

EMRC staff is currently drafting the “Regulation on Qualification and Issuing of Licenses of Specialized Training and Individual Licenses for Personnel using Nuclear Power”. This instruction should include graded approach in order to be applicable to Nuclear Facilities other than Nuclear Power Plants, in particular Research Reactors. When completed, this instruction will allow the applicant to have the information related to the personnel licensing conditions, and will provide EMRC with criteria for assessing compliance of personnel qualifications and licensing personnel.

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| | Observation: There are no requirements for qualification and certification of personnel of the research reactors. |
| (6) | BASIS: NS-R-4 para. 3.11 states that <i>“Within this general aim, the review and assessment shall have the following specific objectives:</i> <i>(a) To determine whether the applicant has the ability, reliability, resources, organizational structure and competent personnel to meet the regulatory requirements; in particular, whether the personnel requiring a licence at the research reactor facility have been appropriately and adequately trained and have been licensed.”</i> |
| R18 | Recommendation: EMRC should establish requirements for qualification and certification of the personnel of research reactors. |

The draft “Instruction on Safety of Research Reactors”, which covers the safety requirements for Research Reactors does not include acceptance criteria. The current criteria used for the JRTR, as well as for the JSA, are based on the vendors’ country requirements as well as U.S. Nuclear Regulatory Commission and IAEA requirements. Inclusion of explicit safety acceptance criteria in its instructions will assist EMRC in its review and assessment and assist the licensees and vendors in developing the design, safety analysis and safety reports for future applications.

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| | Observation: There are no safety acceptance criteria for Research Reactors |
| (7) | BASIS: NS-R-4 para. 3.13 states that <i>“States shall develop their own approach to acceptance criteria, depending upon their particular legal and regulatory infrastructures. Acceptance criteria that are chosen on the basis of suitable principles for safe design and operation shall be made available to the operating organization.”</i> |
| R19 | Recommendation: EMRC should develop safety acceptance criteria for the research reactors. |

6.3. REVIEW AND ASSESSMENT FOR TRANSPORT

The transport application should be reviewed by EMRC to cover the future transport movements of radioactive materials in Jordan which will take place from mid-2016 when Jordan starts producing radioactive materials (JRTR). EMRC, when reviewing such application should take into consideration existing internationally approved design and manufacturing of packages.

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| | <p>Observation: It is expected that in mid-2016, the Jordan Research and Training Reactor will start producing radioactive material, hence it is expected that EMRC will have to approve transport package designs.</p> |
| (1) | <p>BASIS: SSR-6 Para. 802 (a) states that: <i>“Competent authority approval shall be required for the following:</i></p> <p><i>(a) Designs for:</i></p> <ul style="list-style-type: none"> <i>(i) Special form radioactive material;</i> <i>(ii) Low dispersible radioactive material;</i> <i>(iii) Packages containing 0.1 kg or more of uranium hexafluoride;</i> <i>(iv) All packages containing fissile material unless excepted by para. 417;</i> <i>(v) Type B(U) packages and Type B(M) packages;</i> <i>(vi) Type C packages.”</i> |
| S14 | <p>Suggestion: EMRC should consider establishing processes for review, assessment and approval of package designs, taking into account existing internationally approved designs.</p> |

6.4. SUMMARY

NSSD of EMRC has performed the review and assessment of the safety assessments submitted for the JSA and the JRTR. RPCD of EMRC has a dedicated licensing section which reviews and assesses initial licence applications.

It was observed that EMRC has currently no formalized systematic review and assessment processes. For radiation sources, the routine review processes focused more on checking that the correct documents had been submitted rather than on reviewing and challenging their contents and assumptions. A recommendation was made to develop review and assessment processes which take into account a graded approach. For Research Reactors, the IRRS team has noticed that there were no requirements for qualification and certification of personnel requiring a licence, as well as that there were no defined acceptance criteria for future licensing actions. Two recommendations have been made to address these two observations. Finally, IRRS team has made a suggestion with respect to the development of processes to review, assess and approve transport package designs, taking into account existing internationally approved designs.

7. INSPECTION

7.1. GENERIC ISSUES

The majority of inspections carried out by EMRC are performed by its RPCD which is responsible for the regulation of all sources and devices outside the nuclear sector. The descriptions in this module are based upon interviews with staff in this Directorate. Inspections of the Research Reactors are carried out by EMRC's NSSD. Where inspectors from this Directorate adopt different approaches to those in the RPCD these are highlighted below.

7.1.1. INSPECTION APPROACHES, METHODS AND PLANS

Articles 5c and 10 a (4) of Law No (43) of 2007 provide EMRC with the legal authority to conduct inspections of facilities and activities to verify compliance with its licensing and regulatory requirements. Inspections are carried out prior to issuing a licence (site, facility and radiation practice), renewing an existing licence as well as for other reasons determined by EMRC.

RPCD has developed an inspection manual for its inspectors which is currently in draft form. The manual outlines the procedures and steps for inspectors when preparing for and conducting the inspection, as well as the issuing of the inspection reports. A limited number of inspection checklists for specific practices, based upon IAEA TECDOC 1526, are included as an appendix in the manual. While the manual includes a table of inspection frequencies for various types of practice, which takes account of associated risks and hazards, in practice these inspection frequencies are not used. It was noted that there was no reference in the inspection manual to veterinary practices using X-ray units or transport activities and it was confirmed during meetings with the counterparts that these practices are not inspected, since they are not licensed (see Recommendation 15 in Chapter 5).

In order to renew a licence that has expired, EMRC has to inspect the facility as part of its renewal procedures. As all licences are issued for a two year period, this means that each practice must be inspected biannually regardless of the risks associated with the practice.

While an annual inspection programme is usually developed in December for the following year, EMRC did not develop an inspection programme for 2014 due to insufficient inspector resources being available. Instead, each month a schedule of inspections is developed which takes account of those licensees that have applied for a licence renewal, licensees who have failed to apply for a renewal, those licensees which require a follow up inspection and facilities that have applied for a new licence. Therefore the inspection programme is primarily driven by both the licence renewal programme and follow up to previous inspections, rather than by the risks associated with each type of practice or activity, and accordingly the IRRS team does not consider that EMRC takes a graded approach to inspections. Recommendation 8 on inspector resources is provided in Section 3.3.

EMRC carries out both announced and unannounced inspections. Unannounced inspections are performed primarily as a follow up to a previous inspection, where a complaint or concern has been received from a third party or as a reaction to a media story. During 2013 EMRC undertook the following numbers (approximate) of inspections:

- 130 announced,
- 80 unannounced,
- 50 pre-licensing.

In addition 86 site visits were carried out to facilities to verify their source and device inventories in order to commence work on populating the RASOD database inventory of sources and devices that is in the process of being set up. During these site visits, each source and device was assigned a label displaying a unique EMRC reference code generated from the RASOD database.

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| | Observation: The inspection programme is driven by the requirement that all licensees must be inspected before their licence can be issued or renewed rather than by the graded approach where inspection frequencies are based upon the risk associated with each type of practice. |
| (1) | BASIS: GSR Part 1 Requirement 29 states that <i>“Inspections of facilities and activities shall be commensurate with the radiation risks associated with the facility or activity in accordance with a graded approach.”</i> |
| R20 | Recommendation: EMRC should reduce the influence of the current licence renewal process on its inspection programme and instead develop the programme on the basis of the radiation risks associated with facilities and activities. |

During the witnessing of a JSA inspection and the visit to JRTR site, it was noted that although EMRC inspectors could observe abnormal situations in areas such as fire protection, industrial safety and environment, they do not have powers to ensure that the licensees address these situations, nor do they have specialist training in these areas. While these may not be explicitly radiation or nuclear safety issues, they have the potential to impact nuclear safety creating concerns for EMRC as it has no authority in these areas. Examples of such issues include fire protection and industrial safety, which are respectively under the authority of the Civil Defence, which reports to the Ministry of the Interior, and the Labour Ministry. Also, nuclear activities could impact other fields such as environment and health, which are respectively under the Environment Ministry and Health Ministry. Currently, there is no formal coordination of inspection activities with other Ministries. The need for coordination, in particular inspections, with other Ministries is addressed by Recommendation 5 in section 1.5.

7.1.2. INSPECTION PROCESSES AND PRACTICES

When arranging an announced inspection a letter is sent to the facility advising it of the date of the inspection. For unannounced inspections the inspector brings with him/her a letter signed by a Commissioner which states that the unannounced inspection has been authorized. In these cases the inspector may advise the licensee by telephone that an inspection may take place during a particular week, but the exact day is not specified.

EMRC has developed inspection checklists to assist inspectors undertake inspections for a number of practices. It is clear that these are still in development and that further checklists should be developed for additional practices such as dental radiology, veterinary X-ray units, transport activities and cyclotrons.

For the Research Reactor, an inspection manual, which defines the inspection programme, is being drafted based on the U.A.E. Federal Authority for Nuclear Regulation inspection procedure that should provide guidance to inspectors.

There are no timelines set out for when the inspection findings should be sent to the licensee. In practice, for a large facility the inspector endeavours to issue the findings within one week. The inspector prepares an internal report of the inspection which is submitted to the Director of the Directorate. The Director will assess and approve the report and authorize the inspector to issue a formal inspection letter to the licensee setting out the non-compliances identified during the inspection and a deadline by when each non-compliance must be addressed – all inspection reports are signed by a Commissioner. A copy of the inspection letter is provided to the authorization section. The licensee, upon receiving the inspection report, must respond within a specified time period, usually two weeks but it can be up to a month depending on the seriousness (not defined) of non-compliances observed. If no response is received within the specified timeframe, a reminder letter is sent. Failure to respond to the reminder letter results in a follow-up inspection in all cases. If during the follow-up inspection it is noted that the inspection findings have been addressed the matter is then closed. However, if the non-compliances haven't been addressed the inspector can write to the court

in order to commence legal action. In the case of serious (not defined) non-compliances observed during inspections, EMRC will also undertake follow-up inspections to confirm that these non-compliances have been closed out when advised by the licensee. However, a documented procedure has not been developed to formalize this process.

There is also no procedure for maintaining inspection records. This is also discussed in chapter 3 and Recommendation 10.

In previous years when EMRC had larger number of staff it was possible for inspectors to specialize in either medical or industrial inspections. However, with recent losses of staff there are now fewer inspectors available and inspectors must now carry out inspections across all sectors.

EMRC does not formally analyze the findings of its inspections in order to identify areas or issues which warrant greater attention for future regulatory activities. EMRC does however hold informal monthly to bimonthly meetings for its inspectors at which progress against planned inspections and the close out of non-compliances is reviewed.

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| | Observation: EMRC has not formally developed and approved inspection procedures for all types of facilities and activities. In particular there are no inspections performed of either veterinary practices using X-ray units or transport activities. |
| (1) | BASIS: GSR Part 1, Requirement 27, para. 4.52 states that “Regulatory inspections shall cover all areas of responsibility of the regulatory body” ... |
| R21 | Recommendation: EMRC should conduct inspections and develop the associated inspection procedures to cover all facilities and activities in Jordan, including transport. Note: This Recommendation also covers issues raised in section 7.5. |

7.1.3. INSPECTORS

Inspectors are appointed by the Commissioner in accordance with Article 21 (a) of Law No (43) of 2007. While eight inspectors were appointed in EMRC’s RPCD in June 2014 only three of these routinely perform inspections; of the remaining five, one is doing the IAEA post-graduate course in radiation protection and the other inspectors are primarily dedicated to the review and assessment of licence applications.

No formal training programme has been developed for new inspectors and there are no criteria established to determine when a new member of staff is deemed competent to be appointed as an inspector. A formal competency-based training programme for inspectors should be developed and should include training on soft skills such as inspection techniques and protocols, interviewing skills, knowledge of the legislation, as well as an understanding of sector specific activities and the selection and use of equipment. Such a training programme would ensure that both newly recruited and existing inspectors are provided with the necessary skills to undertake competent and professional inspections. It would also allow EMRC to ensure that both its inspectors and inspections are consistent in their approaches. The satisfactory completion of such a training programme, should be formally recognized, possibly through certification, and used as a criteria for determining when a new staff member is deemed competent to be appointed as an inspector and carry out inspections unsupervised. Although training of EMRC staff in general is already addressed in Chapter 1, the IRRS team considers that it is important to emphasize it here for the inspectors, as it is not always feasible to obtain the support from international TSOs to conduct inspections that require an urgent presence on site. Therefore EMRC inspectors must be competent, to an appropriate level, in order to carry out inspections of all sectors it regulates. Recommendation 8 on the training of EMRC inspectors is included in section 3.3

From direct observation of inspections and interviews with EMRC staff it was apparent that in some cases the inspectors did not have sufficient training and knowledge of the facility to ensure that the inspections undertaken were comprehensive and effective. For some non-routine inspections related to specific activities at the Research Reactors, the NSSD may not have the necessary detailed expertise and in these cases EMRC will usually use the services of TSOs to assist with these inspections, though as mentioned above EMRC may not have time to wait for TSO support when an urgent response is required.

Inspectors are not provided with any warrant or means of identification which confirms that they have been appointed as inspectors of EMRC. Consequently, if challenged they are unable to produce evidence of their appointment as EMRC authorized inspectors, or of their powers as provided under Law No (43) of 2007.

Inspectors are afforded the right to enter and inspect any place suspected of containing unlicensed sources or engaging in activities in violation of the law in accordance with Article 21 of Law No (43) of 2007. However, it is not clear from the Law whether this power of entry extends to premises which are in compliance with EMRC's requirements. Individual inspectors may have implied powers of entry by virtue of Articles 5 and 10, however this could be challenged. While inspectors enjoy the privileges of judiciary members (police), this may not necessarily entitle them to enter any premises at any time. Recommendation 2 in section 1.2 addresses powers of inspectors.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| | Observation: EMRC has not established criteria for determining when a new member of staff is deemed competent to be appointed as an inspector. No formal evidence of this appointment is provided to inspectors. |
| (1) | BASIS: GSR Part 1, Requirement 18, para.4.13 states that <i>“A process shall be established to develop and maintain the necessary competence and skills of staff of the regulatory body, as an element of knowledge management. This process shall include the development of a specific training programme on the basis of an analysis of the necessary competence and skills. The training programme shall cover principles, concepts and technological aspects, as well as the procedures followed by the regulatory body for assessing applications for authorization, for inspecting facilities and activities, and for enforcing regulatory requirements.”</i> |
| R22 | Recommendation: EMRC should establish formal criteria for determining when a new staff member is deemed competent to be appointed as an inspector and provide the inspector with documented evidence of that appointment. |

7.2. INSPECTION OF RADIATION SOURCES FACILITIES AND ACTIVITIES

7.2.1. INSPECTION OF GAMMA IRRADIATION FACILITY

IRRS team members accompanied an inspection performed by EMRC inspectors of RPCD at a Gamma Irradiation Facility located at, and operated by, JAEC. The inspectors had between one and a half to two years of experience, though they had little experience of inspecting irradiation facilities. The inspectors used a one-page checklist to assist them with the inspection. The inspection comprised of :

- a meeting with the RPO and the head of the irradiation facility;
- review of records and documents;
- a walk around the irradiator facility to assess compliance with EMRC regulatory requirements. The Co-60 sources were lowered during the inspection and it was not possible to raise them in a short time from the pool as there was product in the middle of a sterilization treatment that could not be disturbed.

The IRRS team members observed that while the inspectors demonstrated a good knowledge of radiation protection issues they did not have a detailed understanding of the operation of the facility. Overall the inspection could have benefited from an inspection plan that gave a framework to the inspection. The IRRS team noted that while the inspectors focused largely on assessing compliance against regulatory requirements and on carrying out radiation measurements, there was relatively little attention given to assessing the safety culture of the facility.

The IRRS team members conducted an interview with the facility management on how inspections are conducted and the relationship between the facility and EMRC. The facility management advised that it was their experience that inspectors did not always have a detailed understanding of their work and that no information was provided in advance of the inspection on what would be required of the licensee on the day.

7.2.2. INSPECTION OF KING HUSSEIN CANCER HOSPITAL

IRRS team members accompanied an inspection performed by EMRC inspectors of RPCD at King Hussein Cancer Center located in Amman. One of the inspectors had recently joined EMRC, having previously worked for eight years as a medical physicist at the hospital. The second inspector has been an inspector with EMRC for two years.

The inspectors used a checklist to assist them with the inspection. The inspection comprised of :

- a meeting with the RPO, a medical physicist and the chief medical physicist of the facility;
- review of records and documents;
- a walk around the radiotherapy and brachytherapy department to assess compliance with EMRC regulatory requirements.

The IRRS team members observed that while the inspectors demonstrated a good knowledge of radiation protection issues and of the operation of the facility, they did not really drive the inspection as they sometimes seemed uncertain about what should be provided to them by the operator and how to assess what was provided.

At the end of the inspection, the inspectors summarized their inspection findings, some of which were challenged by the operator regarding their regulatory basis.

The IRRS team members conducted an interview with the RPO and the chief medical physicist of the facility on how inspections are conducted and the relationship between the facility and EMRC.

The IRRS team was advised that, given the nature of the activities carried out at the hospital, it would have expected an annual inspection from EMRC and was surprised that no inspection was performed in 2013.

It was appreciated that EMRC had sent the new inspection checklist in advance of the inspection so that it could prepare what was required, as no information had been provided in advance of the 2012 inspection on what would be required of the licensee.

The lack of regulations and guidelines from EMRC was highlighted as a concern as it was often unclear as to what standards EMRC was assessing the hospital against.

The training of occupationally exposed workers and EMRC's personal licensing system was also discussed. There was a concern expressed that the content of the mandatory training courses is too generic and basic and should be tailored for specific groups of workers to take account of their responsibilities and duties.

7.3. INSPECTION OF RESEARCH REACTORS

During the visit to JRTR, the IRRS team member observed that EMRC currently has a resident site inspector at the JRTR facility that follows all construction activities including concrete pouring,

welding activities, receipt of equipment etc. The resident inspector ensures generic compliance verification activities on-site and informs EMRC head office of the JRTR construction progress. In particular, the resident informs the reviewers/inspectors of any activities in their field of expertise to ensure that they can timely carry out inspections or reviews specific to their areas of expertise. EMRC is also conducting inspections at the vendor manufacturing sites in South Korea in order to verify that appropriate QA standards are being met.

The IRRS team accompanied inspectors from the NSSD on a site visit to the JRTR where it was determined that EMRC does not have a programme which specifies the inspection frequency for the JRTR. For instance, the JRTR inspections and their scope are driven by the construction activities scheduled on-site. For specific non-routine inspections where EMRC inspectors do not have sufficient detailed technical knowledge, EMRC requests the support from KINS through the special agreement signed between the two parties (EMRC & KINS). This observation was also made during the witnessing of an inspection of the JSA. The development of an inspection plan, which sets out when inspections of JSA and JRTR should be carried out, will enable EMRC to assess whether its regulatory requirements are being adequately addressed in all safety areas, particularly when both of these facilities become operational.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| | Observation: EMRC has a resident inspector at JRTR during the construction phase. |
| (9) | BASIS: GSR Part 1, Requirement 29, para. 4.52 (29) states that <i>“Regulatory inspections shall cover all areas of responsibility of the regulatory body, and the regulatory body shall have the authority to carry out independent inspections. Provision shall be made for free access by regulatory inspectors to any facility or activity at any time, within the constraints of ensuring operational safety at all times and other constraints associated with the potential for harmful consequences. These inspections may include, within reason, unannounced inspections. The manner, extent and frequency of inspections shall be in accordance with a graded approach.”</i> |
| GP4 | Good practice: EMRC has a resident inspector at JRTR construction site. |

7.4. INSPECTION OF WASTE MANAGEMENT FACILITIES

IRRS team members accompanied an inspection performed by EMRC inspectors of the RPCD at the National Waste Storage Facility operated by JAEC. The facility was unlicensed at the time of the inspection as the radiation practice licence had expired in February 2012 and had not been renewed by EMRC.

The inspectors used a detailed check list to assist them with their inspection. The inspection consisted of:

- A walk around of the waste store, which considered security aspects and on-site area monitoring;
- A meeting with the RPO and Head of the Radiation Waste Management Unit;
- A review of relevant documentation.

The IRRS team members observed that the inspectors demonstrated good knowledge of the facility and current issues and the interactions with the licensee were professional and cordial. The inspection was well structured and followed the format of the checklist.

The IRRS team members interviewed the facility management to assess the relationship between the facility and EMRC. The facility management advised that their relationship with EMRC was generally good, but was largely dependent on the inspector they dealt with at any given time. They advised that the turnover of inspectors in EMRC causes problems as new inspectors do not have a complete understanding of the facility’s work and safety aspects. It was also pointed out that a lack of

guidelines from EMRC presented some difficulties for the facility and in the absence of guidelines on transport requirements they took a decision to follow TS-R-1. Recommendation 24 in chapter 9 addresses this issue.

7.5. INSPECTION OF TRANSPORT

Based upon interviews with EMRC staff the IRRS team was informed that EMRC does not carry out any transport related inspection. Recommendation 21 in Section 7.1.2 addresses this issue.

7.6. SUMMARY

EMRC is committed to an active inspection programme. This commitment is evidenced by the ongoing development of an inspection manual and checklists, which will assist EMRC to ensure that its inspections are carried out in a structured and consistent manner.

EMRC's inspection programme for radiation sources and devices is primarily driven by the requirement to inspect all facilities and activities as a prerequisite to the renewal of an existing radiation practice licence or the granting of a new one. This means that all licensees must be inspected every two years regardless of the risks or hazards associated with the facility or activity, which is not consistent with a graded approach to inspection planning. While EMRC has developed a schedule of inspection frequencies for different types of facilities and activities, which takes account of the associated risks and hazards, it will be difficult to implement this with current resources if the licence renewal requirements, in their current format, continue to influence the inspection programme. The IRRS team recommended that EMRC develop its inspection programmes using a graded approach and that all facilities and activities are included in the scope of these programmes. The IRRS team also note that EMRC has not developed an inspection programme for research reactors and these should be included in its inspection programmes.

The inspectors that were witnessed demonstrated a good knowledge of radiation protection. The IRRS team judged that they could benefit from additional training to further develop both their soft skills and their understanding of the nature of the activities that take place at the licensees' sites so that the inspections could be more effective.

8. ENFORCEMENT

8.1. ENFORCEMENT POLICY AND PROCESSES

The different enforcement tools and powers of EMRC are described in Law No (43) of 2007. The enforcement measures provided in the Law are:

- Imposition of fines,
- Suspension of a licence,
- Revocation of a licence,
- Closure of a facility,
- Confiscation of radioactive sources, materials, equipment or devices,
- Disposal of confiscated materials,
- Imprisonment.

There is no legal basis for other enforcement tools, consistent with a graded approach, such as verbal/written notification, written warnings, imposition of additional regulatory requirements and conditions, and legal prosecutions.

EMRC has developed a draft enforcement policy which the IRRS team was advised will be issued as an instruction. The draft policy includes, as a decision making tool, a flow chart to assist EMRC staff determine the appropriate enforcement action to take. By issuing this policy as an instruction, EMRC will be seen as open and transparent organization, allowing both licensees and the public to understand how it takes its decisions in relation to enforcement actions. The IRRS team encourages EMRC to issue this policy as an instruction.

There is no provision in Law No (43) of 2007 for parties to appeal against an enforcement action carried out by EMRC. Recommendation 2 in section 1.2 addresses this issue.

8.2. ENFORCEMENT IMPLEMENTATION

EMRC has used its enforcement powers, as provided under Law No (43) of 2007 on only two occasions. On both occasions the inspector discussed the case with his/her Director who advised the then DG (of the former JNRC) that an enforcement action should be taken against a licensee. Following the approval of the former JNRC Board, the enforcement actions were then carried out.

- In 2013 the licence for a Co-60 teletherapy unit located at a hospital was revoked as the source was being used for patient treatment despite it having decayed to an activity that was no longer suitable for use.
- In 2010, the enforcement action involved an NDT company found to have been carrying out radiographic exposures in a public street during rush hour with an uncertified operator. In this case a financial penalty was imposed on the company and its licence revoked.

The IRRS team was advised that no training has been provided for inspectors on how or when the current enforcement tools provided for in the Law should be used.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| | Observation: EMRC has not established and implemented an enforcement policy to provide for a graded approach to enforcement actions. |
| (1) | BASIS: GSR Part 1 Requirement 30 states that <i>“The regulatory body shall establish and implement an enforcement policy within the legal framework”...</i> |
| (2) | BASIS: GSR Part 1, Requirement 30, para. 4.54 states that <i>“The response of the regulatory body to non-compliances with the regulatory requirements or with any condition specified in the authorization shall be commensurate with the significance for safety of the non-compliance, in accordance with a graded approach.”</i> |

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

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| R23 | Recommendation: EMRC should establish and implement an enforcement policy in accordance with a graded approach and ensure that all relevant staff are appropriately trained on enforcement actions. |
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8.3. SUMMARY

Law No (43) of 2007 provides EMRC with a legal basis for carrying out enforcement actions. These have been used successfully in recent years when two separate licensees were found to be operating outside the requirements of their licence. However the list of enforcement tools available to EMRC should be extended in the revised Law to provide for additional tools consistent with a graded approach to enforcement.

EMRC inspectors have not been trained in how or when to carry out enforcement actions. However a draft enforcement policy has been developed by EMRC which sets out the decision making process for its staff and this should be used as the basis for future training. It was noted that EMRC intends to issue the policy as an instruction which will be available to licensees and interested parties, demonstrating a commitment by EMRC to openness and transparency in terms of how it makes its enforcement decisions.

9. REGULATIONS AND GUIDES

9.1. GENERIC ISSUES

Jordan has established a legislative and regulatory framework for the use of nuclear energy, the uses of radiation sources and for the protection of people and the environment from the harmful effects of ionizing radiation. This framework consists of: Law No (43) of 2007, regulations and instructions.

9.1.1. EXISTING REGULATIONS AND GUIDES

The only published regulations at the time of the mission are:

- Regulation number 8/2013 “Basis and Conditions for Granting Licenses and Permits for the Radiation Work”;
- Regulation number 9/2013 “Fees for Licenses and Permits for the Radiation Work”;
- Regulation number 43/2014 “Safe Use of Nuclear Energy”.

The IRRS team was advised that EMRC has drafted the following regulations:

- Regulation on Radiation Protection;
- Regulation on Uranium Mining and milling;
- Regulation for the fees for nuclear facilities;

In addition, EMRC prepares instructions. The main difference between regulations and instructions is that instructions are published directly by EMRC. They are legally binding documents just like regulations.

The IRRS team was advised that EMRC has drafted the following instructions:

- Procedures of Licensing Nuclear Facilities and Associated Activities,
- Provision of Physical Protection and Security of Nuclear Facilities, Nuclear Material and Radioactive Substance,
- Conditions and Procedure for Notification about events in nuclear facilities and sites with sources of ionizing radiation,
- Licenses for Specialized Training Qualification and Individual Licenses for use of Nuclear Power,
- Fund for Decommissioning of Nuclear Facilities,
- Decommissioning of nuclear facilities,
- Nuclear emergency preparedness and planning,
- Safety of nuclear power plants,
- Safety of spent nuclear fuel management,
- Safety of Research Reactors,
- Site Survey and Site Selection for Nuclear Facilities,
- Site Evaluation for Nuclear Facilities,
- Licensing of Radioactive Waste Management Facilities,
- Transportation of Nuclear Material,
- Design Envelope for NPPs,
- Categorizing radiation facilities and activities,
- Licensing of Radiation Protection Officers,
- Dose limits,
- Safe transportation of radioactive material.

The IRRS team noticed that EMRC does not systematically prepare and issue guides. The IRRS team considers that guidance documents for licensees would be very beneficial for consistent implementation of the regulatory requirements.

Recommendation 3 in section 1.2 relates to the urgency of finalizing and issuing all pieces of the regulatory framework for nuclear and radiation safety.

9.1.2. PROCESS FOR DEVELOPING REGULATIONS AND GUIDES

In Jordan, the process for issuing regulations includes the approval by the Council of Ministers after drafting by EMRC and revised by the legislation and opinion bureau for final clearance. However, the instructions and guides are issued by EMRC.

The Legislation and Opinion Bureau in Jordan makes available all draft regulations for public comments.

EMRC does not have an internal process to develop and update regulations and instructions.

The regulations and instructions are developed on an as-needed basis and are not developed following a systematic process to ensure adequate coverage of the activities and facilities, safety and priority areas. EMRC will benefit from developing and implementing a regulations and instructions and guides development and review process.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| | Observation: EMRC does not have a process to develop and update regulations and instructions; EMRC does not develop guides. |
| (1) | BASIS: GSR Part 1 para. 4.61 (32-34) states that <i>“The regulatory body shall establish, within the legal framework, processes for establishing or adopting, promoting and amending regulations and guides. These processes shall involve consultation with interested parties in the development of the regulations and guides, with account taken of internationally agreed standards and the feedback of relevant experience. Moreover, technological advances, research and development work, relevant operational lessons learned and institutional knowledge can be valuable and shall be used as appropriate in revising the regulations and guides.”</i> |
| R24 | Recommendation: EMRC should establish and implement a process to develop and update regulations, instructions and guides. Note: This Recommendation also covers issues raised in section 7.4. |

9.2. REGULATIONS AND GUIDES FOR RADIATION SOURCES FACILITIES AND ACTIVITIES

EMRC has developed limited guidance for applicants to assist them when applying for a license. EMRC website has a dedicated page which sets out the list of documents that must be submitted in support of the following licence application types:

- Personal license,
- Radiation Practices license,
 - Nuclear medicine
 - Diagnostic radiology
 - Radiotherapy
 - Industrial
- Import of sources and devices.

However, no guidance has been developed which provides advice to applicants or licensees in the area of radiation safety.

EMRC has not developed any guidance documents for licensees which set out its standards/requirements against which it assesses licence applications, conducts inspections and takes regulatory decisions. Based upon interviews that the IRRS team members conducted with licensees,

it is clear that there is a gap in the regulatory infrastructure which creates a certain level of frustration, especially during inspections, as licensees are not clear as to what they are being assessed against.

Recommendation 3 in section 1.2 relates to the urgency of finalizing and issuing all pieces of the regulatory framework for nuclear and radiation safety.

9.3. REGULATIONS AND GUIDES FOR RESEARCH REACTORS

Draft instructions have been mainly prepared for Nuclear Power Plants as part of the national nuclear power programme. There are two research facilities that have been licensed for construction or operation based on the requirements of the countries of origin, the IAEA requirements and US NRC requirements.

The draft instruction on Safety of Research Reactors, which is based on NS-R-4, should be published. Furthermore, an instruction based on NS-R-3 for site evaluation for nuclear facilities, in particular for research reactors, should be prepared and published. Currently, there is no guidance on the application of graded approach regarding safety assessment of research reactors and preparation of the safety analysis report which is particularly important given that Jordan will have soon two operational research reactors. This guidance should be consistent with IAEA Safety Guide SSG-20. A further guidance document on commissioning of research reactors also needs to be developed since JRTR will be commissioned soon. This document should be consistent with NS-G-4.3.

Recommendation 3 in section 1.2 relates to the urgency of finalizing and issuing all pieces of the regulatory framework for nuclear and radiation safety.

9.4. REGULATIONS AND GUIDES FOR WASTE MANAGEMENT FACILITIES

Regulation on the Safe Use of Nuclear Energy No (43) of 2014 was enacted in April 2014. This will be used to licence the institutional licence for the radioactive waste storage facility located at JAEC. A draft Instruction on Licensing of Radioactive Waste Management and Spent Fuel Management Facilities has been developed but has yet to be finalized.

Recommendation 3 in section 1.2 relates to the urgency of finalizing and issuing all pieces of the regulatory framework for nuclear and radiation safety.

9.5. REGULATIONS AND GUIDES FOR TRANSPORT

EMRC has developed draft Instructions for the safe transport of radioactive materials based on IAEA Safety Standards (the Arabic translation of TS-R-1 2009).

Recommendation 3 in section 1.2 relates to the urgency of finalizing and issuing all pieces of the regulatory framework for nuclear and radiation safety.

9.6. SUMMARY

The system of regulations is enabled by the Law No (43) of 2007. EMRC has established a number of regulations and instructions aimed to ensure the radiation safety of facilities and activities existing in Jordan.

The IRRS team recognized that IAEA Requirements are not yet fully implemented in the current system of regulations, as many regulations and instructions are still in draft. They should be finalized and EMRC should establish and implement an appropriate process to develop and update these regulations, instructions and guides.

10. EMERGENCY PREPAREDNESS AND RESPONSE

10.1. GENERAL EPR REGULATORY REQUIREMENTS

Basic responsibilities

Law No (43) of 2007 requires that licensees have an emergency plan consistent with the hazards of the work and according to regulations issued by EMRC. The law gives EMRC a high level aim to protect the environment, human health and property from the hazards of contamination and exposure to ionizing radiation. This high level aim enables EMRC to undertake a role in emergency preparedness and response but the Law does not further define that role.

Requirements on Emergency Preparedness and Response (EPR) are included in the Regulation on Safe Use of Nuclear Energy which specify that EMRC should issue an instruction on Nuclear Emergency Preparedness and Planning.

This regulation requires the licensee to undertake on site planning, and requires EMRC to establish the requirements for the off site plan through instructions and require the off site plan to be developed by the Jordan National Committee for Emergency Response. The instruction on Nuclear Emergency Preparedness and Planning (which covers both nuclear and radiological emergencies) has been drafted taking GS-R-2 as one of its references.

There is no regulation addressing EPR for radiation facilities and activities. The IRRS team was informed that EMRC has decided that in the absence of this regulation for radiation facilities and activities, IAEA standards would apply. This decision was communicated to licensees by letter. In the view of the IRRS team this represents an insufficient basis for EPR requirements in radiation facilities and activities.

Currently EMRC does not have dedicated personnel working on emergency topics. Nevertheless, EPR is covered partially by NSSD and RPCD. In the view of IRRS team there should be a dedicated organizational unit to address EPR. Suggestion 5 in chapter 3 addresses the structure of EMRC.

Due to the lack of organizational focus and limitation on resources, EMRC has not been able to adequately consider EPR on its regulatory system, or confirm that the licensee has adequate arrangements on EPR.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| | <p>Observation: Current legal and regulatory framework does not fully cover emergency preparedness and response for licensees.</p> |
| (1) | <p>BASIS: GS-R-2 para. 3.8 states that <i>“The regulatory body shall require that arrangements for preparedness and response be in place for the on-site area for any practice or source that could necessitate an emergency intervention ... The regulatory body shall ensure that such emergency arrangements are integrated with those of other response organizations as appropriate before the commencement of operation. The regulatory body shall ensure that such emergency arrangements provide a reasonable assurance of an effective response, in compliance with these requirements, in the case of a nuclear or radiological emergency. The regulatory body shall require that the emergency arrangements “shall be tested in an exercise before the commencement of operation ...”</i>”</p> |
| R25 | <p>Recommendation: EMRC should complete the regulatory framework for EPR and ensure that licensees have adequate arrangements in place to respond to nuclear and radiological emergencies.</p> <p>Note: This Recommendation also covers issues raised in sections 10.2, 10.3, 11.2.14.</p> |

Assessment of threats²

The draft Instruction on Nuclear Emergency Preparedness and Planning requires an analysis of the radiological hazards in Jordan to be undertaken. In this instruction, the nuclear and radiation related threats are grouped according to the threat categories shown in Table I of GS-R-2, which establishes the basis for developing generically optimized arrangements for preparedness and response in case of nuclear or radiological emergency.

At the national level, a comprehensive threat (hazard) assessment has not been developed but the Jordan National Committee for Emergency Response is currently working on it. There is a national emergency plan covering only conventional emergencies (which is partially confidential) under the Ministry of Interior. EMRC is currently working on the draft of the nuclear and radiological section of this plan.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| | Observation: Currently there is no comprehensive national threat (hazard) assessment. |
| (1) | BASIS: GS-R-2 para. 3.15 states that <i>“The nature and extent of emergency arrangements [for preparedness and response] shall be commensurate with the potential magnitude and nature of the [threat]... associated with the facility or activity.” (Ref. [10], para. 6.4.) The full range of postulated events shall be considered in the threat assessment. In the threat assessment, emergencies involving a combination of a nuclear or radiological emergency and a conventional emergency such as an earthquake shall be considered. Any threat associated with nuclear facilities in other States shall also be considered ... The threat assessment shall be so conducted as to provide a basis for establishing detailed requirements for arrangements for preparedness and response by categorizing facilities and practices consistent with the five threat categories shown in Table I.”</i> |
| (2) | BASIS: GS-R-2 para. 3.16 states that <i>“Operators, the national coordinating authority (see para. 3.4) and other appropriate organizations shall periodically conduct a review in order to ensure that all practices or situations that could necessitate an emergency intervention are identified, and shall ensure that an assessment of the threat is conducted for such practices or situations. This review shall be undertaken periodically to take into account any changes to the threats within the State and beyond its borders, and the experience and lessons from research, operating experience and emergency exercises.”</i> |
| S15 | Suggestion: EMRC should consider continuing the cooperation with other relevant organizations to develop a comprehensive national threat (hazard) assessment. |

10.2. FUNCTIONAL REGULATORY REQUIREMENTS

Establishing emergency management and operations

The draft Instruction on the Safety of Nuclear Power Plants contains requirements on arrangements for prompt recognition of emergencies, timely notification and alerting of response personnel, situation assessment on the progress of the accident, its consequences and required mitigation measures, and provision of the necessary information to authorities. These arrangements shall be established from the time that nuclear fuel is brought to the site, and completed before the

² The term “threat” is being used in this module under the meaning of GS-R-2 IAEA requirement. Nonetheless, it should be considered that the new version of this document will use the term “hazard”.

commencement of fuel loading. However, the Instructions only require these arrangements to be established at a general level. Detailed guidance is expected to be developed at a later date.

Identifying, notifying and activating

Requirements for licensees to classify emergencies are included in the draft Instruction on Nuclear Emergency Preparedness and Planning, to facilitate the identification of nuclear or radiological emergency and to start the emergency response actions. This classification system is in line with the requirements in GS-R-2.

The draft Instructions include arrangements for prompt recognition of emergencies, timely notification and alerting of response personnel, situation assessment on the progress of the accident, its consequences and needed mitigation measures, provision of the necessary information to authorities.

The scrap metal issues are controlled by EMRC's BCD. There are portal monitors in some of these facilities but currently no formal procedures have been established in event of a detection of a radioactive source.

In the case of emergencies involving an orphan source or radioactive contamination, the notification is sent to this directorate who activates EMRC's response.

Taking mitigatory actions

The draft Instruction on the Safety of Nuclear Power Plants contains requirements for NPP operator to ensure plant safety, including implementing measures for accident prevention and mitigation of their consequences. This instruction also contains requirements on the emergency preparedness and mitigatory actions.

The draft Instruction on Nuclear Emergency Preparedness and Planning defines mitigatory actions, but there are no requirements specified for these actions.

Taking urgent protective action

The draft Instruction on Nuclear Emergency Preparedness and Planning contains requirements for urgent protective actions and intervention levels for the protection of public in an emergency. These requirements are in line with the GS-R-2.

The emergency planning zones are also defined in this draft. However the draft does not include criteria on how to define the radii of the zones.

Providing information and issuing instructions

Some of the draft instructions include references to communication with the public. The Safety of Nuclear Power Plants instruction indicates that emergency preparedness shall be coordinated and communicated with the public in a timely manner. Similarly, the Regulation on the Safe Use of Nuclear Energy requires the licence (nuclear facilities) to ensure that information is provided to the public (and other entities) when necessary.

The responsibility for providing information to the public in case of radiological or nuclear emergencies has not been delegated to a body (or bodies).

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| | Observation: Current legislation does not clearly assign responsibilities for the roles (including EMRC's) on providing information and issuing instructions to the public during emergencies. |
| (1) | BASIS: GS-R-2 para. 4.82 states that <i>“All practicable steps shall be taken to provide the public with useful, timely, truthful, consistent and appropriate information throughout a nuclear or radiological emergency.”</i> |
| (2) | BASIS: GS-R-2 para. 4.83 states that <i>“Arrangements shall be made for: providing useful, timely, truthful, consistent and appropriate information to the public in the event</i> |

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| | <i>of a nuclear or radiological emergency; responding to incorrect information and rumors; and responding to requests for information from the public and from the news and information media”.</i> |
| (3) | BASIS: GSR Part 1 para. 2.23 states that <i>“The government shall specify and shall assign clear responsibilities for decision making in an emergency, and shall make provision for effective liaison between authorized parties and competent authorities and for an effective means of communication”.</i> |
| S16 | Suggestion: EMRC should consider defining its role in public communication on emergency preparedness and response, in cooperation with relevant governmental organizations. |

Protecting emergency workers

The IRRS team was informed that the facility’s Radiation Protection Officer (RPO) is responsible for the protection of emergency workers on-site. However, it is not clear who is responsible for protecting emergency workers off-site.

First responders have been provided with some equipment for detecting radiation but as it was recently found by EMRC, this equipment may not be enough to respond to radiation emergencies and it is not periodically calibrated. The IRRS team was advised that a government project to address these issues is expected to be initiated.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| | Observation: The responsibilities for the protection of emergency workers (on-site and off-site), are not clearly specified by the legislation. There is no guidance on the management, control and recording of doses received by emergency workers. |
| (1) | BASIS: GS-R-2 para. 4.60 states that: <i>“National guidance that is in accordance with international standards shall be adopted for managing, controlling and recording the doses received by emergency workers. This guidance shall include default operational levels of dose for emergency workers for different types of response activities, which are set in quantities that can be directly monitored during the performance of these activities (such as the integrated dose from external penetrating radiation). In setting the default operational levels of dose for emergency workers the contribution to doses via all exposure pathways shall be taken into account.”</i> |
| (2) | BASIS: GS-R-2 para. 4.65 states that <i>“The [person within each response organization] responsible for ensuring compliance with the requirements [for the protection of workers undertaking an intervention] shall be specified in emergency plans [and procedures].”</i> |
| S17 | Suggestion: EMRC should consider clarifying the allocation of responsibilities for the protection of emergency workers (on-site and off-site) and issuing guidance on the management, control and recording of emergency workers exposure. |

Assessing the initial phase

It is established in the draft instructions that it is the operator’s responsibility to make a situation assessment if an emergency occurs, to define its consequences and to define and implement mitigatory actions. Operational intervention levels are not defined in this draft.

During EMRC inspections of licensees, EPR elements are considered as part of the general inspection procedure. Nonetheless, current arrangements do not include the need to verify the ability of the licensee to assess the initial phase during an emergency.

Currently EMRC does not verify that the licensee has arrangements in place to recognize emergencies and trigger its response actions. EMRC should ensure that operators have in place arrangements to

promptly identify and activate appropriate actions to mitigate the potential consequences of a nuclear or radiological emergency. This issue is covered in recommendation 25.

Managing the medical response

A committee has been established, led by the Ministry of Health, to deal with occupational exposure. This committee is expected to be convened in the event of an emergency to provide support in the treatment of patients as needed.

As per the draft regulations, the RPO of the facility is responsible for the on-site response in emergency situations and it is foreseen that this RPO will coordinate the medical response. However, the current legislation does not include requirements for licensees on initial medical treatment in case of overexposure.

Current legislation does not include requirements for licensees of category III facilities (emergency threat categories) to have arrangements in place to provide first aid to overexposed or contaminated persons on its premises. However, for categories I and II facilities these arrangements are required. EMRC should ensure that the operators of category I and II facilities have in place arrangements for first aid, estimation of doses, medical transport and initial medical treatment of contaminated or overexposed persons. These arrangements should also ensure coordination with the national radiation emergency plan once it has been approved. Recommendation 25 addresses the need for a comprehensive regulatory framework for EPR and for licensees to have adequate arrangements in place..

Other activities in emergency preparedness

Criteria for agricultural countermeasures against ingestion and longer-term protective actions; mitigation of non-radiological consequences and recovery actions are not defined yet. As advisor to the Government, and coordinator of the Jordan National Committee for Emergency Response, it would be expected that EMRC ensures that these elements are included in the emergency plan.

10.3. REGULATORY REQUIREMENTS FOR INFRASTRUCTURE

Authority

According to the Regulation on the Safe Use of Nuclear Energy, the on-site emergency plan for all facilities must be approved by EMRC. The regulatory body is responsible for ensuring that on-site emergency arrangements provide a reasonable assurance of an effective emergency response.

Once the National Emergency Plan is drafted, it should be approved by the Higher Council of Civil Defence and the plan is expected to be integrated in the National emergency Plan for Conventional Emergencies.

Organization

The draft Instruction on Nuclear Emergency Preparedness and Planning requires the operator, EMRC and other involved organizations to identify the knowledge, skills and abilities necessary to perform the emergency response functions as specified in the regulation, as well as making arrangements for the selection and training of personnel in order that they can undertake the necessary emergency response actions.

Coordination of emergency response

The Higher Council of Civil Defence headed by Ministry of Interior, coordinates all type of emergencies at the national level as per Civil Defence Law No. 18/1999 Art 3. The Jordan National Committee for Emergency Response is expected to define the role of relevant organizations having responsibilities in nuclear and radiological emergencies. EMRC is chairing this committee. Currently EMRC's advises to both the Government and response organizations during the planning process related to a nuclear or radiological emergency.

Plans and procedures

Among the conditions established for the licensee (in draft regulations and instructions) is a requirement that it prepares an emergency plan and obtains approval from EMRC before commencing operations. An on-site emergency plan for the research reactor currently under constructions has been prepared by the operator (JAEC) and is currently being reviewed and revised by the Jordan National Committee for Emergency Response.

For licensees using only radioactive sources, Article 12 of Regulation on the “Basis and conditions of granting licenses and permits for radiation works” No 8 of 2013, classifies the facilities as either, small, medium or large. An on-site emergency response plan is only required for licensees that are categorized as large facilities. The emergency plan prepared by these facilities is reviewed and approved by EMRC during the licensing process. There are no requirements on the content of these emergency plans.

The inspector assessing the licence application is responsible for reviewing the emergency response plan, based on an internal sheet which serves as reference. However, the IRRS team found that the review of these plans is not made in a consistent and effective manner and is not a clear regulatory requirement. Thi issue of a comprehensive EPR regulatory framework is covered in Recommendation 25.

Logistical support and facilities

The draft Instruction on Nuclear Emergency Preparedness and planning, requires that adequate tools, instruments, supplies, equipment, communication systems, emergency facilities and documentation, needed to provide adequate response in case of emergency, should be listed in the emergency plan(s) and their availability should be ensured.

This draft also specifies that equipment used for emergencies should, if possible, be the same as that used in normal situations but with controls to ensure that their availability is not compromised - the intention being that operators would be familiar with the operation of the equipment. It is also a requirement that this emergency logistical support is defined and described in the on-site emergency plans.

Training, drills and exercises

According to the Regulation on the Safe use of Nuclear Energy the licensee shall conduct training, drills and exercises. The draft Instruction on Nuclear Emergency Preparedness and Planning requires that the staff and organizations shall be regularly involved in drills and exercises to ensure that they are able to effectively perform their assigned response functions. It is also a requirement that the performance of these exercises shall be evaluated by the exercise organizer and other independent expert organizations against established response objectives. Currently, these requirements are not being fully implemented by EMRC regulatory system.

Large facilities (as per EMRC definition) are required to carry out an annual exercise to test their EPR arrangements, but sometimes these are only carried out every two years and only cover on-site response. The plans are reviewed by EMRC against a checklist.

Quality assurance programme

As mentioned in the draft Instruction on Nuclear Emergency Preparedness and Planning, the licensee of nuclear facilities is expected to prepare and implement a comprehensive quality assurance programme covering all activities which should include the emergency preparedness and response. Furthermore, the programme should ensure a high degree of availability and reliability of all supplies, equipment, communication systems and facilities, plans, procedures and other arrangements necessary to perform the critical response functions.

10.4. ROLE OF REGULATORY BODY DURING RESPONSE

The IRRS team was advised that EMRC plans to propose that Jordan National Committee for Emergency Response define, within the national emergency plan, the EMRC response role.

Under current arrangements, EMRC is the initiator of the national response. EMRC has designated some contact points for this purpose, however these contacts currently cannot provide a 24/7 response capability. Once a notification about an emergency is received, EMRC would activate its response. In responding to the emergency the equipment routinely used for inspections would be used. As stated in section 4 of this report, EMRC management system does not include EPR elements.

The IRRS team was informed that EMRC responses to previous radiological emergencies had required consultation with member of the Jordan National Committee for Emergency Response. This resulted in a case by case approach rather than a systemic response to this type of emergencies.

As part of its training activities, a dirty bomb scenario exercise was run some years ago. EMRC personnel also participated in IAEA training courses for first responders.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| | Observation: EMRC does not have its own comprehensive emergency response system to fulfil all its responsibilities during an emergency. |
| (1) | BASIS: GS-R-2 para. 5.10 states that <i>“In planning for, and in the event of [a nuclear or radiological emergency], the regulatory body shall act as an adviser to the government and [response organizations] in respect of nuclear safety and radiation protection.” (Ref. [10], para. 6.6.).”</i> |
| (2) | BASIS: GS-R-2 para. 5.31 states that <i>“The operator and the response organizations shall identify the knowledge, skills and abilities necessary to be able to perform the functions specified in Section 4.”</i> |
| R26 | Recommendation: EMRC should develop its own emergency response arrangements including plans, procedures, training and drills. |

10.5. SUMMARY

Law No (43) of 2007 provides the basis for Emergency preparedness and response and leads to the development of regulations and instructions. There is a draft Instruction on Nuclear Emergency Planning and Preparedness, which considers as its main reference IAEA GS-R-2. However, this legislation does not assign comprehensive requirements to licensees on emergency preparedness and response. Emergency preparedness and response elements in EMRC are covered partially by two directorates and there is no dedicated personnel working on this topic. As a result, EMRC does not ensure that emergency preparedness and response is systematically considered throughout its regulatory system.

Currently there is no comprehensive national threat (hazard) assessment. As advisor to the Government, EMRC should continue its efforts to improve this situation as its role in this process, is increasingly being recognized by relevant organizations.

While EMRC has a role during the response to emergencies in its capacity as a regulatory body, it does not have its own comprehensive emergency response system to fulfil all its responsibilities during an emergency.

11. TAILORED MODULE FOR COUNTRIES EMBARKING ON NUCLEAR POWER (SSG – 16)

11.1. INTRODUCTION TO TAILORED MODULE FOR COUNTRIES EMBARKING ON NUCLEAR POWER

Scope of the review of the tailored module

During the IRRS preparatory meeting, Jordan requested the inclusion of the tailored module for countries embarking on nuclear power to be included in the scope of the IRRS, specifically for countries in Phase 2 – Safety infrastructure preparatory work for construction of a nuclear power plant (NPP) after a policy decision has been taken. As stated in the IRRS Guidelines, this tailored module comprises a review against actions set out in IAEA Safety Guide SSG-16, “Establishing the Safety Infrastructure for a Nuclear Power Programme,” and the IAEA requirements on which the actions are based.

Jordan has an existing regulatory framework for the oversight of the facilities and activities. There is overlap within the scope of the elements of SSG-16 and of the IRRS modules. In the areas of overlap, the IRRS team documented its review within the IRRS modules, provided the appropriate cross references in the SSG-16 elements, and limited the discussion in the tailored module to the supplemental information in support of the nuclear power programme. Appendix VI “List of IRRS Mission Findings related to the Tailored Module for Countries Embarking on Nuclear Power” provides a cross-reference of findings in this chapter to the other chapters in the report.

Summary of the Jordan Nuclear Power Programme

In November 2006, a high-level Ministerial Committee chaired by the Prime Minister was established to develop a roadmap for implementing the nuclear energy programme. The Committee set up the Nuclear Energy Programme Implementing Organization (NEPIO) and established a goal of providing 30 percent of electricity from nuclear by 2030. In July 2007, two Laws, Nos. (42) and (43), established the JAEC and the JNRC respectively. JNRC was designated as the regulatory body to ensure the safety of the nuclear power programme, along with other uses of ionizing radiation. In April 2014, new legislation in Law No. (17) of 2014 merged the JNRC into the EMRC which will now carry out the regulatory oversight of radiological safety, including the safety of the nuclear power programme. JAEC is an independent body mandated to articulate a vision, strategy, and roadmap to develop the use of nuclear technology for research applications and generating electricity. JAEC now acts as the effective NEPIO for Jordan. JAEC will also assist in creating the future operating organization for the first potential NPPs in Jordan. It is envisioned that the operating organization will be partially owned by the Government of Jordan and international investors. The potential NPP would be composed of two pressurized water reactors, based on the Russian AES-92 at the Al Samra site. The net-generation capacity is about 1,000 MWe per reactor, and the plant is expected to be in operation during 2023-2025 with a life time of 60 years.

The Project is intended to be implemented on a two-phased approach. The first stage (Pre-Investment Phase (PIPh)) includes concluding all financing requirements, site characterization and environmental impact assessment. Stage two (Investment Phase) of the project is the implementation and construction phase.

Currently, JAEC is conducting negotiations with the potential reactor vendor on two parallel tracks. First, there is the Project Development Agreement (PDA) where all activities and responsibilities related to the project during the PIPh is addressed and agreed upon and will be approved by the Cabinet. Second, the Inter-Governmental Agreement, which is a political framework agreement related to the project, is also being negotiated and finalized between the Governments of Jordan and the Russian Federation. Both agreements will focus on defining the responsibilities between both parties before the start of investment and construction activities, and are expected to be signed by the end of the second quarter of 2014.

11.2. CONSIDERATION OF ELEMENTS OF SSG-16

Each of the SSG-16 elements is considered in the following sections. SSG-16, Element 18 - Preparation for Commissioning does not contain any actions in Phase 2 and is therefore out of the scope of this IRRS mission.

11.2.1. SSG-16 Element 01 National Policy and Strategy

The IRRS team's views on the Jordanian national policy and strategy for nuclear safety infrastructure are set out in Section 1.1 in this report. Additional observations with regard to the development of an infrastructure for a new nuclear power programme are considered below.

In September 2011, JAEC, in its capacity as the Nuclear Energy Programme Implementing Organization (NEPIO), issued a document titled "White Paper on Nuclear Energy in Jordan." The IRRS team was advised that this white paper was initiated by the Prime Minister and is considered to encapsulate the nuclear power programme policy and strategy for Jordan. The IRRS team found that the white paper does provide the justification as to why a nuclear power programme should be pursued in Jordan and the overall benefit it would provide the country. Specifically, a nuclear power programme would help improve the severe electricity supply issues that are hampered by unreliable fuel supplies to current fossil generating stations, assist in addressing water supply issues, and provide an overall improvement to the economy. The white paper captures many of the initiatives undertaken by the high-level government, JAEC, and EMRC to implement a nuclear power programme. For example, it identifies a number of conventions for which Jordan has signed, the necessary activities that are on-going to prepare the regulatory framework for safety, competence building, research and development, and potential environmental, social, and economic impacts of a prospective nuclear power programme. The white paper addresses the relevant IAEA standards and expectations, and refers to the legal bases through which safety will be assured throughout the life cycle of a new NPP. Therefore, while the white paper is not necessarily in the same form as a policy or a strategy document, it summarizes the strategy of the Jordanian nuclear power programme that has been taking place for approximately seven years. Overall, the white paper demonstrates that the government is fully aware that embarking on a nuclear power programme implies a firm and long-term commitment to maintaining activities that are necessary for safety. In addition, the government has taken due account of the assessment of the elements of the safety infrastructure and of the fundamental principle of justification when making a decision on whether or not to introduce a nuclear power programme.

Going forward, the government should develop an integrated strategy that involves all stakeholders involved in the nuclear power programme (regulatory body, operating organization, educational resources, industrial capabilities, etc.) in order to support overall government planning, budgeting, and allocation of resources (technical, legal, human, financial, and others) to support safe implementation of the nuclear power programme. The integrated strategy should identify specific goals, milestones, and dependencies between stakeholders and be periodically reviewed by the government and updated accordingly. Such a strategy will help address key elements for EMRC, such as the ability to hire and retain adequate numbers of competent staff, as it will need to prepare for regulatory oversight of a nuclear power programme.

The IRRS team reviewed Law No. (43) of 2007 which gives EMRC the authority to implement their safety responsibilities with regards to a nuclear power programme. While the law does not specifically address the nuclear power programme, it does provide a high-level framework from which regulations can be developed to ensure the safety of NPPs. Section 1.2 of the report provides additional discussion on the law.

The IRRS team discussed the approach that the Government of Jordan has put into place to promote knowledge transfer to support the development of the safety infrastructure for the nuclear power programme. The IRRS team noted that the government has put into place a number of agreements with organizations in other states involved in the nuclear power programme (see summary in SSG-16 Element 2 below). The government has further engaged with organizations within Jordan to promote the development of a national capability to support a long-term nuclear power programme, which includes interaction with academic and research institutions.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

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| | Observation: The government does not have an integrated national strategy for pursuing a nuclear power programme that effectively addresses challenges to safety for future activities. |
| (1) | BASIS: GSR Part 1, Requirement 1 states that <i>“The government shall establish a national policy and strategy for safety, the implementation of which shall be subject to a graded approach in accordance with national circumstances and with the radiation risks associated with facilities and activities, to achieve the fundamental safety objective and to apply the fundamental safety principles established in the Safety Fundamentals.”</i> |
| (2) | SSG-16, Action 8, states that <i>“The government should ensure that all the necessary organizations and other elements of the safety infrastructure are developed efficiently and that their development is adequately coordinated.”</i> |
| S18 | Suggestion: The government should consider developing an integrated national strategy for the nuclear power programme going forward that identifies and addresses potential challenges to safety, involves all interested parties, and is periodically updated. |

11.2.2. SSG-16 Element 02 Global nuclear safety regime

Jordan’s participation to the global nuclear safety regime is discussed in Chapter 2 of this report. Considering that Jordan is a country embarking on nuclear power, its participation in the global nuclear safety regime is satisfactory except for the limited participation in the 6th Review Meeting of the Convention on Nuclear Safety which was held in 2014. Jordan submitted its national report late, only submitting the report immediately before the meeting took place so that the report could not have been subjected to the review process by the contracting parties of the Convention. The IRRS team identified this as an important issue and recommends that Jordan actively participates in the review process of the Convention in order to demonstrate its commitment to nuclear safety and fulfil its obligations on the international conventions to which it is a party. Recommendation 7 raised for this issue is presented in Section 2.1 of this report.

Jordan is party to the main international safety instruments except the Joint Convention on the Safety of Spent Fuel Management and Safety of Radioactive Waste Management. The process for ratification of the Joint Convention has been started in the country. Recommendation 7 raised for this issue is presented in Section 2.1 of this report. Jordan is member of the four safety standards committees of the IAEA (RASSC, NUSSC, WASSC, TRANSSC) and attends the meetings of the committees.

The IRRS team found that Jordan signed several cooperation agreements on the peaceful use of nuclear energy with other countries, including several countries with advanced nuclear power such as Canada, Republic of Korea and USA. EMRC is negotiating a similar arrangement with the Russian Federation’s regulatory body, which is the vendor country of the Jordanian NPP. The IRRS team suggests that EMRC should consider extending its cooperation to the vendor country of the selected reactor type by concluding the negotiations and extending its cooperation with other countries having similar reactor design. Another option is to participate in the international forums, including the Multinational Design Evaluation Program’s VVER Design Working Group.

EMRC is a member of the Regulatory Cooperation Forum and Arab Network of Nuclear Regulators. It is actively cooperating with the IAEA and European Commission to get assistance to establish the nuclear safety infrastructure in the country. It has been using IAEA services, including the technical review missions, INIR and IRRS missions in order to establish and improve the necessary infrastructure for nuclear safety starting from the early stages of its nuclear power programme. The IRRS team found this recommendable to the other embarking countries and a good practice is identified in Section 2.1 of this report.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

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| | <p>Observation: EMRC has several bilateral cooperation agreements with regulatory bodies of other countries but not with the vendor country and the countries with similar reactor type.</p> |
| (1) | <p>BASIS: GSR Part 1, Requirement 15, Para. 3.4, states that <i>“The regulatory body shall establish and maintain a means for receiving information from other States and from authorized parties, as well as a means for making available to others lessons learned from operating experience and regulatory experience.”</i></p> <p>SSG-16, Action 19, states that <i>“The regulatory body should implement a cooperation programme with the vendor State and with other regulatory bodies that have experience of oversight of NPPs of the same type as that selected.”</i></p> |
| S19 | <p>Suggestion: The regulatory body should consider establishing cooperation with regulatory bodies of the vendor country and countries with NPPs of the same type.</p> <p>Note: This Suggestion also covers issues raised in section 11.2.4.</p> |

11.2.3. SSG-16 Element 03 Legal framework

Law No (43) of 2007 and Regulation on the Safe Use of Nuclear Energy No (43) of 2014 provide the essential elements of the national legal framework for nuclear safety in Jordan. Details on the legal framework are discussed in Section 1.2 of this report.

Law No (43) of 2007 provides high level requirements on the licensing of nuclear facilities and radiation protection whereas the Regulation No (43) of 2014 provides the principles of nuclear safety including the prime responsibility of the operator and protection of the people and the environment from the harmful effects of the ionizing radiation. Regulation No (43) also sets out the list of activities which require licenses and permits, responsibilities of the licence holders, emergency management requirements and security and safeguard requirements. EMRC issued and drafted a number of instructions. “Instruction on the Procedure for Issuing Licenses and Permits for Nuclear Facilities and Associated Activities (draft)” provides the process and procedure for the licensing of NPPs.

On March 31, 2014, Law No (17) of 2014 was issued, which restructured various parts of the government. Among the agencies that were restructured, the JNRC was discontinued and its rights, obligations, and assets became those of the EMRC. In addition to the JNRC, EMRC includes the Electricity Regulatory Commission and the Natural Resources Commission. A new law has been drafted in order to establish the organization, roles and responsibilities of the newly created EMRC. The IRRS team recommends enacting the draft law in a timely manner to provide the legal framework for nuclear safety, which is essential to the safe implementation of the nuclear power programme. The recommendation 2 raised for this issue is presented in the Section 1.2 of this report.

The issue of having different regulatory functions in one organization and the potential clash on the decision making was discussed in Section 1.3 of this report, and recommendation 4 was raised.

11.2.4. SSG-16 Element 04 Regulatory framework

The IRRS team’s review on the independence of the regulatory body and appointment of senior managers is provided in Section 1.3 and 3.2 of this report, respectively. Additional observations with regard to the regulatory framework specific to the nuclear power programme are considered below.

Regarding the regulatory approach to licensing a potential NPP, EMRC decided to utilize a mixed approach (mixture of prescriptive and performance based), which allows flexibility and balances the needs for staffing expertise. The approach and regulatory documents are based on Bulgarian regulations. EMRC views the Bulgarian regulations as compatible with IAEA and WENRA recommendations, and the size of the nuclear power programme in Bulgaria is similar to that of

Jordan, if the proposed nuclear power programme moves forward. In the proposed Jordanian approach, both deterministic and probabilistic assessments are required in the safety assessment. The probabilistic assessment is used to support and inform the deterministic assessment to reach an overall safety conclusion.

Instructions are mandatory and provide practical requirements on specific subjects. There is no guidance set by EMRC, including codes and standards. In the Jordanian regulatory framework, applicants need to specify and justify the acceptability of the codes and standards that guide the construction of a nuclear power plant. This approach allows flexibility for the designers and prevents established reactor designs from making design changes solely due to regulatory framework differences and not safety reasons. However, this approach will require the applicants and licensees to clearly understand EMRC expectations expressed in the instructions. Early communication with the operating organization on application of the regulations and instructions will help ensure both parties have a common understanding since there is no guidance. In some cases, guidance may be needed on issues such as how the licensing process will be implemented in practice.

Law No (43) of 2007 includes the list of regulations to be developed in order to support the execution of the law. Among them, Regulation on the Safe Use of Nuclear Energy providing the framework for the nuclear safety was issued in April 2014. Based on this regulation, EMRC drafted a number of instructions, including “Instruction on the Safety of Nuclear Power Plants” and “Instruction on the Procedure for Issuing Licenses and Permits for Nuclear Facilities and Associated Activities,” in order to setup the practical and technical requirements for the implementation of the licensing and inspection activities concerning the nuclear power programme. EMRC is planning to issue all the draft instructions once the new draft Law on Energy and Minerals Authority is issued. The JAEC and EMRC are utilizing those draft instructions in this stage of embarking on a nuclear power programme. The IRRS team found that utilizing the draft documents during the early stages of the project could potentially create issues and problems later during the implementation of the project. The IRRS team recommends issuing the draft regulations and instructions in an urgent manner. Recommendation 4 raised for this issue is presented in Section 1.2 of this report.

The laws and regulations are published in the Official Gazette of Jordan, whereas instructions are not. EMRC announces the regulations and instructions through its web site. In addition to this, when a new legal document is issued, it is communicated to interested parties, including applicants and licensees, by sending them official letters. EMRC established a committee with three members from JAEC to discuss drafts of regulations and instructions in order to allow them to comment on the draft texts and to be aware of the requirements from the beginning of their development. Ultimately, EMRC is responsible for the final content of the instructions.

EMRC “Instruction on the Procedure for Issuing Licenses and Permits for Nuclear Facilities and Associated Activities” provides fixed timelines for issuing licenses and permits, particularly for NPPs. The IRRS team found that this could place unnecessary pressure and complications on EMRC since they are contained in legal requirements. Experience from other countries licensing new NPPs has shown that the licensing schedule is often influenced by factors outside the control of the regulator, such as lack of or delays in providing adequate information to the regulator by the applicant. An alternative practice may be to provide timeliness goals in an overall strategy document with accompanying assumptions on the quality and timeliness of all stakeholders involved. The IRRS team found that communication between JAEC and EMRC is based on mutual understanding. Communication channels between the two organizations are established and implemented efficiently. There is a written protocol for communication between EMRC and JAEC that was implemented during the licensing of JRTR. It is expected that a similar protocol will be utilized during the licensing of the NPP.

As discussed in Section 11.2.2 of this report, EMRC has several bilateral agreements with the regulatory bodies of other countries, and negotiations are underway with the regulatory body of the potential vendor country. Suggestion 19 was raised for this issue in Section 11.2.2 of this report.

11.2.5. SSG-16 Element 05 Transparency and openness

The IRRS team’s consideration of the Government of Jordan’s approach to communicating and consulting with interested parties and the general public is set out in Section 3.8 of this report. With regard to the nuclear power programme, it is notable that the government initiated work to prepare and educate the general public to understand the nature of the nuclear power programme.

With respect to EMRC, Law No (43) of 2007 specifies that EMRC is to raise public awareness of radiation safety. EMRC’s Quality Management Manual discusses public outreach by requiring certain documents to be made publicly available, including safety evaluation reports, certain meeting minutes, regulations, instructions and licenses/permits. If fully implemented, the criteria in EMRC’s Quality Management Manual would make it one of the more transparent and open regulators. The IRRS team noted that enhancing the awareness of future construction and operating personnel at a potential NPP on how they can raise safety concerns would benefit overall safety. Currently, Law No (43) of 2007 requires anyone that witnesses a violation of the law to inform EMRC. One example of raising awareness is posting contact information on reporting safety concerns readily available to such personnel, and receiving safety concerns from them, has helped uncover significant safety issues based on past experience in other countries. EMRC should consider developing means to assist interested parties on how to inform EMRC of safety concerns.

EMRC possesses a website whereby basic information is provided to the public. The IRRS team noted that enquiries from the public can be made through the website and responded by EMRC staff. EMRC is developing a public information plan which will include better utilization of the website to provide information to the public. Optimum use of the EMRC website could provide an avenue to communicate to the public the large amount of information that would be generated during NPP licensing activities. Section 3.8 of this report discusses the process by which other government departments and the public can consult on new legislation and regulations. Taken together, the IRRS team noted that the Government of Jordan’s approach to stakeholder engagement on the proposed NPP programme represents a good example of effective openness and transparency which helps relevant parties and the public contribute to decisions on the nuclear power programme. It augments an existing national approach to public and stakeholder engagement with due consideration of the added issues relating to the development of a new nuclear power programme.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| | Observation: Law No (43) of 2007 requires anyone that witnesses a violation of the law to inform EMRC. However, an adequate process to implement this requirement does not exist. |
| (1) | BASIS: GSR Part 1, Requirement 32, states that <i>“The regulatory body shall establish or adopt regulations and guides to specify the principles, requirements, and associated criteria for safety upon which its regulatory judgments, decisions, and actions are based.”</i> |
| S20 | Suggestion: EMRC should consider developing means to inform interested parties on how they can raise safety concerns to EMRC. |

11.2.6. SSG-16 Element 06 Funding and financing

With regard to the mechanism for funding of EMRC for the nuclear power programme, Law No (43) of 2007 describes its funding sources. Since the former JNRC is being merged into EMRC, a new law will address its funding which is not expected to significantly change. Although companies are charged for the costs of regulatory oversight, including for review and assessment of an NPP licence application, these costs are remitted to the state rather than EMRC. Of one special note, the IRRS team observed that Law No (43) of 2007 has EMRC receiving the funds collected as a result of their fines issued. While the fines go to the treasury and EMRC cannot spend above their budgeted amount by the government, there does not appear to be any actual conflict of interest concerns. However, it is still contrary to international standards and poses a perceived conflict of interest. With regard to the

funding and financial capabilities of the operating organization, “Instruction on the Procedure for Issuing Licenses and Permits for Nuclear Facilities and Associated Activities (draft),” requires the applicant to provide documentation confirming sufficient financial resources to support operation of the NPP, which includes decommissioning and management of spent fuel and radioactive waste. “National Policy for Radioactive Waste and Spent Nuclear Fuel Management 2013 (draft)” states “the government of the Hashemite Kingdom of Jordan will enact legislation to establish a fund for the decommissioning of the nuclear facilities and the management of spent fuel and radioactive waste, both in the short and longer term.”

Jordan has invested significant resources for the support of education and training and research facilities to date. Through JAEC, the Government of Jordan established a nuclear engineering programme at JUST and offers nuclear science degrees at two other universities. It also possesses research capabilities which include a synchrotron (a special light source for experiments) and the JSA. JAEC is currently constructing the JRTR at JUST, which will help provide research and practical experience with nuclear reactors. Through discussions with EMRC and JAEC, several of their respective staff members are pursuing advanced degrees and on-the-job training related to nuclear power in countries with advanced nuclear power programmes.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| | Observation: Law 43 /2007 states that EMRC revenue includes charges of fines imposed to licensees. |
| (1) | BASIS: GS-G-1.1, Para. 2.17, states that <i>“In order to prevent abuses or the appearance of abuses on the part of the regulatory body, fines levied in respect of enforcement actions should not be used to contribute to the funding of the regulatory body.”</i> |
| S21 | Suggestion: The government should consider removing from EMRC’s source of funding the fines levied in respect of enforcement actions on the licensees. |

11.2.7. SSG-16 Element 07 External support organizations and contractors

The approach to using external organizations to provide technical and other support is a fundamental issue in the design and staffing of a regulatory body, as discussed in Sections 3.3 and 4.3 of this report. SSG-16 Element 12 of this report also considers the use of TSOs in the wider context of EMRC resource strategy for the new reactor build programme.

Jordan plans to utilize a variety of external support organizations and contractors to support the nuclear power programme, for both the operating organization and EMRC. EMRC has a limited number of staff to support a nuclear power programme, and they do not envision having a large set of permanent staff performing all the licensing activities. Therefore, they will need strong support from TSOs. Already, EMRC has utilized, through a contract, the Korean Institute of Nuclear Safety to support the licensing activities for the JRTR, and it has taken advantage of IAEA services to provide an assessment of its licensing activities.

Though no formal plans have been established yet, EMRC plans to use an external TSO to provide support for any licensing activities associated with a potential NPP. This will require putting in place the technical and project management infrastructure to support such an approach. The IRRS team noticed that in past activities, EMRC utilized the same contractors as JAEC, the promoter for a nuclear power programme. For example, an external TSO was utilized by both EMRC and JAEC. In this case, the TSO assisted in drafting new EMRC regulations and instructions, and it also drafted the white paper on a nuclear power programme for JAEC. Additionally, EMRC uses JAEC for laboratory services such as instrument calibration. While these examples did not pose an actual conflict of interest, it is important to take measures to address conflicts of interest, whether it is actual or perceived. The IRRS team did not observe any procedures that address conflict of interest when using

external support organizations or contractors. Therefore, the IRRS team suggests that EMRC should develop arrangements to address actual, potential, or perceived conflicts of interests.

EMRC recognizes the need to be an intelligent customer for work that is conducted on its behalf by TSOs and this means that it will need to put in place both the technical capability to discharge this function and also the project management infrastructure. That infrastructure may be anticipated to grow significantly, and EMRC will need to consider how best to manage this. During the course of discussions, the IRRS team suggested that one way for EMRC to address the technical capability is to utilize a permanent or temporary advisory committee. Article 7.k of Law No (43) of 2007 already provides the ability of EMRC to establish an advisory committee. Such a committee would include recognized technical experts on NPP safety topics and would provide an independent peer review of TSO and EMRC staff safety conclusions. While this committee would not make safety conclusions for EMRC, it could provide recommendations to the EMRC Board of Commissioners for consideration. Using an advisory committee would be an efficient way to address the potential challenges with using new and less experienced technical review staff for a country embarking on a nuclear power programme. Section 3.4 offers Suggestion 7 related to this topic.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| | Observation: In some cases EMRC contracted the same TSOs as JAEC, and has used the services of JAEC, but the IRRS team did not identify any formal process to ensure no conflicts of interest. |
| (1) | BASIS: GSR Part 1, Requirement 20, Para. 4.20, states that <i>“Arrangements shall be made to ensure that there is no conflict of interest for those organizations that provide the regulatory body with advice or services.”</i> |
| R27 | Recommendation: EMRC should develop arrangements to avoid actual, potential, or perceived conflicts of interest when employing external support organizations. |

11.2.8. SSG-16 Element 08 Leadership and management for safety

With respect to EMRC, this element and the issues associated with it are addressed in Section 4 of this report. With respect to the operating organization, the law requires the organizational entities conducting the activities to have an integrated management system.

EMRC is considering leadership and management for safety as the infrastructure is being established for a nuclear power programme. For instance, Articles 111 and 112 of “Instruction on the Safety of Nuclear Power Plants (draft)” requires operating organizations to give safety the highest priority, develop a safety policy which encourages a comprehensive safety culture, communication by management, and adherence by all staff. The safety policy and its implementation are to be reviewed by EMRC. The IRRS team discussed ways to assess the safety culture of an operating organization and recognized it as a challenging task. The IRRS team provided an example of an inspection procedure that included questions for interviewing staff of an operating organization on issues related to safety culture and types of information to observe (e.g., safety surveys, number of safety concerns raised to management and EMRC, etc.).

11.2.9. SSG-16 Element 09 Human resources development

JAEC conducted a study on human resource development for the implementation of the nuclear power programme of Jordan and prepared a report on “Human Resources Development for Jordan Nuclear Program”. The report includes main organizations which have important roles in the implementation of the programme. Although the report includes a chapter for the human resources development plan of the Jordanian regulatory body, the main focus of the report was given to the future operating organization. The report does mention specific challenges faced by EMRC on attracting and retaining highly qualified and trained staff due to limited funding and inadequate salary levels. The hiring system, which is implemented by the Civil Service Bureau of the Government of

Jordan, was ineffective to provide such hiring and retention capacity to EMRC as it prevents them from establishing competitive salaries as compared to private industry and international regulatory bodies and provides limited flexibility and role to EMRC to select its staff. The IRRS team recommends the government to establish strategies and mechanisms to attract and retain high quality trained personnel in EMRC and provide adequate human resources to EMRC. Recommendations 6 and 8 raised for this issue are presented in Sections 1.8 and 3.3.

NSSD is the organizational unit of EMRC that is responsible for licensing and inspection activities for NPPs. The IRRS team was informed that the number of staff in the NSSD has reached 25, including 10 new engineers who were hired in recent years. However, six staff left NSSD last year. There is a plan to add six new staff to the directorate in 2014. According to the human resource development report, the number of staff in this directorate is planned to reach 40 by the Year 2016. The plan which is presented in this report covers only up to 2016, which is the very early stage of the nuclear power programme implementation. Planning should be extended at least until the operating licence is issued by EMRC for the NPP units. Moreover, the existing human resource development plan includes only the projected number of staff and does not include details of the competencies needed. The IRRS team recommended that the human resource development plan should include a competency plan which will provide the necessary training and other capacity building activities in order to establish adequate capacity and competency. Recommendation 8 raised on this issue is presented in Section 3.3 of this report.

There is no specific human resource development unit in EMRC. The human resource development activities in EMRC are implemented mainly by the international cooperation directorate. Establishment of a dedicated unit for implementation of the human resources development activities including planning, coordination and implementation of the human resources planning, competency needs assessment and training for EMRC would be helpful.

EMRC is utilizing international cooperation in order to support training in the field of nuclear safety. The IAEA technical cooperation projects provide the main tool for such training. Cooperation with the European Commission, other regulatory bodies and participation in the international forums and networks are also sources used for training.

A number of technical cooperation projects have been established with the IAEA and EC, in addition to Nuclear Cooperation Agreements (NCA) with a number of countries with advanced nuclear power programmes, to support capacity building activities for JAEC and EMRC staff.

JUST established a nuclear engineering department, where graduated nuclear engineers have the basic capabilities in conducting specific nuclear safety studies and analysis, including criticality studies, dose assessment and thermal-hydraulic analysis. There is a plan to establish a master's programme in nuclear safety at JUST.

11.2.10. SSG-16 Element 10 Research for safety and regulatory purposes

With respect to EMRC, this element is addressed in Sections 1.1 and 1.8 of this report. Below are research for safety and regulatory purposes as they relate to a potential nuclear power programme.

At the national level, Jordan is establishing facilities to support a nuclear research programme. One example is the Jordan Center for Nuclear Research that includes a 5 MW multi-purpose research reactor. This reactor is under construction on the campus of JUST and is designed and constructed by Korea Atomic Energy Research Institute and Daewoo Engineering and Construction Company. The Center for Nuclear Research also plans to include a radio-isotope production facility, a cold neutron source research facility, a radioactive waste facility for the research reactor, and an education and training building. There is also an option to construct a fuel fabrication plant. The facility might eventually become a regional center which will offer IAEA training courses and host conferences. Another example is SESAME (Synchrotron Light for Experimental Science and Applications in the Middle East), which is the first of its kind in the region to support research in areas such as matter physics, material science, and environmental studies. A third example is the JSA, which is designed to fulfil the training needs of students and is equipped to perform all of the fundamental experiments required for a typical nuclear engineering university programme.

EMRC is involved with international cooperation through IAEA and the European Union. They also have bi-lateral agreements with countries, such as Republic of Korea, Canada, and the United States, who have advanced nuclear power programmes. While this does not constitute “research” it does provide a means for EMRC to be engaged with research activities in these countries from which EMRC could obtain and apply the results to their nuclear power programme. EMRC recognizes the need to assess safety research needs for Jordan and participate in such research activities based on safety significance and other safety priorities.

The IRRS team considers that the actions taken both at a national level as well as by EMRC are satisfactory.

11.2.11. SSG-16 Element 11 Radiation protection

With respect to EMRC, this element and its findings are addressed in Sections 1.5 of this report. Below is a discussion of radiation protection as it relates to a potential nuclear power programme.

In August 2013, the Jordanian Cabinet decided on the Al-Samra site as the preferred location of a potential NPP. In discussions with JAEC, they are currently in the process of procuring a contractor to do the site assessment activities. Consequently, no environmental impact assessment has been initiated at this time. The environmental impact assessment is regulated by the Ministry of Environment, and EMRC takes part in the environmental impact assessment process with regard to radiological impacts. Currently, there is “Instruction on the Review of the Environmental Impact Assessment Document, Radiological Part (draft),” that is developed by EMRC.

11.2.12. SSG-16 Element 12 Safety assessment

NSSD of EMRC is responsible for performing safety review and assessments for licensing. EMRC started building competency in this directorate in order to effectively implement the required tasks during the licensing of a potential NPP. Training has been provided to the EMRC staff on deterministic and probabilistic safety analysis with the help of IAEA in order to develop competence to prepare for the conduct of the review of safety assessments.

EMRC is planning to utilize services from TSOs in order to support its licensing activities. This does not relieve the responsibility of making decisions on nuclear safety issues and licensing. In order to be an intelligent customer for the services which are to be rendered by the TSO, EMRC needs to have adequate project management capabilities and technical knowledge on the safety assessments.

JAEC and EMRC identified the necessity for developing a master capacity building plan in the country involving relevant organizations and planning to conduct needs assessment, including human resources and competency, that is required to perform the tasks properly. The IRRS team found this is a necessity for the preparation for licensing of a NPP and suggested developing and implementing this plan in timely manner. The IRRS team considers building competences in all technical areas needed in the assessments that have to be conducted by EMRC as an important issue. Recommendation 8 in this issue is presented in Section 3.3 of this report.

11.2.13. SSG-16 Element 13 Safety of radioactive waste, spent fuel management and decommissioning

The overall approach to the management of radioactive waste, spent fuel management and decommissioning is considered in Chapters 1 and 5 through 9 of this report.

At the national level, there is a “Policy for Radioactive Waste and Spent Nuclear Fuel Management – 2013 (draft).” This draft policy is discussed in Section 1.7. In addition, EMRC developed “Regulation for Safety of Spent Nuclear Fuel Management (draft).” The regulation covers the requirements for nuclear safety and radiation protection of the spent fuel management and includes requirements for all stages of the lifetime of the facilities, from site selection to decommissioning. It also deals with all activities of spent fuel management including storage, transport at the site, and

spent fuel handling. The requirements cover the design and operation of both wet and dry storage technology.

The IRRS team identified that the approval of the draft policy is an important issue at an early stage of the implementation of the nuclear power programme and raised suggestion S2 in Section 1.7 of this report.

11.2.14. SSG-16 Element 14 Emergency preparedness and response (regulatory aspects)

The overall approach to the emergency preparedness and response is considered in detail in Chapter 10 of this report.

EMRC drafted “Instruction on Nuclear Emergency Preparedness and Planning” to provide the basic requirements on the emergency preparedness and response. The IRRS team was informed that, including this instruction, there is an on-going activity to develop the national nuclear and radiological emergency plan. Considering Jordan is embarking on a nuclear power programme, the draft instruction and the other relevant studies and documents should consider the NPP that may be built in Jordan. Recommendation 25 related to this issue is presented in Section 10.1 of this report.

11.2.15. SSG-16 Element 15 Operating Organization

Within the context of the IRRS review, there is an appropriate regulatory framework in place to support the near-term activities expected to be taken by the operating organization. The IRRS team met with representatives of the future operating organization who informed the IRRS team that they are aware of these provisions. At the time of the mission, Jordan Nuclear Project Company was in the process of officially forming. The representatives of Jordan Nuclear Project Company have received the final and draft regulations and instructions and are interacting with EMRC. The representatives also discussed some questions regarding implementation of certain portions of the regulations and instructions. EMRC is aware that future discussions with the operating organization on specific topics for the regulations and instructions would benefit the efficiency and effectiveness of future licensing reviews. Further consideration of the operating organization is not included within the scope of this review.

11.2.16. SSG-16 Element 16 Site survey, site selection and evaluation

Regulation on Safe use of Nuclear Energy provides the framework for the siting. According to the Article 7 of the regulations, EMRC issues the permit for siting. Under this framework, EMRC drafted “Instruction on Licensing of Nuclear Facilities and Associated Activities”, “Instruction on Site Survey and Site Selection for Nuclear Facilities” and “Instruction on Site Evaluation for Nuclear Facilities” in order to provide the requirements for site survey, site selection and site evaluation, as well as, the authorization requirements. The IAEA team was informed that the IAEA safety standards and guides have been utilized when drafting the instructions.

The issuance of the drafts is an important issue before the implementation of site evaluation work in order to avoid conflicts and problems which might occur during the review of site evaluation reports by EMRC and during the later stages of constructing a potential NPP.

According to the latest project schedule, the site evaluation report is expected to be submitted to EMRC in 2016. EMRC identified the need for external support in order to review the site evaluation report. As such, EMRC is planning to hire a TSO to support EMRC in reviewing the site evaluation.

11.2.17. SSG-16 Element 17 Design safety

General requirements on the design of nuclear facilities have been established by the Regulation on the Safe Use of Nuclear Energy No (43) of 2014. Specifically, “Instruction on Safety of Nuclear Power Plants (draft)” provides the requirements that determine the general conditions the design of nuclear facility has to fulfil. The IRRS team compared the instruction to IAEA Safety Standard SSR-2/1, “Safety of Nuclear Power Plants: Design,” and found that the criteria within the instruction

closely follows the IAEA safety standard. The instruction adequately addresses fundamental safety functions, defence-in-depth, plant states, design basis, design extension, design limits, postulated initiating events, and reliability and failure tolerance requirements. In many cases, the instruction provides a solid set of criteria that takes into account the latest experience with licensing new NPPs. However, the IRRS team performed a limited review of the instruction and identified that the instruction did not cover some systems and activities covered by the IAEA safety standard. These design aspects included compressed air systems, post-accident sampling systems, lighting, overhead lifting, aspects of emergency power supplies (e.g., diesel generator fuel oil and its supply systems), and steam supply systems. The IRRS team recommended that EMRC should perform a thorough review of the draft regulation to ensure complete coverage of safety topics. While not specifically outlining Fukushima-related issues, the EMRC criteria do address design-extension and severe accident events. At this time, the instruction is still draft, but has been communicated to the operating organization.

The IRRS team discussed with EMRC their regulatory approach for setting criteria for a potential NPP. EMRC has opted for an option that is a mixture of prescriptive and performance-based approach. Specifically, they establish higher-level design criteria, but do not publish guidance or require conformance to specific industrial standards. This approach provides the operating organization with the flexibility of addressing safety issues, but will require a higher level of expertise, both on the part of the operating organization and EMRC, since there is no specific guidance. The IRRS team communicated to the operating organization and EMRC that one of the largest contributors to delays in licensing new NPPs have been applications that did not provide the adequate design information and analysis demonstrating compliance with the regulatory requirements. Using methods, such as a safety case approach (claims, arguments, evidence), may be one means to help ensure a sufficient set of information provided at the beginning of the licensing process.

At the national level, the JAEC has taken into consideration various aspects to ensure safety of a potential NPP. For example, during its site selection activities, it compared sites for hazards, such as possible seismic activity. It also considered infrastructure needs such as cooling water and the electric power grid. Currently, Jordan plans to upgrade the electric power grid to support a potential NPP.

The IRRS team observed that considerable work has been done for the current stage of the nuclear power programme, both at a national level and by EMRC.

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| | Observation: Based on a limited review, the draft instruction on Safety of Nuclear Power Plants did not address certain systems and activities in IAEA SSR-2/1. |
| (1) | BASIS: Requirements of SSR-2/1 as a whole. |
| (2) | BASIS: SSG-16, Action 174, states <i>“The regulatory body should prepare and enact national safety regulations on design that are necessary for bid specification.”</i> |
| S22 | Suggestion: EMRC should consider adopting the provisions of IAEA SSR-2/1 as the basis of its requirements for NPP design. |

11.2.18. SSG-16 Element 19 Transport Safety

The overall approach to and regulatory documents on the transport safety is considered in detail in Section 9.5 of this report.

EMRC drafted “Instruction on Safe Transport” based on IAEA Safety Standard “Regulations for the Safe Transport of Radioactive Material, 2012 Edition (SSR-6)”. EMRC should consider the necessary transportation of the fresh and spent nuclear fuels as well as the radioactive waste to be generated in Jordanian NPP when revising regulatory documents and preparing the plans for the transportation. Section 9.5 of this report provides additional information.

11.2.19. SSG-16 Element 20 Interfaces with nuclear security

According to Law No (43) of 2007 and Law No. (17) of 2014, EMRC is the regulatory body for both nuclear security and nuclear safety aspects. There are other national organizations involved in the nuclear security activities in the country, namely EMRC, JAEC, Security Departments and Armed Forces. EMRC is managing and coordinating nuclear security issues through the National Committee for Nuclear Security.

EMRC drafted “Instruction on the Provision of Physical Protection and Security of Nuclear Facilities, Nuclear Material and Radioactive Substances” to cover the requirements on the physical protection of nuclear materials and nuclear facilities. This draft was developed based on the IAEA guidance.

The arrangements between safety and security aspects are considered at the early stages of siting nuclear facilities. For instance, safety and security aspects were considered in the site survey for the JRTR research reactor and the countrywide survey for the NPP. Several meetings have been conducted by the relevant organizations during the site survey and selection activities for the potential NPP.

Recommendation 3 addresses the completion of the regulatory framework.

11.3. SUMMARY

Jordan is planning to build a nuclear power plant with two units of about 1,000 MWe each. The programme will be implemented based on several agreements between governments of Jordan and Russian Federation.

EMRC drafted and issued several regulations and guides which will form the regulatory framework for nuclear power safety. There is a need to issue all drafted regulatory documents in timely manner.

EMRC implemented several activities regarding the human resource development and the training of its staff in order to build the adequate competency in the organization to support its regulatory activities associated with the nuclear power programme.

Considering the implementation of the nuclear power programme is at an early stage, the IAEA team recognized that Jordan has taken many steps in establishing the safety infrastructure using good interaction with the international organizations and forums. However, there are certain initiatives still to be taken by the Government of Jordan and by EMRC to effectively manage the safety of the nuclear power programme. The IRRS team identified 21 findings; including 11 recommendations, 9 suggestions and one good practice to be considered by the Government of Jordan and EMRC to utilize when they continue to build the nuclear safety infrastructure for nuclear power programme. As the majority of these findings are also applicable to the overall legal and regulatory framework related to the current facilities and activities, they have been recorded in the other IRRS Chapters. Appendix VI “List of IRRS Mission Findings Related to the Tailored Module for Countries Embarking on Nuclear Power” provides a cross-reference of these findings.

The IRRS team emphasizes the benefit of repeating the self-assessments based on the IAEA guidance in SSG-16 as the nuclear power programme progresses in order to monitor progress in establishing the safety infrastructure in different stages.

12. ADDITIONAL AREAS

12.1. CONTROL OF MEDICAL EXPOSURES

The legal and regulatory framework in the medical exposure area consists of Law No (43) of 2007 and Regulation number 8 “Basis and Conditions Regulation for Granting Licenses and Permits for the Radiation Work”, 2013 which is applicable to medical as well as industrial facilities and workers.

The IRRS team notes that since 2007, no comprehensive regulation relevant to the application of the Law No (43) of 2007 for the protection of patients has been published, which represents a significant gap in the regulatory framework. In the recent past, EMRC has worked on the following documents:

- The Radiation Protection Regulation (draft);
- Quality assurance manual for hospitals (draft) describing the contents of the expected QA/QC program in radiotherapy;
- Radiation Incident Report (draft) describing the organization to implement in radiotherapy services to report and analyse incidents.

The Radiation Protection Regulation medical exposure section is directly based on GSR part 3 although some of GSR part 3 requirements are missing.

There is a Radiological Services Directorate within Ministry of Health. This directorate provides audits and follows up inspections carried out by EMRC.

- Responsibilities of the government

No diagnostic reference levels, no dose constraints for carers and comforters and no criteria and guidelines for the release of patients have been defined yet. The government should ensure that these levels, constraints and criteria will be defined as a result of consultation between the MoH, EMRC and the relevant professional bodies.

The Minister of Health asserted the importance of cooperation between EMRC and the MoH when he met the IRRS team. However, it was explained by EMRC counterpart that cooperation with the MoH could be further strengthened (inspection findings sharing, involvement in regulation writing). Representatives from the Ministry of Health used to be members of the JNRC Board but this is not the case anymore. The government should ensure that an effective and efficient cooperation takes place between both authorities involved in radiation protection control in health facilities. Recommendation 5 on that issue is provided in section 1.5.

EMRC explained that the consultation of professional bodies (Jordan Medical Physicists Association, Jordan Medical Association) about the draft radiation protection regulation has not yet been made, but is planned. EMRC should ensure that this consultation is conducted so that the relevant parties are notified of their duties in relation to protection and safety for individuals undergoing medical exposures.

- Responsibilities of the regulatory body

Regulation no 8/2013 on “Basis and conditions for granting licenses and permits for radiation work”, defines the education, training and competence requirements for staff with duties in relation to the radiation protection of patients. However, this training is general and does not contain any section specific to patient protection. Furthermore, there are no requirements regarding periodic refresher training. EMRC should develop such training requirements and define the contents of this training. Specific training programmes according to the activities performed should be considered in order to address the specificities and risks of each activity.

- Responsibilities of registrants and licensees

Responsibilities of licensees regarding radiation protection of patients are currently not defined in the Jordanian regulation. However, during the inspection performed at King Hussein Cancer Center, the professionals encountered demonstrated a good knowledge of international guidelines and

recommendations, and they have organized themselves in order to meet most of the responsibilities of licensees' requirements of GSR Part 3.

The draft regulation on radiation protection includes GSR part 3 requirements on the responsibilities of registrants and licenses. Furthermore, it states that licensees shall ensure that medical personnel and paramedical personnel meet the respective requirements for education, training and competence in radiation protection. Those requirements, especially with regard to training in patient protection, need to be defined by EMRC as addressed in previous section.

Article 46 (5) of the draft regulation also introduces ambitious technical requirements regarding the equipment used for different activities (measurement device to assess the quantity of radiation produced by the equipment during a procedure, capacity to transfer the dosimetric information to the examination record). EMRC should consider introducing in the regulation a timeframe for the compliance with these requirements as it is likely that the equipment currently used in Jordan do not meet these requirements.

- Justification of medical exposure

Justification of medical exposure is currently not a regulatory requirement in Jordan although a prescription is usually needed to perform a radiological examination or to deliver a treatment involving radiation.

Article 47 (3) of the draft regulation requires licensees to take into account relevant national or international referral guidelines for the justification of the medical exposure of an individual patient in a radiological procedure. However, no referral guide offering guidance for generic justification has been published so far. The MoH should carry out the process of establishing generic justification of radiological procedures, in conjunction with the appropriate professional bodies. These referral guidelines should be reviewed periodically so that they take into account advances in knowledge and technological developments.

- Optimization of medical exposure

The application of the optimization principle is currently not a regulatory requirement for medical exposures in Jordan. However, during the inspection performed at King Hussein Cancer Center, the staff interviewed demonstrated a good knowledge of international guidelines and recommendations on that topic. For instance, King Hussein Cancer Center medical physics team follow the Quantec guidelines regarding the exposure of volumes other than the planning target volume.

Establishing a quality assurance program and a quality control program is a requirement to obtain a practice license. There are currently no mandatory instructions on what the contents of this QA/QC program should be. In the absence of guidance, each facility has developed its own QC program. There is usually no medical physicist in diagnostic radiology facilities but at least one company is licensed to perform QC in radiology.

EMRC set up a quality assurance committee in 2011 to define the QC and QA requirements for radiology and radiotherapy, on the basis of the IAEA "Establishing a Hospital Quality Assurance Program For Radiation-Generating Equipment" guide.

A draft instruction on QA / QC programs has been produced by this committee, defining the types and frequencies of QC controls to perform as well as acceptance criteria. Based on a limited review, this instruction will have to be amended as it contains sections redundant with other draft regulations. The licensees' responsibilities regarding the development of QA programs should be clarified. Furthermore, EMRC should define its expectations regarding the "independent" verification of calibrations of radiotherapy units prior to clinical use.

Article 51 of the draft regulation requires licensees to perform local assessments, at approved intervals for radiological procedures for which diagnostic reference levels have been established. As addressed in the "responsibilities of the government" section of this module, diagnostic references levels are still to be defined.

Finally, requirements regarding the regular and independent audits of the programme of quality assurance for medical exposures mentioned in article 52 (3) should be elaborated.

- Pregnant women and breast feeding women

There is currently no regulatory requirement on this topic. However, during the inspection performed at King Hussein Cancer Center, the staff demonstrated that pregnancy is taken into account for the justification and the optimization of the exposure. There were also visible signs in the facility that request female patients who are to undergo a radiological procedure to notify the personnel in the event that they might be pregnant.

- Release of patients

No criteria and guidelines for the release of patients have been developed yet as addressed in the “responsibilities of the government” section of this module. It was explained that in the absence of regulation on that topic, licensees usually develop their own criteria and guidelines and establish a record keeping organization to register the results of measurements performed on patients before their release.

- Unintended and accidental medical exposures

Minimizing the likelihood of unintended or accidental exposure, investing such exposures and, if appropriate, implementing corrective actions is currently not a regulatory requirement.

However, between 2011 and 2012, JNRC commissioned a committee to define unified methods of reporting and documenting radiation incidents in radiotherapy. This committee comprised representatives of the MoH and public and private hospitals. It produced a report that defines the scope and methodology for incident reporting and analyzing. This report, once the draft regulation has been issued, and according to its content, could usefully become either instructions or guidance for licensees. EMRC should also consider developing guidance on event reporting for activities other than radiotherapy.

Article 56 of the draft regulation requires that for radiotherapeutic practices, the quality assurance programme should include a study of the risk of accidental or unintended exposures. EMRC should consider defining internal as well as external guidance regarding its expectations on the methodology used to undertake this study. It may also consider suggesting licensees to review and update this study regularly on the basis of the reported incidents.

- Reviews and records

There is currently no regulatory requirement to conduct radiological reviews and to maintain records, except for QC records, and developing a QC program is a licence requirement.

The draft regulation defines the record keeping requirements in terms of which records are to be kept and for how long. It also defines the requirements for radiological reviews. EMRC should consider developing guidance regarding its expectations as to what the contents of these radiological reviews should be.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

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| | Observation: There is presently no regulation, instruction or guidance applicable to patient protection (justification, optimization, responsibilities of licensees... etc.). |
| (1) | BASIS: GSR Part 3 para. 3.144 to 3.184 define the requirements for patient protection during medical exposure |
| R28 | Recommendation: EMRC should without delay finalize the regulatory requirements on medical exposure, making sure that they are compliant with GSR Part 3, and prepare the instructions required for their application. Some of this framework should be developed in consultation with the Ministry of Health and relevant professional bodies. Guidance should also be developed. |
| | Observation: There are presently no training requirements regarding patient protection for medical staff involved in the delivery of doses to patients. |
| | BASIS: GSR Part 3 para. 2.32 states that <i>“The regulatory body shall ensure the application of the requirements for education, training, qualification and competence in protection and safety of all persons engaged in activities relevant to protection and safety.”</i> |
| (1) | BASIS: GSR Part 3 para. 3.149 states that <i>“3.149. The regulatory body shall ensure that the authorization for medical exposures to be performed at a particular medical radiation facility allows personnel (radiological medical practitioners, medical physicists, medical radiation technologists and any other health professionals with specific duties in relation to the radiation protection of patients) to take on the responsibilities specified in these Standards only if they: (b) meet the respective requirements for education, training and competence in radiation protection, in accordance with para. 2.32.”</i> |
| | BASIS: RS-G-1.5 on Radiological Protection for Medical Exposure to Ionizing Radiation provides detailed guidance on the contents and requirements of the training that should be delivered. |
| R29 | Recommendation: EMRC should develop training requirements regarding patient protection. |

12.2. OCCUPATIONAL RADIATION PROTECTION

Legal and regulatory framework, general responsibilities of registrants, licensees, employers and workers.

The legal and regulatory framework in the occupational radiation protection area consists of:

- Law No (43) of 2007 Radiation Protection, and Nuclear Safety and Security Law establishes the legal and regulatory framework for radiation protection.
- Regulation number 8 “Basis and Conditions Regulation for Granting Licenses and Permits for the Radiation Work” 2013.

The IRRS team notes that, since 2007, no comprehensive regulation relevant to the application of the Law No (43) of 2007 for the protection of workers has been published. This represents a significant gap in the regulatory framework. In the recent past, EMRC has worked on the following regulatory documents:

- The Radiation Protection Regulations (RPR, draft) is the basic radiation protection safety standard.
- The Radiation Protection Code of Practice (draft). The Code of Practice supports the RPR and gives additional information.
- Instruction “Requirements and instructions for granting licenses for radiation protection officers”, (Draft 2014).

The RPR are broadly based on the EU directive on radiation protection and classifies occupationally exposed workers into Category I and Category II. The EU directive is in turn based on GSR part 3. The Radiation Protection Regulation and Code of Practice do not use the GSR Part 3 terminology of exposure situations in terms of ‘planned, emergency and existing’.

The annual dose limits are consistent with GSR Part 3. However, the footnotes to the dose limits given in the GSR Part 3 should be included. The annual dose limits are included in the Code of Practice. As the Code of Practice is a mixture of instruction and guidance, it is considered to be appropriate to move the annual dose limits to the RPR, possibly as an annex. The Code of Practice should be turned into an Instruction, and the guidance part of the Code could form the basis of a radiation protection guidance document.

Some items in the GSR Part 3 have not been included in the current framework, and it is considered to be relevant to include them in the next revision of the RPR. Some inconsistencies were also observed in the radiation protection regulatory framework. These gaps or inconsistencies include:

- By the current Law No (43) of 2007 it is prohibited to employ or train any person under the age of 18 years while annual dose limits are established in the Code of Practice for persons between the age of 16-18 years of age. It was informed that a new law relevant to radiation protection is being drafted that will correct this inconsistency when approved.
- The definition of controlled and supervised areas in the Regulations should be critically reviewed.
- No specific requirements state that the conditions of service of workers shall be independent of whether they are or could be subject to occupational exposure. Special compensatory arrangements, or preferential consideration with respect to salary, special insurance coverage, working hours, length of vacation, additional holidays or retirement benefits, shall neither be granted nor be used as substitutes for measures for protection and safety in accordance with the requirements of the GSR Part 3.

- No specific requirements state that employers should ensure that the exposure of workers undertaking remedial actions in existing exposure situations is controlled in accordance with the relevant requirements for occupational exposure in planned exposure situations;
- The RPR does not establish a strategy for occupational radiation protection against exposure due to ^{222}Rn in workplaces, including the establishment of an appropriate reference level for ^{222}Rn ;
- It is not required in the RPR that the type and frequency of the workplace monitoring to be carried out should be based on dose rate, activity concentration in air and surface contamination, and their expected fluctuations;
- There is no mandatory requirement to ensure that emergency workers who undertake actions in which the doses received might exceed 50 mSv do so voluntarily. Nor is there a requirement that emergency workers have been clearly and comprehensively informed in advance of the associated health risks, as well as of available protective measures; and that they are, to the extent possible, trained in the actions that they may be required to take.
- Dose constraints are not mentioned in the RPR as part of optimization of protection and safety of workers.
- No mandatory requirements require employers, registrants and licensees to facilitate compliance by workers with the requirements of the RPR and Code of Practice.
- No mandatory requirements require employers to record any report received from a worker that identifies circumstances which could affect compliance with the RPRs and to take appropriate action;
- No clear requirements in the RPRs to require workers to follow any applicable rules and procedures for protection and safety specified by the employer, registrant or licensee;
- No specific requirement in the RPRs to require workers to cooperate with the employer, registrant or licensee with respect to protection and safety and the operation of radiological health surveillance and dose assessment programmes;
- No specific requirement in the RPR require the workers to report to the employer, as soon as possible, circumstances that could adversely affect protection and safety for any reason.

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| | Observation: The Regulatory framework for occupational radiation protection is incomplete and contains inconsistencies. |
| (1) | BASIS: GSR Part 3 para. 3.25 states that <i>“For occupational exposure and public exposure, registrants and licensees shall ensure, as appropriate, that relevant constraints are used in the optimization of protection and safety for any particular source within a practice”.</i> |
| (2) | BASIS: GSR Part 3 para. 5.27 states that <i>“The regulatory body or other relevant authority shall establish a strategy for protection against exposure due to ^{222}Rn in workplaces, including the establishment of an appropriate reference level for ^{222}Rn. The reference level for ^{222}Rn shall be set at a value that does not exceed an annual average activity concentration of ^{222}Rn of 1000 Bq/m^3, with account taken of the prevailing social and economic circumstances.”</i> |
| R30 | Recommendation: EMRC should review and revise the regulatory framework for occupational exposure control, including regulations, instructions and guidance, for consistency and completeness with respect to GSR part 3 and approve the draft regulations and instructions as quickly as possible. |

Outside workers

The Code of Practice establishes that comprehensive monitoring; dose evaluation and keeping of records of total exposure of outside workers should be performed. The objective is to provide the outside workers with the same level of radiation protection as that provided to Jordanian workers.

Requirements for radiation protection programmes

The structure and content of radiation protection programmes are given in article 5.11 of the IAEA Safety Series number RS-G-1.1. All the items in this article are mentioned in the draft regulatory framework, with the exception of:

- The assignment of responsibilities for occupational radiation protection and safety to different management levels, including corresponding organizational arrangements and, if applicable (for example, in the case of itinerant workers), the allocation of the respective responsibilities between employers and the registrant or licensee;
- The methods for periodically reviewing and auditing the performance of the RPP, and
- The requirements for the assurance of quality and process improvement.

Monitoring programmes and technical services

External dosimetry

The Code of Practice states: *“For category I workers, a monitoring period for the evaluation of a personal dosimeter shall be one month. This provision means that a one-month monitoring interval is uniformly determined for work carried by category I worker in the controlled area. This approach is fully in compliance with international recommendations.”*

However, the current practice is that Category I workers exchange their dosimeters on a three month basis.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| | Observation: Category I workers exchange their dosimeters on a three month basis. |
| (1) | BASIS: RS-G-1.3 para. 3.16 states that <i>“The frequency of dosimeter exchange should be established by the dosimetry service depending on the type of work being performed and the anticipated exposure associated with the work, and the characteristics of the dosimeters and the overall limit of detection of the dosimetry system. Exchange frequencies can range from daily, in special operations, to every six months, if the exposure is expected to be very low, but exchange periods of one to three months are typical.”</i> |
| S23 | Suggestion: EMRC should consider implementing a monthly dosimeter exchange for Category I workers. |

Special monitoring possibilities for pregnant women should be made available to fulfil the RPR and Code of Practice. Monthly or weekly dose assessments in the region of the abdomen are considered a good practice. As the available monitoring period is three-monthly, shorter monitoring periods are not possible at present.

The Code of Practice mentions extremity dosimetry as one of the possible monitoring techniques: *“The selection of the personal dosimeter depends not only on the type of radiation in the given radiation field but also on the form of requested dosimetry information. The following types of personal dosimeters are most often used in practice (among other examples)...extremity dosimeters - giving information on angular distribution of the radiation field and on the magnitude of exposure (dose) to the given part of body (extremities, etc)”*.

Although extremity dosimetry was available in the past, there is no extremity dosimetry service available at present, and no extremity dosimeter reports for the recent past are available. There are work practices where extremity dosimeters are required, for example, during the direct handling of ¹²⁵I seeds in brachytherapy work, and for staff that prepare and inject radiopharmaceuticals into patients in the nuclear medicine clinics. The extremity dosimetry service should be restored as soon as possible.

The external dosimetry service visited at JAEC uses TLD dosimeters for photon radiation and for neutron radiation. It uses a HARSHAW 4500 TLD reader and a nitrogen generator for the nitrogen supply. No back-up equipment is available so that an equipment failure may cause a delay in the supply of dosimeters, possibly leading to a six-month monitoring interval.

There is no biological dosimetry laboratory in Jordan, nor is there an agreement with a laboratory outside the country.

Individual internal dosimetry

The Code of Practice includes a statement on internal dosimetry: *“At the workplaces with a possibility of internal occupational exposure, radionuclide intakes and/or committed effective doses caused by internal exposure of individual workers shall usually be determined by radionuclide activity measurements in a worker’s body or the worker’s excreta. Activities shall be converted to an intake by means of respiratory and digestive tract models and by the kinetics of appropriate elements.”*

Although there is little work at present with open sources except for that performed in nuclear medicine clinics, Jordan is advancing into the nuclear technology area. A multi-purpose research and production reactor with neutron beams and hot cells for radionuclide separation and a synchrotron are under construction. These activities can cause internal contamination. It is now time for Jordan to establish an internal dosimetry infrastructure – possibly starting with a whole body counter for the multi-purpose nuclear research reactor, with commissioning foreseen for 2016. The Director of Nuclear Safety of JAEC informed the IRRS team that JAEC has plans to establish internal dosimetry laboratories in conjunction with the reactor operation.

Suggestion 3 to the Government of Jordan to implement plans for internal exposure monitoring is given in section 1.9.

National Dose Register

EMRC is responsible for maintaining the national dose register. The three month dose reports are currently paper based. The advantages of a computer based national dose electronic register include facilitating:

- keeping track of occupational doses;
- inspection optimization;
- dose optimization, and
- evaluating and reporting on the national radiation protection status.

The computer based dose register may be merged with the existing data base of occupationally exposed persons.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| | Observation: EMRC receives the quarterly occupational dose reports for monitored workers on paper and maintains a paper based national dose register. |
| | BASIS: GSR Part 3 para. 3.73 (e) states that <i>“The regulatory body shall be responsible, as appropriate, for provision for maintaining exposure records and results of the assessment of doses from occupational exposure.”</i> |
| S24 | Suggestion: EMRC should consider establishing a computerized national register of occupational dose records. |

Calibration services

The RPR states in Article 71: “Radiation monitoring devices shall be examined, accurately maintained, and calibrated within the period specified by the Commission, by a specialist laboratory licensed by the Commission.” It is suggested that this article includes the calibration period, usually established as a one year period.

A SSDL is operated by JAEC. The SSDL calibrates dose rate meters for gamma radiation and produces calibration curves for the TLD services. However, the SSDL does not have the equipment to calibrate or do quality checks for the neutron dosimetry service. Neutron dosimetry will become more important with the start of the research reactor commissioning foreseen for 2016.

The SSDL has the large area alpha and beta sources for calibrating surface contamination survey meters, but this calibration service is not carried out in Jordan.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| | Observation: EMRC surface contamination meters are not calibrated. |
| | BASIS: RS-G-1.1 para.5.46.states that “The equipment to be used in the monitoring programme should be suitable for the radiation type(s) and the form(s) of radioactive material encountered in the workplace. The equipment should be calibrated to meet appropriate standards.” |
| S25 | Suggestion: EMRC should consider including in the radiation protection regulatory framework specific requirements for calibration of portable and fixed dose rate and surface contamination measuring equipment. |

Training services and staff training and re-training

All occupationally exposed workers are obliged to carry out a standard training course that is authorized by EMRC. The criterion for holding the course is when the waiting list reaches a required number of persons. It can happen that a few months may pass before the necessary number of candidate participants is reached and the course is held. The course is 30 hours long and staff is not allowed to be exposed to ionizing radiation until he or she has completed the course and the person is licensed. Comments from licensees and inspectors indicate that a review of the course contents is a possibility for improvement. Practical aspects of radiation protection should be emphasized in the course.

The course for RPOs is under preparation and the course material and syllabus will be based on the “Instruction on Requirements and instructions for granting licenses for radiation protection officers”. This draft Instruction contains a comprehensive syllabus and requirements for RPO qualification and training. Article (3) of this Instruction establishes that:

“The following conditions are required to licence a radiation protection officer in the large radioactive institutions:

1. To hold the first university degree in health physics, or medical physics, or physics, or physical engineering, or medical engineering, or nuclear engineering, or medicine in the field of radiation.
2. To have a work experience of no less than two years in the field of radiation that the institution practices.
3. To pass a specialized training course in the field of radiation protection with a minimum of sixty hours and shall be recognized by the commission or to submit a proof that certifies his completion of a radiation protection course during his study complies with the articles no. (6 and 7) of these instructions.”

The radiation protection regulatory framework should require that periodic radiation protection re-training courses for the staff be given by the licensee’s RPO so that changes in the local rules and procedures, or changes to the installation, incidents and new good practices may be informed and discussed.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| | Observation: There is no specialized training course available for radiation protection officers in Jordan. Re-training by the RPO is not included in the radiation protection regulatory framework. |
| (1) | BASIS: GSR Part 3 para. 2.22 states that <i>“The government shall ensure that arrangements are in place for the provision of the education and training services required for building and maintaining the competence of persons and organizations that have responsibilities relating to protection and safety.”</i> |
| (2) | BASIS: RS-G-1.4 para. 3.37 states that: <i>“The training should be tailored to the particular radiation application and the type of work performed and should be designed so that a worker develops the necessary skills to work safely. The training programme should ensure that all workers receive adequate and up to date information on the health risks associated with their occupational exposure, whether normal exposure, potential exposure or exposure in an emergency, and on the significance of actions to be taken for protection and safety. It should also include local rules, safety and warning systems, and emergency procedures. Each training subject should be covered to the appropriate depth for a specific radiation application and the potential hazards associated with it. Workers should also be made aware of the presence of other hazardous agents in the workplace which may affect the safety of sources, such as inflammable items or corrosive agents. Female workers who are likely to enter controlled or supervised areas should be provided with appropriate information on the potential risks to an embryo or foetus due to exposure to radiation. They should also be made aware of the importance of notifying their employer as soon as pregnancy is suspected. Training should always include on the job training. Those workers who are not working directly with ionizing radiation, but are nevertheless working in the vicinity of radiation sources (including, for example, cleaning and maintenance staff), should be informed of the potential hazards associated with radiation sources and trained in the basic protection and safety procedures, especially the recognition of warning signs and signals.”</i> |
| (3) | BASIS: RS-G-1.1 para. 5.100 states that: <i>“Periodic retraining should be provided to ensure that workers have the most up to date knowledge relevant to their work, and that they do not become complacent about workplace hazards. Retraining should also be undertaken when there are significant changes in policy or procedures. Training should be updated at regular intervals.</i> |
| S26 | Suggestion: EMRC should consider, in consultation with the relevant training course providers, establishing arrangements to support the availability of authorized radiation protection training courses for RPOs. The radiation protection framework should include provisions for the re-training of occupationally exposed workers by the RPO. |

12.3. SUMMARY

EMRC has made advances in recent years in the areas of medical and occupational radiation protection. The legislative and regulatory framework of the Government of Jordan for the areas of medical and occupational radiation protection requires further work to develop, review and approve the required regulations, instructions and guidance. The framework should be brought into line with the IAEA GSR Part 3 requirements.

For medical exposure, the principles of optimization and justification and how to apply them should be included in the regulatory framework.

The government should ensure that an effective and efficient cooperation takes place between all authorities involved in radiation protection control in health facilities and also in the occupational radiation protection area. EMRC, Ministry of Health, Ministry of Labour and other professional societies and organizations should identify the respective responsibilities as to all radiation protection matters, including regulation, inspection and authorization. The requirements for quality control of patient exposures should be clearly defined.

The occupational radiation infrastructure should be expanded to include neutron dosimetry and surface contamination calibration activities. An internal dosimetry infrastructure should be established. Training courses for RPOs should be made available.

APPENDIX I LIST OF PARTICIPANTS

| INTERNATIONAL EXPERTS | | | |
|-----------------------|------------------------------------|--|--|
| 1. | LOY John | Federal Authority for Nuclear Regulation (FANR) | john.loy@eaa.gov.ae |
| 2 | VLAHOV Nikolay | Bulgarian Nuclear Regulatory Agency (BNRA) | n.vlahov@bnra.bg |
| 3. | BSAT Hassan | Lebanese Atomic Energy | bsat@cnrs.edu.lb |
| 4. | CEYHAN Mehmet | Turkish Atomic Energy Authority | Mehmet.Ceyhan@taek.gov.tr |
| 5. | EL-MONGY Sayed Ali M.Hassan | Egyptian Nuclear and Radiological Regulatory Authority (ENRRA) | sayedelmongy@hotmail.com |
| 6. | FASSI FEHRI Majid | Canadian Nuclear Safety Commission | Majid.FassiFehri@cnsccsn.gc.ca |
| 7. | FENNELL Stephan | Radiological Protection Institute of Ireland (RPII) | sfennell@rpii.ie |
| 8. | HUNT John | Comissão Nacional de Energia Nuclear do Brasil | john@ird.gov.br |
| 9. | JACKSON Terry | U.S. Nuclear Regulatory Commission | Terry.Jackson@nrc.gov |
| 10, | NIZAMSKA Marina | Bulgarian Nuclear Regulatory Agency (BNRA) | M.Nizamska@bnra.bg |
| 11. | ÖHLÉN Elisabeth | Swedish Radiation Safety Authority | Elisabeth.Ohlen@ssm.se |
| 12. | RUEL Delphine | ASN (Nuclear Safety Authority) | Delphine.RUEL@asn.fr |
| 13. | GAN Pek Yen | Atomic Energy Licensing Board | ganpy@aelb.gov.my |
| 14. | SHIMA Masakazu | Nuclear Regulation Authority, Japan | Masakazu_shima@nsr.go.jp |
| IAEA STAFF MEMBERS | | | |
| 1. | MANSOUX Hilaire | Division of Radiation, Transport and Waste Safety | H.Mansoux@iaea.org |
| 2. | JONES Geoffrey | Division of Nuclear Installation Safety | G.Jones@iaea.org |
| 3. | RODRIGO Salinas | Incident and Emergency Centre | R.Salinas@iaea.org |
| 4. | SWOBODA Zumi | Division of Radiation, Transport and waste Safety | Z.Swoboda@iaea.org |
| LIAISON OFFICER | | | |
| | KASHT Tamer | Liaison Officer | tamer.kasht@jnrc.gov.jo |

APPENDIX II MISSION PROGRAMME

SCHEDULE OF THE IRRS MISSION TO JORDAN

| Time | FRI 13 June | SAT 14 June | SUN 15 June | MON 16 June | | TUE 17 June | | WED 18 June | | Thu 19 June | FRI 20 June | SAT 21 June | | | | | | | | | |
|-------------|-------------------------|---|---------------------------|---------------------------------------|---------------------------|--|---------------------------|---------------------------|---------------------------|-------------------------------|--|--------------------------------------|---|--------|--------------------------|----------------------------------|---------------------------|-------------------------------|---|---------------------|--|
| 9:00-10:00 | Arrival of Team Members | | | Entrance Meeting | Parallel Group Interviews | Visits | Parallel Group Interviews | Visits | Parallel Group Interviews | DTC writes introductory parts | TM write Report TL and DTL review introductory part Draft text of report delivered to TL | Reading, Cross-reading of the Report | <ul style="list-style-type: none"> • Discussing and improving Draft Report • Cross-Reading • TL, DTL, TC and DTC read everything | | | | | | | | |
| 10:00-11:00 | | | | | | | | | | | | | | | | | | | | | |
| 11:00-12:00 | | | | | | | | | | | | | | | | | | | | | |
| 12:00-13:00 | | | Lunch | Lunch IRRS Team and JNRC Counterparts | Standing lunch | | Standing lunch | | Standing lunch | | Standing lunch | | Standing lunch | | | | | | | | |
| 13:00-14:00 | | | | | | Parallel Group Interviews | Visits | Parallel Group Interviews | Visits | Parallel Group Interviews | DTC writes introductory parts | | Policy Issues Discussion, session 1 | | Social Programme, Dinner | Finalization of the Draft Report | | | | | |
| 14:00-15:00 | | | Parallel Group Interviews | Parallel Group Interviews | Visits | | | | | | | | Parallel Group Interviews | Visits | | | Parallel Group Interviews | DTC writes introductory parts | Secretariat edits the report Preliminary Draft Report Ready | Cross-reading by TM | |
| 15:00-16:00 | | Initial Team Meeting: <ul style="list-style-type: none"> • IRRS process • Main objectives • Report writing • Schedule • First observations • In-Group discussions | | | | | | | | | | | | | | | | | | | |
| 16:00-17:00 | | | | | | | | | | | | | | | | | | | | | |
| 17:00-18:00 | | | | Daily Team Meeting | Daily Team Meeting | Daily Team Meeting: Discussion of findings | Daily Team Meeting | Daily Team Meeting | Daily Team Meeting | Daily Team Meeting | | | | | | | | | | | |
| 18:00-20:00 | | | Team Dinner | Dinner | Dinner | Dinner | Dinner | Dinner | Dinner | Dinner | | | Dinner | | | | | | | | |
| 20:00-21:00 | | | | Team Meeting | Team Meeting | Team Meeting | Team Meeting | Team Meeting | Team Meeting | | | TL, DTL, TC and DTC edits the report | | | | | | | | | |
| 21:00-24:00 | | | Writing of the report | Writing of the report | Writing of the report | Writing of the report | Writing of the report | Writing of the report | TM Read Draft | | | | | | | | | | | | |

| | SUN 22 June | MON 23 June | TUE 24 June | WED 25 June |
|-------------|---|--|--|--------------------------------------|
| 9:00-10:00 | Individual discussions of Rs, Ss and GPs with JNRC counterparts | Cross-Reading TL, DTL, TC and DTC read everything Finalization Submission of the Draft to JNRC | Written comments on draft provided by JNRC General discussion on the draft report with JNRC | Submission of the Final Draft |
| 10:00-12:00 | | | | Exit Meeting Press Conference |
| 12:00-13:00 | Standing lunch | Standing lunch | Lunch | Lunch |
| 13:00-15:00 | Policy Issues Discussion, session 2 | Review of the report by JNRC | Team to finalize the report TL finalises Executive Summary and exit presentation TC Drafts the Press Release Briefing of the DDG Finalization of the press release | Departure Home |
| 15:00-17:00 | Individual discussions of Rs, Ss and GPs with counterparts | | | |
| 17:00-18:00 | Daily Team Meeting | | | |
| 18:00-20:00 | Dinner | Dinner | Farewell Dinner | |
| 20:00-21:00 | TL, DTL, TC and DTC includes changes | Free | Free | |
| 21:00-24:00 | | | | |

APPENDIX III SITE VISITS

Facilities visited:

King Hussein Cancer Center (KHCC)

Gamma Irradiator - Jordan Atomic Energy Commission (JAEC)

Interim Waste Storage Facility - Jordan Atomic Energy Commission (JAEC)

Jordan Subcritical Assembly (JSA) - Jordan University for Science & Technology (JUST)

Jordan Research and training Reactor (JRTR) - Jordan University for Science & Technology (JUST)

Utility Company - Jordan Nuclear Utility Company (JNUC)

APPENDIX IV LIST OF COUNTERPARTS

| IRRS EXPERTS | COUNTERPART |
|---|---|
| RESPONSIBILITIES AND FUNCTIONS OF THE GOVERNMENT, GLOBAL SAFETY REGIME | |
| John Loy Nikolay Vlahov Sayed Ali M. Hassan | Dr Majd Hawwari Mohammad Bqoor Tamer Kasht |
| RESPONSIBILITIES AND FUNCTIONS OF THE REGULATORY BODY | |
| John Loy Nikolay Vlahov Sayed Ali M. Hassan | Dr Majd Hawwari Mohammad Bqoor Tamer Kasht |
| MANAGEMENT SYSTEM | |
| Elizabeth Öhlén | Serene Mukattash |
| AUTHORIZATION | |
| Delphine Ruel Stephen Funnell Majid Fassi Fehri | Ahmad Hamdan Moayyad Sabagh Shrooq Shawabkeh Omar Kloub Mohammad Salman |
| REVIEW AND ASSESSMENT | |
| Delphine Ruel Stephen Funnell Majid Fassi Fehri | Ahmad Hamdan Moayyad Sabagh Omar Kloub Mohammad Salman |
| INSPECTION | |
| Delphine Ruel Stephen Fennell Majid Fassi Fehri | Ahmad Hamdan Moayyad Sabagh Shrooq Shawabkeh Omar Kloub Mohammad Salman |
| ENFORCEMENT | |
| Delphine Ruel Stephen Fennell Majid Fassi Fehri | Ahmad Hamdan Moayyad Sabagh Shrooq Shawabkeh Omar Kloub |

| IRRS EXPERTS | COUNTERPART |
|--|---|
| | Mohammad Salman |
| REGULATIONS AND GUIDES | |
| Delphine Ruel Stephen Fennell Majid Fassi Fehri | Ahmad Hamdan Moayyad Sabagh Shrooq Shawabkeh Omar Kloub Mohammad Salman |
| EMERGENCY PREPAREDNESS AND RESPONSE | |
| Marina Nizamska Rodrigo Salinas | Raed Majali Belal Momani |
| TAILORED MODULES FOR COUNTRIES EMBARKING ON NUCLEAR POWER | |
| Terry Jackson Mehmet Ceyhan | Dr Majd Hawwari Tamer Kasht |
| MODULE 11 ADDITIONAL AREAS - Medical Exposure | |
| Delphine Ruel | Issa Khalaileh Rana Habahbeh |
| MODULE 11 ADDITIONAL AREAS - Occupational Exposure | |
| John Hunt | Yazan Masswadeh Mohammad Babbas |
| MODULE 11 ADDITIONAL AREAS - Transport | |
| Hassat Bsar | Mohammad Atevat Osama Natsheh |

APPENDIX V RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

| AREA | | R: Recommendations S: Suggestions G: Good Practices | Recommendations, Suggestions or Good Practices |
|-----------|---|---|--|
| 1. | RESPONSIBILITIES AND FUNCTIONS OF THE GOVERNMENT | R1 | The Government should establish and publish a national policy and strategy for safety on the basis of consideration of a formulation of the policy prepared by EMRC. |
| | | R2 | <p>The government should ensure that the proposed new law addresses the following issues in accordance with GSR Part 1:</p> <ul style="list-style-type: none"> – Assigning prime responsibility for safety to the operator – Provision for appeals against decisions of the regulatory body – Provision for preparedness for, and response to, a nuclear or radiological emergency – Criteria for release from regulatory control – Clear powers for inspectors – Involvement of interested parties and for their input to decision making. <p>Note: This Recommendation also covers issues raised in sections 1.3, 1.4, 3.6, 5.2, 7.1.3, 8.1, 11.2.3.</p> |
| | | R3 | <p>The government should, working with EMRC and as a matter of urgency, complete the regulations and instructions that are currently in a draft form and ensure that the remainder of the regulatory framework is established as soon as possible.</p> <p>Note: This Recommendation also covers issues raised in sections 3.6, 9.1.1, 9.2, 9.3, 9.4, 9.5, 11.2.4, 11.2.19.</p> |
| | | R4 | <p>The Government, in the law and in its policy and strategy for safety, and EMRC, in its internal procedures, should clarify the role and authority of each separate regulatory function of EMRC so that all regulatory judgements and decisions have sound technical basis and are free from undue influences on its regulatory decision-making.</p> <p>Note: This Recommendation also covers issues raised in sections 3.1, 3.2, 11.2.3.</p> |

| AREA | | R: Recommendations S: Suggestions G: Good Practices | Recommendations, Suggestions or Good Practices |
|------|-------------------------------------|---|--|
| | | R5 | The government should ensure that formal coordination arrangements are established between EMRC and other government agencies including the Ministries of Health, Interior, Environment, and Labour. Note: This Recommendation also covers issues raised in sections 7.1.1, 12.1. |
| | | S1 | The government should consider establishing national processes and guidance for protective actions to reduce the risk from unregulated sources. |
| | | S2 | The government should consider timely adoption of the draft national policy on management of spent fuel and radioactive waste and support for its effective implementation. Note: This Suggestion also covers issues raised in section 11.2.13. |
| | | R6 | The government should ensure that EMRC is provided with adequate human resources with the necessary competence to effectively regulate nuclear and radiation risks in the country. Note: This Recommendation also covers issues raised in sections 6.1.2, 11.2.9. |
| | | S3 | The Government should consider establishing internal dosimetry arrangements in a timely manner. Note: This Suggestion also covers issues raised in section 12.2. |
| 2. | GLOBAL NUCLEAR SAFETY REGIME | GP1 | Jordan is participating in several international forums and actively using various international cooperation programs to strengthen its nuclear and radiation safety infrastructure. |
| | | R7 | The government should become a contracting party to the Joint Convention and should demonstrate that respective international obligations are fulfilled by participation in its relevant international arrangements. Note: This Recommendation also covers issues raised in section 11.2.2. |
| | | S4 | EMRC should consider establishing processes for identifying and sharing lessons learnt from operating and regulatory experience. |

| AREA | | R: Recommendations S: Suggestions G: Good Practices | Recommendations, Suggestions or Good Practices |
|------|--|---|---|
| 3. | RESPONSIBILITIES AND FUNCTIONS OF THE REGULATORY BODY | S5 | EMRC should consider finalizing the systematic assessment of its organizational needs for its current and future nuclear and radiation safety regulatory functions and establish its new organization and resources accordingly. Note: This Suggestion also covers issues raised in section 10.1. |
| | | S6 | EMRC should consider developing a statement describing its regulatory values, emphasising its independence in regulatory decision-making and promulgating a statement of expectations for its employees. |
| | | R8 | EMRC should develop, as a matter of urgency, a human resources plan to support its nuclear and radiological regulatory decision-making and establish its internal systematic training programme for current and new inspectors and assessors. Note: This Recommendation also covers issues raised in sections 7.1.1, 7.1.3, 11.2.9, 11.2.12. |
| | | R9 | The government and EMRC should identify and implement innovative approaches to attract and retain highly qualified staff at EMRC to support its nuclear and radiation safety regulatory functions. |
| | | S7 | EMRC should consider the use of one or more technical advisory bodies of experts to support its decision making on important nuclear and radiation safety issues. Note: This Suggestion also covers issues raised in section 11.2.7. |
| | | R10 | EMRC should take prompt actions to establish effective arrangements to manage safety-related documents and records, so as to ensure that they are available, identifiable and easily retrievable. Note: This Recommendation also covers issues raised in sections 4.4, 5.2, 7.1.2. |
| | | S8 | EMRC should consider developing further, and formalizing in a policy, its information and consultation strategy with interested parties. |
| 4. | MANAGEMENT SYSTEM OF THE | R11 | EMRC should proceed further with the establishment and implementation |

| AREA | | R: Recommendations S: Suggestions G: Good Practices | Recommendations, Suggestions or Good Practices |
|------|------------------------|---|---|
| | REGULATORY BODY | | <p>of the integrated management system according to the requirements in GS-R-3 with the aim to achieve and enhance safety. Special attention should be paid to:</p> <ul style="list-style-type: none"> - defining, documenting, and implementing the core regulatory processes - bringing all the requirements for managing the organization together in a coherent way - assigning authority and responsibility for the regulatory processes to designated individuals - assessing and continually improving the processes of the management system. <p>Note: This Recommendation also covers issues raised in sections 4.5, 10.4.</p> |
| | | GP2 | The regulatory body is promoting safety culture in an inventive and constructive way by sending daily safety messages to all staff. Training sessions are held on safety culture and a survey is planned. This contributes to a common understanding of the key aspects of safety culture across the organization. |
| | | R12 | EMRC should appoint an individual reporting directly to senior management with the responsibility and authority to coordinate the development and implementation of the management system. |
| | | S9 | EMRC should consider extending the authority and capacity of the internal audit unit to cover the responsibility of independent assessments of regulatory processes and technical matters related to safety. |
| 5. | AUTHORIZATION | R13 | <p>EMRC should further formalize the application of a graded approach in the authorization process based on the radiation risks associated with facilities and activities.</p> <p>Note: This Recommendation also covers issues raised in section 5.3.</p> |
| | | R14 | EMRC should develop adequate guidance on the format and content of the documents to be submitted by the applicant in support of its licence application. |

| AREA | | R: Recommendations S: Suggestions G: Good Practices | Recommendations, Suggestions or Good Practices |
|------|-----------------------|---|--|
| | | | Note: This Recommendation also covers issues raised in section 5.3. |
| | | R15 | EMRC should ensure that all facilities and activities that require a licence according to Law No (43) of 2007 are licensed and that the licensing renewal process is revised and formalized so that it does not result in facilities operating without a valid licence. Note: This Recommendation also covers issues raised in section 7.1.1. |
| | | S10 | In order to free resources to be directed to higher priority activities, EMRC should consider amending its practices of issuing personal licenses to all workers and individual licenses to each device and source, as well as the registration of exempted sources. |
| | | S11 | EMRC should consider rationalizing the number of databases for sources to ensure that there is a single official comprehensive register of sources and devices in Jordan. |
| | | R16 | EMRC should immediately rectify the licensing status of the radioactive waste facility at JAEC. |
| | | GP3 | Orphan sources and disused sources are transferred for safe storage to a radioactive waste storage facility. |
| | | S12 | EMRC should consider ensuring that the radioactive waste facility at JAEC promptly notifies it of new sources transferred to it and that these records should be appropriately stored. |
| | | S13 | EMRC should consider revising its requirements related to transport licence application so that they include all the relevant information mentioned in TS-G-1.3. |
| 6. | REVIEW AND ASSESSMENT | R17 | EMRC should develop a formal process for review and assessment of safety related applications, taking into account a graded approach. |
| | | R18 | EMRC should establish requirements for qualification and certification of the personnel of research reactors. |

| AREA | | R: Recommendations S: Suggestions G: Good Practices | Recommendations, Suggestions or Good Practices |
|------|-------------------------------------|---|---|
| | | R19 | EMRC should develop safety acceptance criteria for the Research Reactors. |
| | | S14 | EMRC should consider establishing processes for review, assessment and approval of package designs, taking into account existing internationally approved designs. |
| 7. | INSPECTION | R20 | EMRC should reduce the influence of the current licence renewal process on its inspection programme and instead develop the programme on the basis of the radiation risks associated with facilities and activities. |
| | | R21 | EMRC should conduct inspections and develop the associated inspection procedures to cover all facilities and activities in Jordan, including transport. Note: This Recommendation also covers issues raised in section 7.5. |
| | | R22 | EMRC should establish formal criteria for determining when a new staff member is deemed competent to be appointed as an inspector and provide the inspector with documented evidence of that appointment. |
| | | GP4 | EMRC has a resident inspector at JRTR construction site. |
| 8. | ENFORCEMENT | R23 | EMRC should establish and implement an enforcement policy in accordance with a graded approach and ensure that all relevant staff are appropriately trained on enforcement actions. |
| 9. | REGULATION AND GUIDES | R24 | EMRC should establish and implement a process to develop and update regulations, instructions and guides. Note: This Recommendation also covers issues raised in section 7.4. |
| 10. | EMERGENCY PREPAREDNESS AND RESPONSE | R25 | EMRC should complete the regulatory framework for EPR and ensure that licensees have adequate arrangements in place to respond to nuclear and radiological emergencies. Note: This Recommendation also covers issues raised in sections 10.2, 10.3, 11.2.14. |
| | | S15 | EMRC should consider continuing the cooperation with other relevant |

| AREA | | R: Recommendations S: Suggestions G: Good Practices | Recommendations, Suggestions or Good Practices |
|------|--|---|---|
| | | | organizations to develop a comprehensive national threat (hazard) assessment. |
| | | S16 | EMRC should consider defining its role in public communication on emergency preparedness and response, in cooperation with relevant governmental organizations. |
| | | S17 | EMRC should consider clarifying the allocation of responsibilities for the protection of emergency workers (on-site and off-site) and issuing guidance on the management, control and recording of emergency workers exposure. |
| | | R26 | EMRC should develop its own emergency response arrangements including plans, procedures, training and drills. |
| 11. | TAILORED MODULE FOR COUNTRIES EMBARKING ON NULEAR POWER | S18 | The government should consider developing an integrated national strategy for the nuclear power programme going forward that identifies and addresses potential challenges to safety, involves all interested parties, and is periodically updated. |
| | | S19 | The regulatory body should consider establishing cooperation with regulatory bodies of the vendor country and countries with NPPs of the same type. Note: This Suggestion also covers issues raised in section 11.2.4 |
| | | S20 | EMRC should consider developing means to inform interested parties on how they can raise safety concerns to EMRC. |
| | | S21 | The government should consider removing from EMRC's source of funding the fines levied in respect of enforcement actions on the licensees. |
| | | R27 | EMRC should develop arrangements to avoid actual, potential, or perceived conflicts of interest when employing external support organizations. |
| | | S22 | EMRC should consider adopting the provisions of IAEA SSR-2/1 as the basis of its requirements for NPP design. |
| 12. | CONTROL OF MEDICAL | R28 | EMRC should without delay finalize the regulatory requirements on |

| AREA | | R: Recommendations S: Suggestions G: Good Practices | Recommendations, Suggestions or Good Practices |
|------------|--|---|---|
| | EXPOSURES | | medical exposure, making sure that they are compliant with GSR Part 3, and prepare the instructions required for their application. Some of this framework should be developed in consultation with the Ministry of Health and relevant professional bodies. Guidance should also be developed. |
| | | R29 | EMRC should develop training requirements regarding patient protection. |
| 12. | OCCUPATIONAL RADIATION PROTECTION | R30 | EMRC should review and revise the regulatory framework for occupational exposure control, including regulations, instructions and guidance, for consistency and completeness with respect to GSR part 3 and approve the draft regulations and instructions as quickly as possible. |
| | | S23 | EMRC should consider implementing a monthly dosimeter exchange for Category I workers. |
| | | S24 | EMRC should consider establishing a computerized national register of occupational dose records. |
| | | S25 | EMRC should consider including in the radiation protection regulatory framework specific requirements for calibration of portable and fixed dose rate and surface contamination measuring equipment. |
| | | S26 | EMRC should consider, in consultation with the relevant training course providers, establishing arrangements to support the availability of authorized radiation protection training courses for RPOs. The radiation protection framework should include provisions for the re-training of occupationally exposed workers by the RPO. |

APPENDIX VI LIST OF IRRS MISSION FINDINGS RELATED TO THE TAILORED MODULE FOR COUNTRIES EMBARKING ON NUCLEAR POWER

| SSG-16 Element | Location in Report | Finding No. | Finding Text | Observation |
|----------------|--------------------|-------------|---|--|
| 1 | SSG-16 Element 1 | S18 | The Government should consider developing an integrated national strategy for the nuclear power programme that identifies and addresses potential challenges to safety, involves all interested parties, and is periodically updated. | The government does not have an integrated national strategy for pursuing a nuclear power programme that effectively addresses challenges to safety for future activities. |
| 2 | 2.1 | R7 | Government should become a contracting party to the Joint Convention and should demonstrate that respective international obligations are fulfilled by participation in its relevant international arrangements. | Jordan's participation in the Convention on Nuclear Safety has been limited. |
| | 2.1 | R7 | Government should become a contracting party to the Joint Convention and should demonstrate that respective international obligations are fulfilled by participation in its relevant international arrangements. | Jordan is a party to the relevant Conventions, with the exception of the Joint Convention. |
| | 2.1 | GP1 | Jordan is participating in several international forums and actively using various international cooperation programs to strengthen its nuclear and radiation safety infrastructure. | Jordan is benefitting from and contributing to international cooperation in nuclear safety and radiation protection in a substantial way. |
| | SSG-16 Element 2 | S19 | The regulatory body should consider establishing cooperation with regulatory bodies of the vendor country and countries with NPPs of the same type. | EMRC has several bilateral cooperation agreements with regulatory bodies of other countries but not with the vendor country and the countries with similar reactor type. |
| 3 | 1.2 | R2 | Government should ensure that the proposed new law addresses the following issues in accordance with GSR Part 1: | Several elements for an effective governmental and legal framework for safety are missing from the existing law. |
| | 1.3 | R4 | The Government, in the law and in its policy and strategy for safety, and EMRC, in its internal procedures, should clarify the role and authority of each | The nuclear and radiation safety regulator is now included in an organization with other roles that could conflict with its |

| SSG-16 Element | Location in Report | Finding No. | Finding Text | Observation |
|----------------|--------------------|-------------|---|---|
| | | | separate regulatory function of EMRC so that all regulatory judgements and decisions have sound technical basis and are free from undue influences on its regulatory decision-making. | overall mission to ensure nuclear safety. In addition, EMRC is attached to a Minister whose role includes promotion of the energy sector, including nuclear energy. |
| 4 | 1.2 | R3 | The Government should, working with EMRC and as a matter of urgency, complete the regulations and instructions that are currently in a draft form and ensure that the remainder of the regulatory framework is established as soon as possible. | A number of regulations and instructions have been in draft form for the last few years without being issued. |
| | SSG-16 Element 2 | S19 | The regulatory body should consider establishing cooperation with regulatory bodies of the vendor country and countries with NPPs of the same type. | EMRC has several bilateral cooperation agreements with regulatory bodies of other countries but not with the vendor country and the countries with similar reactor type. |
| 5 | SSG-16 Element 5 | S20 | EMRC should consider developing means to inform interested parties on how they can raise safety concerns to EMRC. | Law No. 43 / 2007 requires anyone that witnesses a violation of the law to inform EMRC. However, an adequate process to implement this requirement does not exist. |
| 6 | SSG-16 Element 6 | S21 | The government should consider removing from EMRC's source of funding the fines levied in respect of enforcement actions on the licensees. | Law 43 /2007 states that EMRC revenue includes charges of fines imposed to licensees. |
| 7 | 3.4 | S7 | EMRC should consider the use of one or more technical advisory bodies of experts to support its decision making on important nuclear and radiation safety issues. | Currently no advisory bodies on nuclear or radiation safety have been established for EMRC. |
| | SSG-16 Element 7 | R27 | EMRC should develop arrangements to avoid actual, potential, or perceived conflicts of interest when employing external support organizations. | In some cases EMRC contracted the same TSOs as JAEC, and has used the services of JAEC, but the IRRS team did not identify any formal process to ensure no conflicts of interest. |
| 8 | | None | | |
| 9 | 1.8 | R6 | Government should ensure that EMRC is provided with | EMRC does not possess sufficient staff |

| SSG-16 Element | Location in Report | Finding No. | Finding Text | Observation |
|----------------|--------------------|-------------|---|--|
| | | | adequate human resources with the necessary competence to effectively regulate nuclear and radiation risks in the country. | with the necessary competencies to perform all its regulatory functions. |
| | 3.3 | R9 | Government and EMRC should identify and implement innovative approaches to attract and retain highly qualified staff at EMRC to support its nuclear and radiation safety regulatory functions. | Before merging in EMRC, JNRC lacked a fully developed human resources plan covering recruitment, rotation of staff and a training program based upon a competency framework. |
| | 3.3 | R8 | EMRC should develop, as a matter of urgency, a human resources plan to support its nuclear and radiological regulatory decision-making and establish its internal systematic training programme for current and new inspectors and assessors. | Before merging in EMRC, JNRC lacked a fully developed human resources plan covering recruitment, rotation of staff and a training program based upon a competency framework. |
| 10 | | None | | |
| 11 | | None | | |
| 12 | 3.3 | R8 | EMRC should develop, as a matter of urgency, a human resources plan to support its nuclear and radiological regulatory decision-making and establish its internal systematic training programme for current and new inspectors and assessors. | Before merging in EMRC, JNRC lacked a fully developed human resources plan covering recruitment, rotation of staff and a training program based upon a competency framework. |
| 13 | 1.7 | S2 | Government should consider timely adoption of the draft national policy on management of spent fuel and radioactive waste and support for its effective implementation. | A draft national policy on radioactive waste and spent fuel management has been developed, which still awaits approval by the government. |
| 14 | 10.1 | R25 | EMRC should complete the regulatory framework for EPR and ensure that licensees have adequate arrangements in place to respond to nuclear and radiological emergencies. | Current legal and regulatory framework does not fully cover emergency preparedness and response for licensees. |
| 15 | | None | | |
| 16 | | None | | |
| 17 | SSG-16 | S22 | EMRC should consider adopting the provisions of | Based on a limited review, the draft |

| SSG-16 Element | Location in Report | Finding No. | Finding Text | Observation |
|----------------|--------------------|-------------|---|---|
| | Element 17 | | IAEA SSR-2/1 as the basis of its requirements for NPP design. | instruction on Safety of Nuclear Power Plants did not address certain systems and activities in IAEA SSR-2/1. |
| 19 | 9.5 (1.2) | R3 | The Government should, working with EMRC and as a matter of urgency, complete the regulations and instructions that are currently in a draft form and ensure that the remainder of the regulatory framework is established as soon as possible. | A number of regulations and instructions have been in draft form for the last few years without being issued. |
| 20 | | None | | |

APPENDIX VII REFERENCE MATERIAL USED FOR THE REVIEW

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| <p>Prime Minister Official letter CAR for our findings on the EQ Audit Civil Duty Regulation CNS Jordan National Report 2014 Concrete inspection 7 Concrete Inspection Checklist Design Envelope –JNRC Instruction JNRC_120327 DRAFT Emergency Prep regulation zx Draft Radiation Protection Regulation JNRC Emergency preparedness and types of radiological accidents EQ Test Audit report 8-16 may 2013 Korea Final Draft Regulation on Safe Use of Nuclear Energy inspection steps Instruction on safety of RR_17 SEP2012 Instruction on the Procedure for Issuing Licenses and Permits for Nuclear Facilities and Associated Activities Instruction on the Safety of Nuclear Power Plants Internal meeting May 2013 MoM JAEC QA Manual JNRC instruction on SAR Format JNRC Organizational Structure JNRC Quality Management Manual JNRC_JRTR_Team report_ Technical CSM_Feb 2013_Draft-1 March2013 JRTR SER Final Law No (43) of 2007 Arabic Law No (43) of 2007 English Legislative and opinion bureau Regulation number 1 of 1993 Licence Instruction Licence Regulation-Jordan 16 August 2011- Revised 2012-02-10 Licensing of radioactive sources Reg33 P-drafted_02-2013_V02-Eyad Final Policy statement on the licensing scheme for the JRTR Policy-drafted_09-2013_V04 Radiation Inspection Steps for Radiation Facilities and Activities-Ar Radiation Protection Concepts Radwaste Regulation_17 Sep 2012 Rebar Inspection Checklist Regulation on Basis and Conditions for Granting Licenses and Permits for the Radiation Work Number 8 of 2013 Regulatory Roles in emergency Preparedness Reviewing Steps for Licensing Applications Safety and Security in transportation Sample EQ-Test-Audit-report 8-16 may 2013 Korea Sample Report JSA SF Regulation 17 Sep 2012 Site Evaluation Instructions JNRC -110918 Site Survey and Site Selection Instructions-110210 AG 22.02.2011 White Paper on Nuclear Energy in Jordan – Final Report (September 2011)</p> |
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SARIS

Module Code of Conduct Sources

NPP module

Research Reactors module

Safe Transport Module

Core Questions Module

Country Info

Fuel Cycle Module

Introduction

IRIS module 01 National Policy and Strategy for Safety

IRIS module 03 Legal Framework

IRIS Module

MEDICAL EXPOSURE REGULATOR

Module 10 EPR question set

APPENDIX VIII IAEA REFERENCE MATERIAL USED FOR THE REVIEW

1. INTERNATIONAL ATOMIC ENERGY AGENCY - No. SF-1 - Fundamental Safety Principles
2. INTERNATIONAL ATOMIC ENERGY AGENCY - Governmental, Legal and Regulatory Framework for Safety General Safety Requirement Part 1 (Vienna2010)
3. INTERNATIONAL ATOMIC ENERGY AGENCY - Preparedness and Response for a Nuclear and Radiological Emergency Safety Requirement Series No. GS-R-2 IAEA Vienna (2002)
4. INTERNATIONAL ATOMIC ENERGY AGENCY The Management System for Facilities and Activities. Safety Requirement Series No. GS-R-3 IAEA, Vienna (2006)
5. INTERNATIONAL ATOMIC ENERGY AGENCY – Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, General Safety Requirements Part 3, No. GSR Part 3 (Interim Edition), IAEA, Vienna (2011)
6. INTERNATIONAL ATOMIC ENERGY AGENCY – Safety assessment for facilities and activities, General Safety Requirements Part 4, No. GSR Part 4, IAEA, Vienna (2009)
7. INTERNATIONAL ATOMIC ENERGY AGENCY – Predisposal Management of Radioactive Waste General Safety Requirement Part 5, No. GSR Part 5, IAEA, Vienna (2009)
8. INTERNATIONAL ATOMIC ENERGY AGENCY – Decommissioning of Facilities Using Radioactive Material Safety, Safety Requirement Series No. WS-R-5, IAEA, Vienna (2006)
9. INTERNATIONAL ATOMIC ENERGY AGENCY - Organization and Staffing of the Regulatory Body for Nuclear Facilities, Safety Guide Series No. GS-G-1.1, IAEA, Vienna (2002)
10. INTERNATIONAL ATOMIC ENERGY AGENCY - Review and Assessment of Nuclear Facilities by the Regulatory Body, Safety Guide Series No. GS-G-1.2, IAEA, Vienna (2002)
11. INTERNATIONAL ATOMIC ENERGY AGENCY - Regulatory Inspection of Nuclear Facilities and Enforcement by the Regulatory Body, Safety Guide Series No. GS-G-1.3, IAEA, Vienna (2002)
12. INTERNATIONAL ATOMIC ENERGY AGENCY - Documentation for Use in Regulatory Nuclear Facilities, Safety Guide Series No. GS-G-1.4, IAEA, Vienna (2002)
13. INTERNATIONAL ATOMIC ENERGY AGENCY- - Arrangements for Preparedness for a Nuclear or Radiological Emergency, Safety Guide Series No. GS-G-2.1, IAEA, Vienna (2007)
14. INTERNATIONAL ATOMIC ENERGY AGENCY – Criteria for use in Preparedness and Response for a Nuclear or Radiological Emergency, General Safety Guide Series No. GSG-2, IAEA, Vienna (2011)
15. INTERNATIONAL ATOMIC ENERGY AGENCY - Safety of Nuclear Power Plants: Design, Specific Safety Requirement Series SSR-2/1 IAEA, Vienna (2012)
16. INTERNATIONAL ATOMIC ENERGY AGENCY– Safety of Nuclear Power Plants: Operation, Safety Requirement Series No. NS-R-2, IAEA, Vienna (2000)
17. INTERNATIONAL ATOMIC ENERGY AGENCY - Safety of Research Reactors, Safety Requirement Series No. NS-R-4, IAEA, Vienna (2005.)
18. INTERNATIONAL ATOMIC ENERGY AGENCY - Periodic Safety Review of Nuclear Power Plants Specific Safety Guide SSG-25, IAEA, Vienna (2013)
19. INTERNATIONAL ATOMIC ENERGY AGENCY - A System for the Feedback of Experience from Events in Nuclear Installations Safety Guide No. NS-G-2.11, IAEA, Vienna (2006)
20. INTERNATIONAL ATOMIC ENERGY AGENCY– Assessment of Occupational Exposure Due to Intake of Radionuclides Safety Guide Series No. RS-G-1.2, IAEA, Vienna (1999)
21. INTERNATIONAL ATOMIC ENERGY AGENCY - Assessment of Occupational Exposure Due to External Sources of Radiation Safety Guide Series No. RS-G-1.3, IAEA, Vienna (1999)
22. INTERNATIONAL ATOMIC ENERGY AGENCY - Building Competence in Radiation Protection and the Safe Use of Radiation Sources, Safety Guide Series No. RS-G-1.4, IAEA, Vienna (2001)

23. INTERNATIONAL ATOMIC ENERGY AGENCY - Establishing the safety infrastructure for a nuclear power programme, Specific Safety Guide No. SSG 16, IAEA, Vienna
24. INTERNATIONAL ATOMIC ENERGY AGENCY – Classification of Radioactive Waste, General Safety Guide No. GSG-1, IAEA, Vienna (2009)
25. INTERNATIONAL ATOMIC ENERGY AGENCY – Regulatory Control of Radioactive Discharge to the Environment, Safety Guide Series No. WS-G-2.3, IAEA, Vienna (2000)
26. INTERNATIONAL ATOMIC ENERGY AGENCY – Safety Assessment for the Decommissioning of Facilities Using Radioactive Material, Safety Guide Series No. WS-G.5.2, IAEA, Vienna (2009)
27. INTERNATIONAL ATOMIC ENERGY AGENCY - Convention on Early Notification of a Nuclear Accident (1986) and Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (1987), Legal Series No. 14, Vienna (1987).
28. INTERNATIONAL ATOMIC ENERGY AGENCY - Generic Assessment Procedures for Determining Protective Actions during a Reactor Accident, IAEA-TECDOC-955, IAEA, Vienna (1997)

APPENDIX IX - ORGANIZATIONAL CHART



Energy and Mineral Regulatory Commission (EMRC)

EMRC Structure

