



**INTERNATIONAL ATOMIC ENERGY AGENCY**

**FINAL EPREV REPORT**

**PEER APPRAISAL OF THE ARRANGEMENTS  
IN THE HASHEMITE KINGDOM OF JORDAN  
ON PREPAREDNESS FOR RESPONDING TO A  
RADIATION EMERGENCY**

**Amman, Jordan**

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DEPARTMENT OF TECHNICAL  
COOPERATION

Division for Asia and the Pacific Section 2

DEPARTMENT OF NUCLEAR SAFETY AND  
SECURITY

Incident and Emergency Centre

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Although many individuals are mentioned by name in the report, we would also like to give credit to those persons who were involved in important tasks behind the scenes in organizing the mission, such as translation, logistics and information technology support. The team visited the principal organizations that may take part in emergency preparedness and response (EPR) at all levels. The counterparts responded with a high level of openness and provided valuable contributions – this excellent cooperation was greatly appreciated.

## FOREWORD

Within the United Nations system, the International Atomic Energy Agency (IAEA) has the statutory functions of establishing standards of safety for the protection of health against exposure to ionizing radiation, and of providing for the application of these standards. In addition, under the Convention on Assistance in Case of a Nuclear Accident or Radiological Emergency (Assistance Convention), [1] the IAEA has a function, if requested, to assist Member States in preparing both emergency plans and the appropriate legislation in the case of nuclear accidents and radiological emergencies.

In response to a request from the authorities of the Hashemite Kingdom of Jordan in a letter from the Jordan Atomic Energy Commission No. 5/3/3218 of 14/11/2012, the IAEA fielded EPREV mission to the Hashemite Kingdom of Jordan to conduct, in accordance with Article III of the IAEA Statute, a peer review of EPR arrangements in the Hashemite Kingdom of Jordan vis-à-vis the relevant IAEA standards.

The Hashemite Kingdom of Jordan is a country embarking in a nuclear power programme. The political decision about the construction of the first nuclear power plant was made several years ago, and now site selection is underway. The vendor will be defined soon. At present, Jordan has facilities and practices that address hazard categories III, IV and V. Jordan University of Science and Technology (JUST) is finishing construction of the Jordan Subcritical Assembly, which will start operation in 2013 and will be a hazard category III facility. The Jordan Atomic Energy Commission (JAEC) is managing construction of the hazard category II facility, the Jordan Research and Training Reactor (JRTR), at a site next to the JUST Campus. Commissioning of JRTR is planned for 2016.

In discussions with Counterparts, the team gathered information on issues relating to preparedness and response to radiation emergencies, including licensing, environmental radiation monitoring, use of radioactive sources in medicine, civil protection, occupational radiation protection, food safety and capacity building.

The authorities of the Hashemite Kingdom of Jordan invited the IAEA to perform an EPREV mission with a view to assessing Jordan's current status of preparedness for a radiation emergency and to assist the Jordanian authorities in setting priorities for the rewrite of the National Radiation Emergency Plan (NREP). A further objective of the EPREV was to assist the Jordanian authorities in assigning specific EPR responsibilities to authorities who participate in radiation emergency response.

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# 1. INTRODUCTION

## 1.1. Background

Article III.A.6 of the International Atomic Energy Agency (IAEA) Statute specifies the following two main safety functions of the IAEA:

- To “establish or adopt, in consultation and, where appropriate, in collaboration with the competent organs of the United Nations and with the specialized agencies concerned, standards of safety for protection of health and minimization of danger to life and property”; and
- To “provide for the application of these standards” through, *inter alia*, the rendering of safety review services, including an appraisal of compliance.

The obligations, responsibilities and requirements regarding preparedness for and response to radiation emergencies are set out in the IAEA Safety Standards, in particular the 2002–2011 IAEA publications, Preparedness and Response for a Nuclear or Radiological Emergency, Safety Standards Series No. GS-R-2 [2] (GS-R-2), Arrangements for Preparedness for a Nuclear or Radiological Emergency, Safety Standards Series No. GS-G-2.1 [3], and Criteria for Use in Preparedness and Response for a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GSG-2 [4] (GSG-2). The IAEA General Conference, in resolution GC(46)/RES/9, encouraged Member States to implement the safety requirements for preparedness and response to a nuclear or radiological emergency.

In 2003, the IAEA published the document, Method for Developing Arrangements for Response to a Nuclear or Radiological Emergency (EPR-METHOD) [5] with the aim of fulfilling in part the IAEA’s function under Article 5 of the Assistance Convention [1] to provide a compendium of best practices for planners aiming to comply with international requirements in GS-R-2 [2].

In 2012, the IAEA issued the document, Considerations in Emergency Preparedness and Response for a State Embarking on a Nuclear Power Programme (EPR-EMBARKING) [6] with the aim to assist those States that are considering embarking on a nuclear power programme to develop an adequate level of capabilities for emergency preparedness and response (EPR) to radiation emergencies prior to commissioning their first nuclear power plant, and to ensure the maintenance of the EPR programme throughout the lifetime of the facility.

The Hashemite Kingdom of Jordan (Jordan), through the Jordan Atomic Energy Commission requested the IAEA to organize an Emergency Preparedness and Response Review (EPREV) mission, which was conducted as a peer review using the relevant international standards as a basis. The overall objectives of this mission were to facilitate national efforts in establishing an efficient national nuclear and radiation emergency plan, as well as to support the establishment of a coherent EPR infrastructure in Jordan. The mission’s aim was also to provide Jordan with guidance on how to bring its new draft national emergency response plan to a successful conclusion, taking into account IAEA requirements and the fact that Jordan is constructing a research reactor, to be commissioned in 2016.

## 1.2. Scope

The review focused on Jordan's ability to respond to radiological and nuclear emergencies<sup>1</sup> and was based on an assessment of existing response provisions and capabilities. The mission followed the basic concepts set out in the EPREV Guidelines [7] and in the Terms of Reference of the EPREV mission presented in Appendix I.

The mission was composed of four team members (including the team leader), who addressed the following areas during the ten day EPREV mission:

**(a) Review of the State EPR capabilities:** This activity reviewed the response of national and local level organizations that initiate or support local response to an emergency. The review was conducted within the framework of the IAEA Requirements in GS-R-2 [2] and guidelines in EPR-METHOD [5] and EPR-EMBARKING [6]. This review of State policy also assessed the conditions that ensure the fulfilment of State obligations stemming from the relevant international Agreements and Emergency Conventions [1].

**(b) Facility response review:** This part of the mission reviewed the ability of operator of the facility to identify and respond promptly and effectively to radiological emergencies.

The data that was collected and analysed in this report came from interviews with representatives of key response organizations and institutions, and documents handed over during or before the EPREV mission. The mission concentrated on those areas that the team viewed as crucial to the establishment of sound emergency response capability.

The members of the mission team (see Appendix II) were selected based on their relevant experience in the above mentioned areas.

## 1.3. Process

The general schedule for the mission is shown in Table 1. A complete list of persons interviewed by the team is contained in Appendix III. The mission team visited the named institutions, authorities and facilities where interviews were conducted. Before the mission, the team received reference information in the form of regulatory documents and draft legislation. The following is a list of major organizations involved in the mission:

- Jordan Nuclear Regulatory Commission (JNRC);
- Jordan Atomic Energy Commission (JAEC), including the:
  - Jordan Research and Training Reactor (JRTR),
  - Radiation waste storage facility, and
  - Irradiation facility;
- National Centre for Security and Crisis Management (NCSCM);
- Jordan Armed Forces (JAF);
- Ministry of Interior (MoI), including
  - General Intelligence Directorate (GID),
  - General Civil Defence Directorate (GCDD), and
  - Public Security Department (PSD);
- Ministry of Foreign Affairs (MoFA);
- Ministry of Health (MoH);
- Ministry of Environment (MoEnv);

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<sup>1</sup> The term radiation emergency is used in this the report to mean either radiological or nuclear emergencies.



- Jordan Gendarmerie;
- Jordan Customs;
- Jordan University of Science and Technology (JUST);
- King Hussein Cancer Centre (KHCC).

The review consisted of:

- Determining whether, and to what extent, the arrangements for preparedness and response for radiation emergencies in Jordan were in conformity with international requirements in GS-R-2 [2] and Refs [8, 9], guidance in GS-G-2.1 [3] and GSG-2 [4] and Ref. [10];
- Formulating recommendations and suggestions for meeting the relevant international requirements and other good practices. The publication EPR-METHOD [5], EPR-EMBARKING [6], and associated guidelines in Refs [5, 6, 11, 12, 13, 14, 15, 16, 17] concerning 15 main elements of the framework of EPR provided the basis for these recommendations and suggestions.

The EPREV mission was conducted in line with IAEA guidelines [7] and in accordance with the Terms of Reference (adopted in March 2013) completed in cooperation with the JAEC and the JNRC as the major national stakeholders.

**Table 1: Mission Schedule**

Date	Time	Place	Subject
6 May	21:00	Hotel	<b>Arrival of the team to Amman</b>
7 May	10:00	MoFA	Introductory meeting with the management of JNRC and JAEC, with representatives of Jordanian institutions participating in EPR Presentation of organization and responsibilities of JNRC and JAEC and other main Jordanian parties participating in EPR
8 May	9:00	JAEC	Meeting with parties involved in nuclear power programme
	12:00	JNRC	Meeting with JNRC and JAEC experts on the status of the legal and regulatory framework for EPR Meeting with MoH and MoEnv experts on the status of the legal and regulatory framework for EPR
	1500	KHCC	Visit to King Hussein Cancer Centre
	17:00		EPREV report writing
9 May	9:00	JNRC	Meeting with JNRC and JAEC experts on status of legal and regulatory framework for EPR
	12:00	JAF	Meeting with representatives of the first responders: - GCDD and JAF, - Jordan Gendarmerie, MoI, PSD and GID, - Jordan customs
	15:00	NCSCM	Visit to NCSCM
	17:00		EPREV report writing
10 May	9:00		EPREV report writing
11 May	9:00		EPREV team work with Jordanian self assessment and IEC questionnaire EPREV report writing

Date	Time	Place	Subject
12 May	9:30	JUST	Visit to JUST: <ul style="list-style-type: none"> <li>- Jordan Subcritical Assembly (JSA),</li> <li>- Construction site of Jordan Research and Training Reactor,</li> <li>- Radiation Detection and Measurement Laboratories, and</li> <li>- Internet Reactor Laboratory</li> </ul>
	17:00		EPREV report writing
13 May	9:00	JNRC	EPREV team discussion on draft EPREV report
	12:00		EPREV team discussion on draft EPREV report with counterparts Meetings with stakeholders: GCDD
	17:00		EPREV report writing
14 May	9:00	JNRC	JNRC and JAEC review and comments on draft mission report
	17:00		EPREV report writing
15 May	10:00	PSD	Visit to 911 centre of PSD
	9:00	JNRC	Discussion of JNRC and JAEC comments with counterpart
	12:00		EPREV report writing
	15:00		Delivery of revised draft EPREV report to JNRC and JAEC
	17:00		Preparation to exit meeting
16 May	10:00	MoFA	Exit meeting with representatives of Jordanian institutions dealing with emergency matters
	12:00		<b>End of the mission</b>

#### 1.4. Structure of the report

This report of the EPREV mission to Jordan consists of six sections, five appendixes, a list of terms, a list of acronyms and a list of references.

Section 1 contains general information about the EPREV mission.

Section 2 contains a summary of findings, recommendations and good practices presenting a concise overview of the activities, which need to be performed to upgrade radiation emergency response capabilities in Jordan.

Section 3 presents detailed findings, recommendations and good practices observed by the EPREV team through an analysis of the enacted and draft regulation, and interviews with the Jordanian experts.

Section 4 presents suggestions regarding the integrated action plan for establishing capabilities and arrangements for preparedness and response to a radiation emergency at the first nuclear facility of Jordan.

Section 5 presents suggestions regarding the development of the National Radiation Emergency Plan (NREP) for Jordan.

Section 6 presents suggestions regarding the development of a regulatory base for EPR in Jordan.

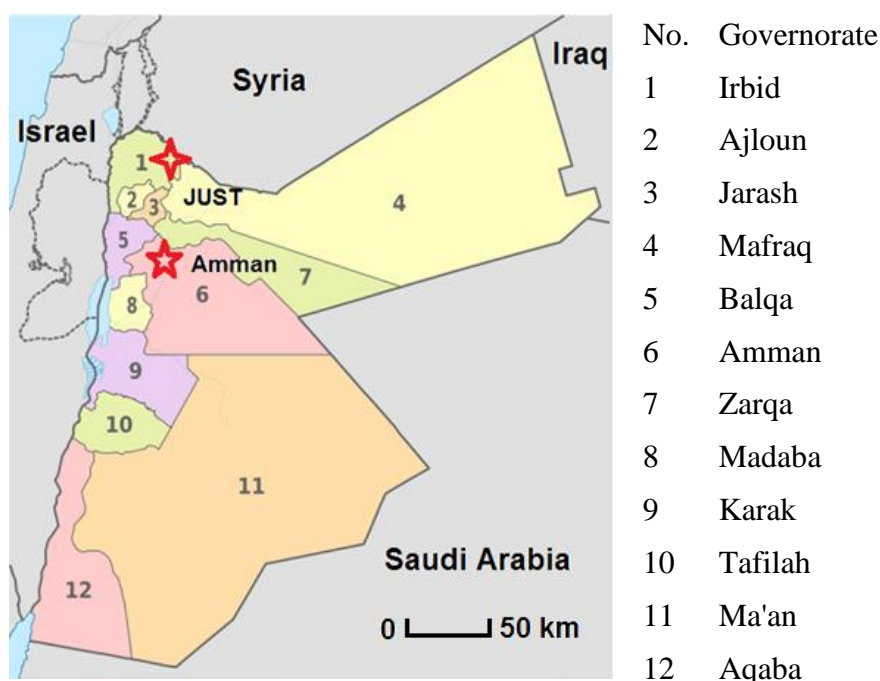
## 2. SUMMARY OF FINDINGS AND RECOMMENDATIONS

The aim of the present section is to provide a concise overview of the activities which need to be performed to upgrade the radiation emergency response capability in Jordan.

### 2.1. Country profile

Jordan has a total land area of 92 300 square kilometres. It is bordered by Iraq (181 km of common borders), Israel (238 km), Saudi Arabia (744 km), Syria (375 km), and the Palestine (97 km). The topography of Jordan is mostly a desert plateau in the east and highland area in the west.

The total population of Jordan is about 6 million (2008 est.), of which about 80% are living in urban areas. The country is composed of 12 governorates given in Fig. 1. Jordan's major cities include Amman, the capital, in the northwest, Irbid and Az Zarqa in the north, and Karak and Aqaba in the south.



*Fig. 1. Administrative structure of Jordan.*

Jordan joined the International Atomic Energy Agency on 18 April 1966 and is also a party to eight multilateral and safeguards agreements with the IAEA. Jordan is, inter alia, a party to the:

- Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, in force 11 January 1988;
- Convention on Early Notification of a Nuclear Accident, in force 11 January 1988;
- Convention on Nuclear Safety, in force 10 September 2009.

The development of a national nuclear programme was started in Jordan in 2007. The programme includes the construction of the JRTR at a site alongside JUST, with a projected power level of 5 MW(th), which will be upgraded to 10 MW(th). The JRTR will be used for scientific research, production of radiopharmaceuticals and training in medical, agricultural and health services. The JRTR project was developed by the Consortium of Korean Atomic Energy Research Institute (KAERI) and Daewoo (KDC), which will supervise construction

of the reactor facility. According to the programme's timelines, the JRTR is scheduled to be built by the end of 2015, and commissioned in 2016. For the first year, the JRTR will be operated by KAERI, and then from 2017 it will be operated by the JAEC. The programme also includes the construction of the first nuclear power plant by 2023.

Since 2010, the Nuclear Power Support Group of the IAEA has considered Jordan as a State at phase 2 of embarking on a nuclear power programme.

More detailed information about country profile of Jordan is available in Ref. [18].

## **2.2. Summary of findings and conclusions**

1. The EPREV team recognized that:
  - The JNRC is the:
    - National Regulatory Body for radiation protection, nuclear safety and nuclear security;
    - National Competent Authority Abroad and Domestic, and National Warning Point for the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency and Convention on Early Notification of a Nuclear Accident.
  - The JAEC is the National Competent Authority for peaceful use of atomic energy in Jordan and for the development of a national nuclear programme; and
  - The Jordan Higher Council of Civil Defence (HCCD) is a national authority supporting the Government with managing response to any emergency in Jordan.
2. The EPREV team recognized that the MoI is the national authority responsible, inter alia, for civil protection of the public and the territory of Jordan for all types of emergencies, but that its responsibilities do not clearly cover radiation emergencies; therefore Jordan has not yet clearly identified a National Coordinating Authority (NCA) for managing EPR to radiation emergencies in line with the international requirements in GS-R-2.
3. The EPREV team recognized that Jordan has some regulatory documents and several draft regulations, including a Draft National Emergency Response Plan (DNERP), which when finalized could be sufficient for the development of EPR arrangements and capabilities adequate to respond to radiological hazards existing within its territory, and those expected in near future.
4. The EPREV team recognized that governorate (local) authorities of Jordan have local emergency plans but that these plans do not cover radiation emergencies.
5. The EPREV team recognized that operators of radiation facilities licenced by JNRC have on-site emergency plans. The emergency plan of the JRTR is under development. The facility on-site emergency plan is one of the legal documents that is required for the application of a licence.

## **2.3. Summary of recommendations**

When the first nuclear fuel is delivered to the site of the JRTR, which will be a hazard category II facility, Jordan will have reached its first milestone in the peaceful use of nuclear power. The IAEA guidelines in EPR-EMBARKING [6] state that to reach this milestone, the country embarking in a nuclear power programme should be ready to manage all the hazards related to a category II nuclear facility in accordance with international requirements in GS-R-2 [2]. The most important steps that need to be addressed to develop sound emergency response commensurate with the hazard assessment for that milestone are presented below as

main elements (ME) of framework for EPR together with recommendations (R) of the EPREV team on the actions to be taken in 2013/2016.

### **Main element 1. Basic responsibilities**

- ME1(R1) The Government should review and revise the legal framework and clarify the allocation of responsibilities among authorities in the area of emergency preparedness and response to radiological and nuclear emergencies, in order to avoid overlaps, conflicting issues or gaps in discharging the different roles and responsibilities for radiation emergencies.
- ME1(R2) The Government should identify a NCA for radiation emergencies, with functions defined in line with the international requirements in GS-R-2, preferably within the framework of an all hazard approach to national emergency planning.
- ME1(R3) The Government should make all reasonable efforts to complete and enact its regulations related to emergency preparedness and response with due account to the international requirements in GS-R-2, and taking into account the progress of the nuclear programme in Jordan. The international requirements should be adopted and transposed by the JNRC into the national regulatory framework, with a specific approach, which takes into consideration the specificity of the legal system, current arrangements and future developments envisaged under the nuclear programme in Jordan.

### **Main element 2. Assessment of hazards**

- ME2(R1) The Government should ensure that the hazard assessment is completed and used for planning emergency preparedness and response at all levels of response to radiation emergencies.
- ME2(R2) The Government should complete and fully implement its newer system for the categorization and inventory of radioactive sources.

### **Main element 3. Establishing emergency management and operations**

- ME3(R1) The Government should ensure that the radiation emergency management and operations structure is integrated into the existing conventional emergency management system, and is coordinated at all levels, and that the decision making process is adapted to take into account the need for rapid decisions early in the emergency.

### **Main element 4. Identifying, notifying and activating**

- ME4(R1) The Government should ensure that the responsibilities of operators of radiation facilities for notification of off-site authorities are clearly defined in the regulations.
- ME4(R2) The Government should ensure that arrangements are in place to monitor scrap metal yards to detect potential orphan sources or metal pieces contaminated with radioactive materials. The training, equipment and procedures for the operators of the scrap metal yards should also be provided.
- ME4(R3) The Government should establish radiation control of the border crossing in international airports of Jordan.

### **Main element 5. Taking mitigatory actions**

ME5(R1) The JNRC should ensure through effective licensing conditions and processes that operators of facilities in hazard category I, II and III have capabilities in place and arrangements for implementation of mitigatory actions.

### **Main element 6. Taking urgent protective actions**

ME6(R1) The JNRC should complete its review of the JRTR safety analysis, and complete arrangements with the University and the Governor of the region for urgent protective actions.

ME6(R2) The Government should ensure that an evaluation of feasibility of protective actions at the chosen site for the nuclear power plant is carried out in line with IAEA guidance in the EPR-EMBARKING.

### **Main element 7. Providing information and issuing instructions and warnings to the public**

ME7(R1) The Government should clarify the relationship between the NCA (to be designated), the HCCD and the NCSCM for the application the “one voice” approach for communication with the public in case of an emergency.

ME7(R2) The NCA should ensure that pre-prepared template statements (press releases) are in place in order to facilitate the prompt communication of information and minimize confusion during an emergency in hazard category IV or in facilities at threat categories III (e.g., JSA), II (the JRTR) and I (the NPP).

ME7(R3) The NCA should exercise the public warning system, once implemented, in a realistic scenario to clarify roles and responsibilities and to ensure that all stakeholders have the same view regarding public communication.

### **Main element 8. Protecting emergency workers**

ME8(R1) The Government should ensure that regulation for protection of emergency workers is in place. The IAEA guidance in GSG-2 and GS-R-2 should be taken into account for the protection of emergency workers and first responders.

ME8(R2) The Government should ensure that the regulations contain clear requirements on training and exercise for emergency workers.

ME8(R3) The Government should ensure that radiation protection requirements and arrangements for emergency workers are clearly addressed in regulation and in plans, including, for example, training, dose registry and appropriate medical examination if needed.

### **Main element 9. Assessing the initial phase**

ME9(R1) The Government should ensure that a full set of OILs, some of which are already in the draft plans, are consistent with GSR-2, and those guidelines in EPR-RESEARCH REACTOR and EPR-NPP PUBLIC PROTECTIVE ACTIONS, are included in relevant regulation on EPR. The NCA should ensure that these OILs are included in radiation emergency response plans at all levels of response.

ME9(R2) The Government should ensure that a full set of emergency planning zones, consistent with GS-G-2.1 and guidelines in EPR-RESEARCH REACTOR and

EPR-NPP PUBLIC PROTECTIVE ACTIONS are included in relevant EPR regulations and plans.

- ME9(R3) The JNRC should improve its ability to predict, monitor and evaluate releases from the JRTR, in particular its laboratory facility processing environmental samples, and ability to evaluate the public emergency exposure before the JRTR is commissioned.

#### **Main element 10. Managing the medical response**

- ME10(R1) The Government should ensure that KHCC, Al Bashir Governmental Hospital, and Hospital of JUST are included in the national arrangements for medical response in the event of a nuclear or radiation emergency as designated hospitals. These arrangements should be described in the NREP.
- ME10(R2) The MoH, in cooperation with the JNRC, should begin programmes on basic medical training and refresher training on the treatment of potentially contaminated patients for medical staff who may first encounter these patients.
- ME10(R3) The MoH, in cooperation with the JNRC, should begin programmes to raise awareness among general practitioners of the medical symptoms of radiation exposure. Programmes should aim at providing appropriate lectures during the basic training of future physicians (before they obtain their medical degree), and also through the credit system when physicians need to undertake refresher courses.
- ME10(R4) The JNRC, in cooperation with the MoH, should assist in developing procedures for decontamination and triage of overexposed and/or contaminated patients.
- ME10(R5) The Government should consider sending patients with severe radiation injuries for medical treatment abroad. The JNRC, in cooperation with the MoH, should develop appropriate procedures for a prompt assistance request from the IAEA, if needed.
- ME10(R6) The NCA, in cooperation with the MoI and JAF, should develop arrangements for decontamination of a large number of people in event of large-scale radiation emergency. These arrangements should be outlined in the NREP.

#### **Main element 11. Keeping the public informed**

- ME11(R1) The Government should ensure that the NREP addresses public information coordination at all response levels. Arrangements and capabilities for emergency public information have to be tested during exercises or specific drills. Due consideration should be given to the IAEA EPR-PUBLIC COMMUNICATION.
- ME11(R2) The JNRC should consider using its homepage to increase awareness of the public in relation to potential dangers of radiation, nuclear safety and expected emergency actions for the public.

#### **Main element 12. Taking agricultural countermeasures, countermeasures against ingestion and longer term protective actions**

- ME12(R1) The Government should establish a regulation on OILs for radionuclides in foodstuff, in case of a radiation emergency, that are consistent with current international guidance in GSG-2.

ME12(R2) The Government should develop a comprehensive concept of operations for agricultural countermeasures, including the use of laboratories of authorized TSO, as well as of the mobile radiation monitoring unit(s) for monitoring of radioactivity in foodstuff and water. Special measures for protection of water supplies should be considered.

**Main element 13. Mitigating the non-radiological consequences of the radiation emergency and the response**

ME13(R1) The Government should ensure that a concept or strategy for mitigating the non-radiological consequences of radiation emergencies and response to emergencies is established, and meets international requirements in GS-R-2 and the IAEA guidelines.

**Main element 14. Conducting recovery operations**

ME14(R1) The Government should ensure that a practical concept for the management of post-emergency recovery operations, and transition from an emergency situation to an existing exposure situation, is in place and meets international requirements in GS-R-2.

**Main element 15. Requirements for infrastructure**

ME15(R1) The Government should continue its efforts to complete the draft NREP of Jordan in a manner that is consistent with international requirements in GS-R-2.

ME15(R2) The JAEC, in cooperation with the Korean Atomic Energy Research Institute as a vendor of JRTR, should complete the Emergency Response Plan for the JRTR as soon as possible. The Government should ensure that the local authorities are involved in the development of off-site emergency plan for JRTR.

ME15(R3) The JAEC should complete a long term agreement with KAERI and IAEA on technical support in case of a severe accident.

ME15(R4) The Government should ensure that, at least one year before commissioning of the research reactor JRTR, a comprehensive radiation emergency exercise is conducted with the involvement and participation of all on-site and off-site organizations at both the local and national levels. The lessons learned from conducting the exercise should be incorporated into future development and enhancement of the national system for the management of radiation emergencies.

ME15(R5) The NCA, with support from the JNRC, should evaluate the needs for radiation detection and personal protective equipment for all first responder teams (civil defence, medical, armed forces, police, and gendarmerie). The training of the first responders on the use of that equipment must also be provided.

ME15(R6) The NCA, with support from the JNRC and JAEC, should develop long term, sustainable programmes for training and staffing of all organizations involved in the response to radiation emergencies before commissioning the JRTR. A long term training programme for all organizations taking part in the emergency response, including first responders, should be implemented. These



programmes should be coordinated with the IAEA's long term (regional) training programme.

ME15(R7) The Government should ensure that a quality assurance programme is established for all organizations having a role in the response to radiation emergencies.

A more detailed description of the current situation is in Section 3, which also provides further background to support the recommended actions.

#### 2.4. Summary of suggestions regarding the action plan for 2013–2016

Section 4 presents suggestions regarding the action plan for establishing capabilities and arrangements for preparedness and response to a radiation emergency at the first nuclear facility of Jordan. It is based on the principal points in the development of capabilities and arrangements for EPR to a radiation emergency in Jordan defined in Section 2 and Section 3 of the report. The Plan covers the period of 2013–2016.

#### 2.5. Summary of good practices

Recognized good practices:

ME4(G1) The EPREV team recognized the development of a tool for declaration of all alerts/emergency cases for the JRTR performed by JAEC as a good practice, notable also because the facility is two years from operation.

ME15(G1) The EPREV team recognized as a good practice the establishment of the nuclear engineering programme in Jordan University of Science and Technology associated with the national power programme, medical physics programme in Jordan University, and the nuclear physics programme in Al-Balqa' Applied University, as a capacity building base for a nuclear power programme. This shows that Jordan has a central institute for the education of future key specialists involved in the EPR programme.

### 3. DETAILED FINDINGS AND RECOMMENDATIONS

The EPREV team's detailed evaluation of the emergency preparedness and response system in Jordan is based on information provided by Government officials and experts whom the mission team interviewed and whose names are included in Appendix III. In some cases, the information was not entirely comprehensive. This was, in part, due to the fact that the national emergency arrangements and support documents, including regulations, are currently being drafted. Where appropriate, the team listed recommendations regarding actions that should be implemented within a short period of time (2013–2016) before commissioning the JRTR. When implemented, those actions will form a solid basis for developing response capabilities adequate to threats related to the operation of the first nuclear power plant (NPP). The recommendations are preceded by the description of the current situation.

#### 3.1 Main element 1. Basic responsibilities

The international requirements in GS-R-2 [2] require (§3.3) that legislation should be adopted to clearly allocate responsibilities for preparedness and response to a radiation emergency. Responsibilities for parties involved in EPR are to be assigned for different levels of response. On-site response is required at the operator level, and off-site response is required at the local and national levels. The international guidance in GS-G-2.1 [3] provides details on these assignments. In launching a nuclear power programme, the State needs to enact or amend any nuclear legislation and associated regulations so as to protect the public, the environment and property from hazards associated with the first NPP. Guidance for this is provided in Part 1 of the IAEA General Safety Requirements [8] and Fundamental Safety Principles [19].

This main element concerns the allocation of roles and responsibilities, the establishment of a governmental body to act as a NCA, and the development of legislation and basic regulations for EPR to meet requirements from:

- GSR Part 1 §2.2–§2.6 and §2.20–§2.24 [8];
- GS-R-2 §2.1–§2.4, §2.5–§2.6, §3.2–§3.11, §3.14–§3.19, §4.35, §4.37, §4.45, §4.56–§4.65, §4.71, §4.88–§4.90, §4.94, §4.97, §5.2–§5.5, §5.25, §5.26, §5.31–§5.36 and §5.37–§5.39 and Addendum to Annex III [2];
- CODEOC §10, §20 (e,v) [20];
- NS-R-2 §2.26, §2.38, §3.8, §5.2, and §5.4 [21].

Implementation of guidelines and recommendations is based on:

- GS-G-2.1 §2.19–§2.22, §3.1–§3.31, §4.15–§4.19, §5.1–§5.6, §6.1–§6.48, Appendix I – Appendix III and Appendix VIII [3];
- GSG-2 §3.1–§3.12, §4.1–§4.7 and Appendix I–Appendix IV [4];
- GS-G-1.1 §3.24 and §3.25 [22];
- EPR-METHOD [5];
- EPR-EMBARKING [6];
- EPR-IECOMM [23].

This element contains, but is not limited to, the following parts, which need to be considered by Jordan for the establishment of a nuclear power programme in line with the guidelines in EPR-EMBARKING [6]:

- ME1.1. Allocation of functions among governmental agencies and jurisdictions involved in preparedness and response to emergencies at facilities of hazard category I and II at all levels;
- ME1.2. Operation of a NCA for developing, maintaining and coordinating arrangements for preparedness and response to emergencies at facilities of hazard category I and II;
- ME1.3. Participation in international conventions relevant to EPR;
- ME1.4. Development of relevant regulations on EPR to emergencies at facilities of hazard category I and II.

### 3.1.1. Current situation

#### Jordan Nuclear Regulatory Commission

The Law on Radiation Protection and Nuclear Safety, and Security No. 43 of 2007 [24] (Law 43/2007) puts in place a generic regulatory system, including licensing, inspections and enforcement. Article 15 of Law 43/2007 defines the basic allocation of functions and responsibilities of EPR in case of radiological emergencies. Law 43/2007 establishes the JNRC as the:

- National Regulatory Body for radiation protection, nuclear safety and nuclear security;
- National Competent Authority Abroad and Domestic, and National Warning Point for the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency and Convention on Early Notification of a Nuclear Accident.

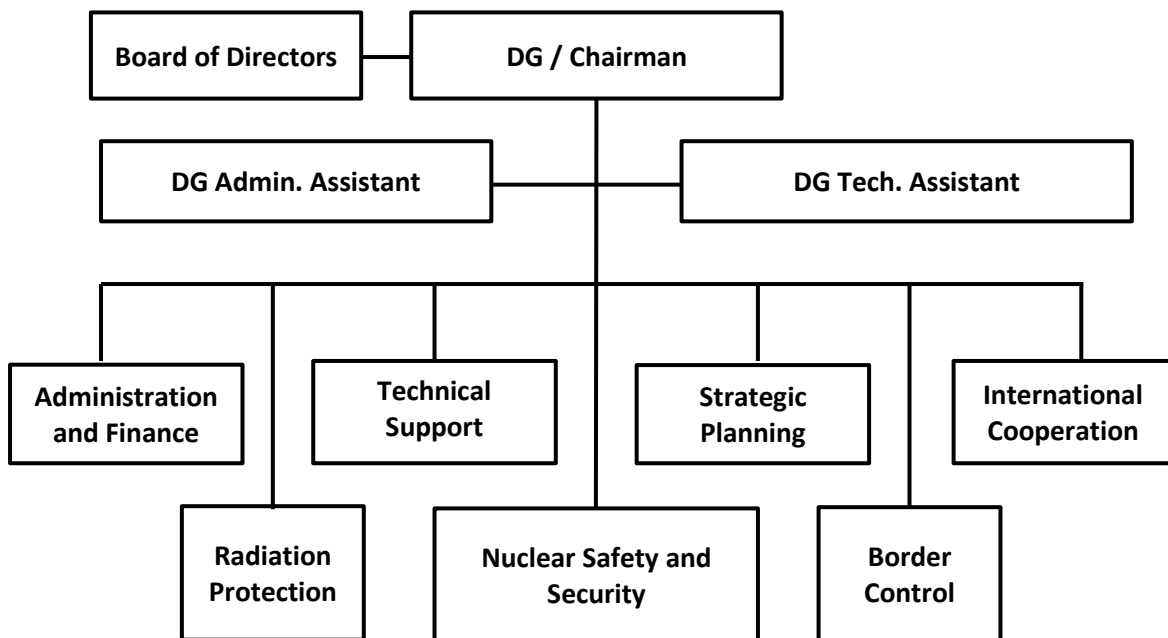


Fig. 2. Structure of JNRC (May 2013).

The scope of the JNRC's work includes the regulation of nuclear safety and security, radiation protection, licensing and inspections of facilities. The EPREV team was informed [25] that in the EPR field, the JNRC is currently responsible for:

- Preparation of regulation for EPR;

- Preparation of the NREP;
- Implementation of the obligations of international conventions, in which Jordan is a party, and which refer to protection against ionizing radiation, nuclear safety and non-proliferation.

The regulation on Basis and Conditions for Granting Licenses and Permits for the Radiation Facilities and Practices No. 33 of 2003 [26] (Regulation 33/2003) is the only one specific regulation currently in place. For strengthening the regulatory system, the JNRC elaborated, in 2009–2013, a number of draft EPR-related specific regulations on:

- Safety of research reactors [27];
- Nuclear emergency preparedness and planning [28] (Draft Regulation on Nuclear Emergency Preparedness and Planning, or DRNEPP);
- Emergency planning zones around nuclear facilities [29];
- Packaging and transport of radioactive substances [30].

Draft regulations in other specific areas include:

- Safety of NPP;
- Procedures for issuing authorizations for activities at nuclear facilities;
- Safety of spent fuel management;
- Management of radioactive waste;
- Decommissioning of nuclear facilities;
- Fees for nuclear facilities and tariffs on the fees collected by the JNRC;
- A decommission fund;
- Conditions and procedures for notification of the JNRC on events in nuclear facilities;
- Qualification and issuing of licenses for specialized training, and individual licenses for the use of nuclear power;
- Conditions and procedures for establishing special statutory areas around nuclear facilities and around facilities with sources of ionizing radiation;
- Physical protection of nuclear facilities.

Currently all draft regulations are in the process of being discussed at the national level.

Article 7 of Law 43/2007 stipulates that the JNRC has the role to “study radiological and nuclear accidents or environmental contamination resulting from radiation leakage and investigate the causes in cooperation with official and private bodies concerned in order to take the necessary measures to prevent or limit the occurrence of such accidents and to treat its effects.” Other responsibilities of JNRC are stipulated in Law 43/2007, regarding environmental radiation monitoring activities for the whole territory of Jordan and checking of radioactivity in imported goods at all border crossing points. The general understanding is that, in response to a radiation emergency, the JNRC should have a role of technical support organization (TSO) to support the decision makers at all levels of response.

Presently, the JNRC reports to the Minister of Energy and Mineral Resources. The JNRC is directly answerable to the Government and has its own budget. The technical staff includes about 120 specialists. The structure of JNRC is presented in Fig. 2.

### **General Civil Defence Directorate**

The Law on Civil Defence No. 18 of 1999 [31] (Law 18/1999) regulates the system of protection and rescue of citizens and property in any disaster or accident in the territory of Jordan. The Law sets rules for the general protection and rescue system in areas such as management and coordination, education, structure, notification and alerting, and

mobilization, but does not deal specifically with different types of emergencies such as nuclear or radiological emergencies. The MoI is the national authority responsible for civil protection of the public and territory of Jordan. This function is allocated for GCDD of the MoI in line with Law 18/1999. The GCDD has responsibilities for:

- Daily operational duties (ambulance services, fire fighting and rescue operations);
- Supervising, controlling, and preventive awareness duties (follow-up for the provision of prevention and self-protection requirements on various occupancies, in addition to the implementation of training and preventive awareness programmes);
- Participating in detecting any chemical or radiological leakage by dealing with concerned parties to manage and takeover the after effects;
- Managing various disasters and emergencies together with other involved parties.

The EPREV team was informed that National Plan to Deal with Emergency Cases and Disasters was issued by GCDD in 2004 in line with Law 18/199 [32]. It includes disaster management plans for conventional emergencies, but does not contain provisions for management of radiation emergencies.

### **Public Security Directorate**

The PSD, another entity of the MoI, has the following responsibilities:

- Facilitating the movement of ambulances and rescue mechanisms;
- Protecting the lives of citizens and their property;
- Maintaining security and stability in the region;
- Controlling the movement in and out of the affected areas.

### **Higher Council of Civil Defence**

Law 18/1999 establishes the HCCD as a national authority supporting the Government with managing response to any emergency in Jordan. The HCCD is led by the Minister of Interior, and the General Director of GCDD in the roles of president and vice-president, respectively. In accordance with Article 8 of the Law, the Prime Minister authorizes the Minister of Interior to make decisions on the protection of the public and the environment in emergency or disaster situations and to take appropriate protective actions.

The following are the members of the HCCD:

- (a) Secretary-General of the Prime Minister,
- (b) Secretaries-General of all Ministers,
- (c) Secretary General of the Highest Council of Youth,
- (d) Representative of the JAF, assigned by the Chief of Staff of JAF,
- (e) Representative of the PSD, assigned by the Director General,
- (f) Representative of the GID, assigned by the Director General,
- (g) Representative of Amman municipality,
- (h) Chairman of the Jordanian Red Crescent Society,
- (i) Chairman of the Commerce Chambers Union,
- (j) Chairman of one of the Industrial Chambers, assigned by the Minister of Industry and Commerce.

The president of HCCD has the right by Law 18/1999 to invite other experts to provide scientific or technical support, but these experts do not have voting rights inside the HCCD. In normal situations, for planning purposes, the HCCD meets every six months. The HCCD is also activated when an emergency situation or disaster occurs. The Secretariat activities for

the HCCD are performed by the Director General of General Safety and Environment Directorate belonging to the MoI.

In line with Article 14 of Law 18/1999, the HCCD is responsible for:

- Setting public policy for civil defence to deal with emergencies and resulting consequences;
- Approving national plans to take the necessary procedures to deal with emergencies and disasters and to specify the duties of governmental entities;
- Approving national plans to provide protection against chemical, radioactive, bacterial contamination, and toxic gases in cooperation with concerned specialized parties;
- Issuing decisions during emergencies, on how to perform the council's duties, and manage its operative centre, the operative centres of the parties represented within, and the operative centres of civil defence committees in the governorates;
- Ensuring the establishment of public shelters;
- Specifying the duties and tasks of civil defence committees formed in governorates in accordance with the rules of this Law;
- Activating the JAF and PSD in case of emergencies and disasters to support civil defence actions;
- Ensuring the creation of voluntary teams of civilians with ages ranging from 18 to 50 years to support civil defence actions;
- Demonstrating alarm techniques for citizens related to emergencies and disasters, and specifying required alarm methods;
- Setting financial estimates for the budget related to emergencies and disasters, and submitting these estimates to the cabinet for approval to be included in the public budget;
- Recommending that the cabinet request local departments, organizations and authorities to assign the required financial allowances in their annual budgets to carry out the duties and tasks determined by the council.

In the case of emergency affecting only one governorate, the Governor is in charge of decision making and implementation of protective actions at the local (governorate) level. When the emergency affects more than one administrative structure, the national level of response and the HCCD will be activated. The decisions adopted at the national level are transferred for implementation at the local level of governorates through the MoI, where Civil Defence Committees are established and operative centres are available for the management of emergency situations.

### **Jordan Nuclear Security Commission**

In 2010, His Majesty King Abdullah II appointed JAF to develop a comprehensive system for security and physical protection of nuclear facilities in relation to Jordan Nuclear Safety and Security Programme. This appointment led to the establishment of the Jordan Nuclear Security Commission (JNSC) as the permanent structure responsible with the security and general safety of nuclear installations [33]. Draft legislation on JNSC is already prepared but not yet issued. According to its provisions, JNSC entities should act as first responders in security events. For such situations, depending on event severity, the Higher Committee of JNSC or the Superior Committee of JNSC will make decisions. The Higher Committee will be composed mainly of representatives from all national organizations and ministries that have roles and responsibilities in emergency situations. The Superior Committee will be composed mainly of top level decision makers from the all national organizations and

ministries that have roles and responsibilities in emergency situations. Depending on how a situation progresses, other security forces or the GCDD will intervene.

### **National Centre for Security and Crisis Management**

His Majesty King Abdullah II appointed JAF to establish the NCSCM as a national coordinating crisis centre for all emergency situations [34]. Draft legislation on the NCSCM is already prepared, but not yet issued. The EPREV team was briefed that the function of the NCSCM is based on an integrated all hazards approach, and considers all preparedness and response components. The vision of the NCSCM is to build national resilience through coherent cross-sector emergency preparedness capabilities in all sectors of society, both public and private, and on all national levels. The goals of the NCSCM include, inter alia:

- Sustaining a secure and stable national environment;
- Building national resilience through coherent (effective, balanced and flexible) response capabilities on all levels, including tactical, operational and strategic;
- Establishing and sustaining a comprehensive national information system capable of providing accurate, timely and relevant information, to enable decision makers on all levels to make rapid and informed decisions in an uncertain environment and enhancing the ability of early warning in a crisis;
- Synchronizing government department efforts in functional interagency crises and consequence management plans.

During peace and stability, the NCSCM function to:

- Act as the National Watch Centre;
- Act as the National all Source Intelligence Fusion Centre;
- Develop, display and continuously update the current common intelligence picture and common operational picture;
- Provide regular centre updates to senior officials on the status of ongoing hazards and incidents;
- Develop a comprehensive national geospatial database;
- Create a comprehensive understanding of national assets and capabilities available to prevent, respond to, and to mitigate consequences (resources);
- Enable rapid and effective decision making in an uncertain environment;
- Provide the venue for interagency coordination;
- Perform risk assessment with an all hazards approach;
- Develop functional interagency crises response policies and plans for priority risks in Jordan;
- Assess national capabilities and develop capacity building programmes in coordination with public and private sectors;
- Oversee the planning and execution of critical infrastructure vulnerability assessment, and its security and emergency planning;
- Plan and conduct regular national level crises response training and exercises.

During crises the NCSCM functions to:

- Act as the National Command Authority Operations Centre;
- Develop and display an accurate common operational picture and common intelligence picture;
- Facilitate effective and timely decision making, and assure the dissemination of the directives, guidance, and intent of the King and the decision makers on the strategic level.

## Jordan Atomic Energy Commission

The JAEC is a National Competent Authority in Jordan for peaceful uses of atomic energy, and was established by the Law of Atomic Energy No. 42 of 2007 [35]. The structure of JAEC is presented in Fig. 3.

The EPREV team was informed that the JAEC will:

- Conduct and support research and studies in the theoretical and applied fields related to nuclear energy and radiation technology;
- Establish and develop scientific research facilities and laboratories concerning nuclear energy and radiation technology;
- Set the necessary technical fundamentals to extract local nuclear materials such as uranium, thorium, zirconium and vanadium, produce heavy water and establish facilities and constructions necessary to extract and mine these elements independently or in cooperation with the public or private sectors;
- Process, fabricate and manage nuclear materials in all stages of nuclear fuel cycle;
- Manage and dispose of radioactive waste.

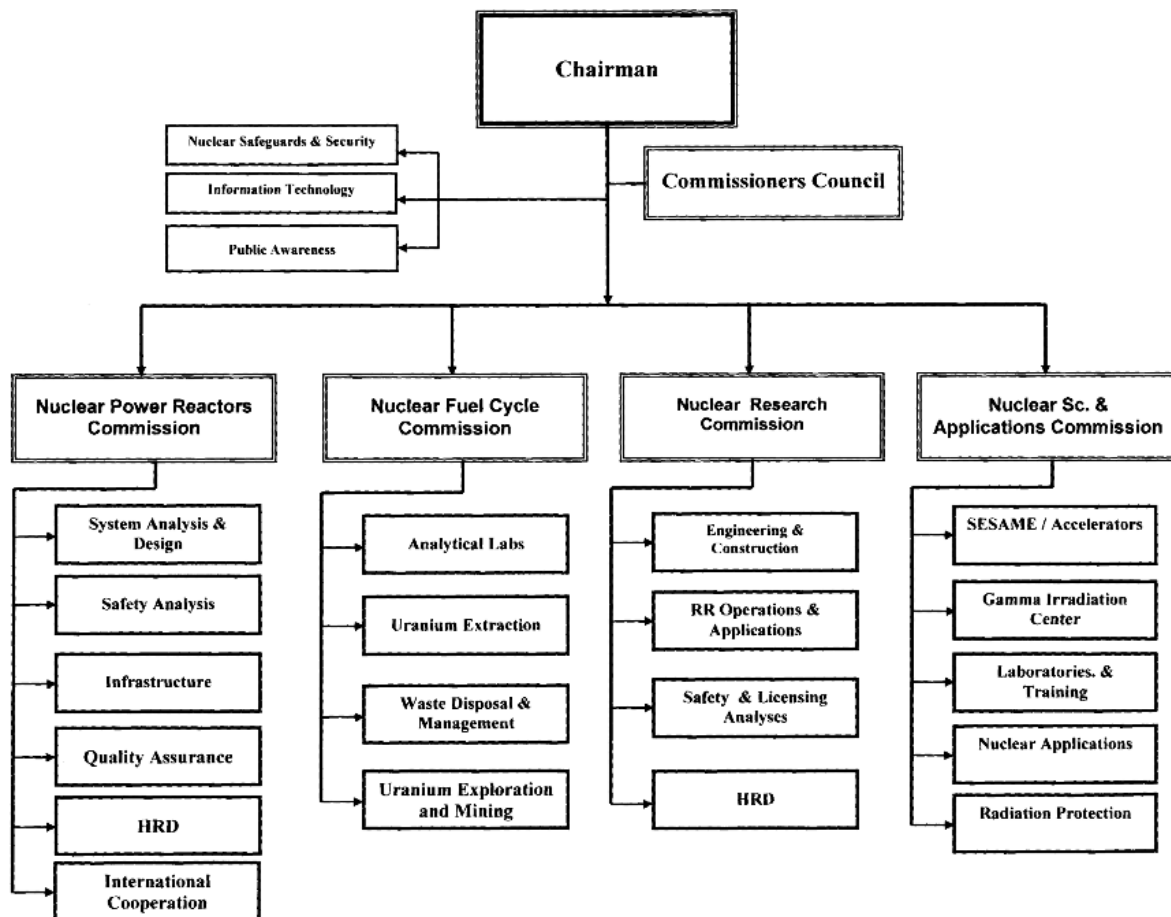


Fig. 3. Structure of JAEC (May 2013).

The EPREV team was briefed that in its role as National Competent Authority and operator of the JRTR, the JAEC has drafted:

- The DNERP [36], which considers the existing arrangements in Jordan for response to radiological emergencies and DRNEPP [28]; and
- A draft Emergency Response Plan for JRTR [37, 38, 39], which considers the existing arrangements in Jordan for response to radiological emergencies and draft regulation [28,



27] and includes on-site and off-site components. The local authorities (governors) were not involved in the development of off-site emergency preparedness for JRTR.

### **3.1.2. Situation in relation to commissioning JRTR**

A review of the enacted regulations and interviews with representatives of the involved parties show that each of the following organizations, namely the

- Jordan Nuclear Regulatory Commission (JNRC),
- General Civil Defence Directorate (GCDD),
- Higher Council of Civil Defence (HCCD),
- National Centre of Civil Defence (NCSCM),
- Jordan Nuclear Security Commission (JNSC), and
- Jordan Atomic Energy Commission (JAEC)

perform some duties and responsibilities which, in line with the international requirements in GS-R-2, should be allocated to the NCA. The functions of the NCA are to:

- Ensure that the functions and responsibilities of operators, response organizations and other involved parties are clearly assigned and understood by all concerned;
- Ensure that the responsibilities for preparedness and response to a radiation emergency are clearly allocated;
- Resolve differences and incompatible arrangements among the various involved parties;
- Coordinate the assessment of radiological threats within the country;
- Develop a NREP, which integrates preparedness and response to emergencies at facilities, and includes activities that address all hazards at all levels;
- Coordinate the development of plans and procedures within the international, national, local and operator levels;
- Guide the planning process;
- Ensure that a review is conducted periodically to identify any practice or event that could necessitate an emergency intervention.

The EPREV team was briefed that the requirement for establishing a NCA exists in the DRNEPP [28]. However, the Government did not identify an existing governmental body to act as a NCA for managing EPR to radiation emergencies in line with international requirements in GS-R-2 [2]. The MoI, which normally is responsible for the protection of the public for all emergencies, is not assigned responsibility as a Coordinating Authority for radiation emergencies.

A number of responsibilities included in the DRNEPP are not reflected in the legislation or in the draft regulations prepared by the JNRC. Although there are no legal provisions in place, the DNERP [36] identifies the JNRC as a “coordinating body of the Government of Jordan for integrated preparation and realization of measures for protection of public and environment against results of events with radiological effects,” but responsibilities and duties allocated for that role are not yet defined.

### **National Emergency Centre for Nuclear Accidents**

The DRNEPP envisages the establishment of a new National Emergency Centre for Nuclear Accidents (NECRA). The NECRA should be a national facility with a similar role as the NCSCM, but with a focus on managing radiation emergencies, supported by technical

analysis by the Emergency Response Centre of the JNRC. The establishment of this Centre is under development. The role of the NECRA as presented in DNERP [36] should be redefined to ensure proper alignment with the roles of NCSCM, HCCD, JNRC, GCDD and JNSC.

The enacted and draft regulations do address many of the EPR needs and requirements but will need enhancement to provide a complete basis for clear allocation of responsibilities for EPR in line with the international requirements in GS-R-2.

### **3.1.3. Recommendations**

- ME1(R1) The Government should review and revise the legal framework and clarify the allocation of responsibilities among authorities in the area of emergency preparedness and response to radiological and nuclear emergencies, in order to avoid overlaps, conflicting issues or gaps in discharging the different roles and responsibilities for radiation emergencies.
- ME1(R2) The Government should identify a NCA for radiation emergencies, with functions defined in line with the international requirements in GS-R-2, preferably within the framework of an all hazard approach to national emergency planning.
- ME1(R3) The Government should make all reasonable efforts to complete and enact its regulations related to emergency preparedness and response with due account to the international requirements in GS-R-2, and taking into account the progress of the nuclear programme in Jordan. The international requirements should be adopted and transposed by the JNRC into the national regulatory framework, with a specific approach, which takes into consideration the specificity of the legal system, current arrangements and future developments envisaged under the nuclear programme in Jordan.

## **3.2. Main element 2. Assessment of hazards**

This element addresses the alignment of State radiological hazard assessment with:

- GS-R-2 §3.6 – §3.11 [2];
- CODEOC §16, Annex I [20].

Implementation of guidelines and recommendations is based on:

- GS-G-2.1 §2.19–§2.30, §4.6, §4.11–§4.14, §4.23, §4.25, §4.28, §4.29, §6.1–§6.48, Appendix I – Appendix III [3];
- RS-G-1.9 §2.1–§2.4, §3.3–§3.8 [40];
- EPR-METHOD [5];
- EPR-EMBARKING [6].

This element contains, but is not limited to, the following parts, which need to be considered by Jordan for the establishment of a nuclear power programme in line with the guidelines in EPR-EMBARKING [6]:

- ME2.1 Regulations about the assessment of radiological hazards in a State;
- ME2.2 Hazard assessment in a State performed in accordance with the IAEA Safety Standards GS-R-2 and GS-G-2.1;
- ME2.3 Periodic reassessment of hazards.

### **3.2.1. Current situation**

The DRNEPP [28] describes hazard assessment as the process of systematically analysing the hazards associated with facilities, activities or sources within or beyond the borders of the State in order to identify: (a) events and associated areas for which protective actions may be required within the State; and (b) actions that would be effective in mitigating the consequences of such events.

The DNERP [36] is the only regulation which includes a summary and analysis of radiological hazards in Jordan. The hazard assessment addresses both accidents at radiation facilities, and terrorist related radiological hazards. The default approach is applied for categorization of hazards given in the IAEA Safety Standards GS-R-2 and GS-G-2.1. Categorization includes five categories with numerical criteria in terms of thermal power for reactor facilities and activity of sources for radiation facilities. The JSA is run by the JUST, and is classified as a hazard category III facility. It will be fuelled with 3.4% enriched uranium dioxide and will be maintained in a sub-critical state (max  $K_{\text{eff}} = 0.95$ ).

The EPREV team was informed that JNRC uses the categorization of radioactive sources in accordance with IAEA guidance in Ref. [20, 40, 14], but no regulation regarding categorization of sources is in place. The EPREV team was informed that there are approximately 10 locations with dangerous radioactive sources in Jordan and 6 of them are in IAEA category 1. All locations with dangerous radioactive sources have physical protection.

The EPREV team reviewed a demonstration of JNRC's current system for inventory of radiation sources and was informed that a newer system was near completion with advanced search capabilities, including IAEA source categorization. The radiation source registry is continuously updated by the JNRC through a process of notification and inspection activities. To date, the final registry has not yet been completed. At the moment, the registry does not include the categorization of sources.

### **3.2.2. Situation in relation to commissioning JRTR**

The DNERP[36] recognizes the JRTR will be a hazard category II facility. The off-site emergency plan for JRTR is under development by the JAEC in line with this categorization. The EPREV team was informed that the hazard assessment will be revised after completion of the safety assessment of the JRTR. Criteria for such a revision were not presented.

### **3.2.3. Recommendations**

- ME2(R1) The Government should ensure that the hazard assessment is completed and used for planning emergency preparedness and response at all levels of response to radiation emergencies.
- ME2(R2) The Government should complete and fully implement its newer system for the categorization and inventory of radioactive sources.

### **3.3. Main element 3. Establishing emergency management and operations: authority, organization, and coordination of emergency response**

This element concerns the realization of the allocation of responsibilities through the implementation of a concept of operations<sup>2</sup> and an all hazard approach in planning to meet the requirements from:

- GSR Part 1 §2.20–§2.24 [8];
- GS-R-2 §3.3, §3.4, §4.6–§4.9, §4.11, §4.19, §4.22, §4.31, §4.48–§4.52, §4.79, §4.90, §5.3, §5.6–§5.9, §5.10–§5.12, §5.13 –§5.24 and §5.25–§5.30 [2];
- NS-R-2 §2.32, §2.33 [21];
- NS-R-3 §2.1, §2.2, §2.12, §2.28 and §2.29 [41].

Implementation of guidelines and recommendations is based on:

- GS-G-2.1 §2.22–§2.30, §4.6, §4.11–§4.14, §4.23, §4.25, §4.28, §4.29, §6.1–§6.48, Appendix I – Appendix VIII, and Annex [3];
- EPR-METHOD [5];
- EPR-EMBARKING [6];
- EPR-FIRST RESPONDERS [11];
- EPR-RESEARCH REACTOR [12].

This element contains, but is not limited to, the following parts, which need to be considered by Jordan for the establishment of a nuclear power programme in line with the guidelines in EPR-EMBARKING [6]:

- ME3.1. Assignment of functions, allocation of responsibilities, establishing coordination and providing resources for emergency preparedness and response at all levels;
- ME3.2. Acting in accordance with the NREP ;
- ME3.3. Evaluation of feasibility of protective actions at the chosen site for the nuclear power plant and other nuclear installations.

#### **3.3.1. Current situation**

The EPREV team was informed that the National Plan to Deal with Emergency Cases and Disasters, issued by GCDD in 2004, is based on an incident command and control concept with common structures to the MoI or JAF. In accordance with the DNERP [36, 42], the Incident Command System (ICS) will be implemented in Jordan for the management of radiation emergencies.

#### **3.3.2. Situation in relation to commissioning JRTR**

The EPREV team was informed that, in accordance with the DNERP [36, 42], if a radiation emergency affects only one governorate, the Governor is in charge of managing the emergency at the level of the governorate. When an emergency affects more than one administrative structure, the national level of management through the HCCD is activated. The decisions adopted at the national level would be transferred through GCDD for implementation at the level of governorates, where Civil Defence Committees with operative centres are established [32]. This decision making arrangement might be slow in the case of a

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<sup>2</sup> Concept of operations describes the general response for each type of emergency at facilities and practices existing in a State.

nuclear accident, when timing for implementation of protective actions would be critical. Response to a nuclear emergency must be initiated immediately after an event, prior to any potential emergency exposure, as defined in Refs [2, 3, 5]. Use of the HCCD as the primary element of decision making, just after the event, may delay implementation of protective actions. In line with international requirements and guidelines in [2, 3, 5], emergency response should include precautionary and urgent protective actions in case of a nuclear emergency at a hazard category I or II facility, which shall be implemented by the local authorities following notification and emergency classification by the facility operator. The operator should base notification and emergency classification on Emergency Action Levels (EALs), which should be defined in on-site emergency plans. The concept of operations for defined emergencies has to be coordinated in off-site emergency plan with emergency classification provided by operator of the facility. The crisis management committees, such as the HCCD, or technical support organizations, such as the NECRA, should have a role in adapting the response strategy, if development of an actual emergency is beyond the predefined scenarios used for the design of the concept of operations.

### **3.3.3. Recommendations**

ME3(R1) The Government should ensure that the radiation emergency management and operations structure is integrated into the existing conventional emergency management system, and is coordinated at all levels, and that the decision making process is adapted to take into account the need for rapid decisions early in the emergency.

## **3.4. Main element 4. Identifying, notifying, and activating**

This element concerns the development of capabilities for identifying and assessing a radiation emergency, notifying and activating response at all levels and terminating emergency to meet requirements from GS-R-2 §3.19, §3.20, §4.12–§4.31, §4.49, §4.50, §4.53–§4.55, §4.66–§4.73, §4.82–§4.84 and §4.97–§4.100 [2].

Implementation of guidelines and recommendations is based on:

- GS-G-2.1 §2.1, §2.12–§2.18, §4.1–§4.10, and Appendix VI [3];
- GSG-2 Appendix III, Appendix IV [4];
- EPR-METHOD [5];
- EPR-EMBARKING [6];
- EPR-MEDICAL [13];
- EPR-FIRST RESPONDERS [11];
- EPR-IECOMM [23];
- EPR-D-VALUES [14];
- IAEA-TECDOC-955 [43];
- EPR-RESEARCH REACTOR [12];
- IAEA Safety Report No. 48 [44].

This element contains, but is not limited to, the following parts, which need to be considered by Jordan for the establishment of a nuclear power programme in line with the guidelines in EPR-EMBARKING [6]:

- ME4.1. Operation of a single national warning point for contact with the IAEA and to other States in compliance with Assistance and Early Notification Conventions;

- ME4.2. Awareness of the local authority, operators, the public and potential first responders to an emergency at facility of hazard category I and II (response organizations) to the indicators of a potential radiation emergency, notifications and other immediate actions;
- ME4.3. Arrangements and procedures for the notification of involved parties and initiation of response at all levels, in a timely, accurate and appropriate manner;
- ME4.4. Arrangements and procedures for immediate and effective actions of first responders to an emergency at facility of hazard category I and II (response organizations);
- ME4.5. Arrangements and procedures for notifying of neighbouring countries and the IAEA in case of a radiation emergency associated with hazard categories I and II;
- ME4.6. Arrangements and procedures for assessing the initial phase of the reactor accident at the facilities of hazard category I and II by the operator;
- ME4.7. Arrangements and procedures for promptly initiating an on-site and off-site response in the event of a radiation emergency at the facilities of hazard category I and II.

#### **3.4.1. Current situation**

Jordan is a party to the Notification and Assistance Conventions [1]. The JNRC is the designated single National Warning Contact Point for these conventions. The EPREV team was assured during a briefing that the NCSCM could also play the role of back-up Contact Point or National Warning Point of the country to the IAEA [34].

For the time being, there is no registered Jordanian user of the IAEA Unified System for Information Exchange (USIE). The only USIE user from Jordan is the INES National Officer (who is also from JNRC), but he is not registered as an Emergency Contact Point in line with the IAEA guidelines in Ref. [23].

According to Article 4 of Law 18/1999 [31], the HCCD should implement public alarming systems for emergencies and disasters, and specify required methods to demonstrate alarm system adequacy. The alarm systems make use of private television and radio channels, and the loud speaker system of the Mosques.

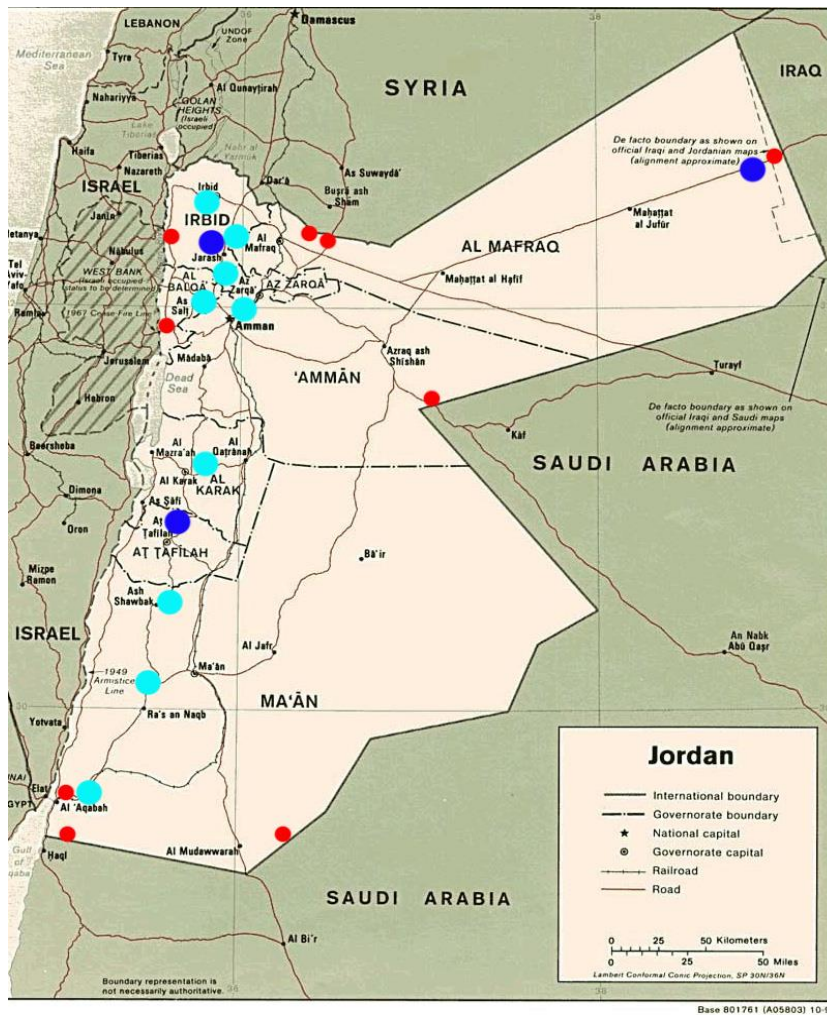


Fig. 5. Radiation Monitoring Network in Jordan

In line with Article 7 of Law 43/2007 [24], the national radiation monitoring network is in place and operated by the JNRC [25]. The JNRC is responsible for monitoring and reporting its results to the Government. The network has two levels as presented in Fig. 5 and includes:

- Three main Environmental Monitoring Stations (EMSs) measuring ambient dose rate, airborne radioactivity and ground deposition (blue dots in Fig. 5),
- Nine secondary EMSs measuring ambient dose rate (light blue dots in Fig. 5).

The EMS points are remotely connected to the JNRC's Headquarters capital and could function as elements of the early warning system. The first notification level of the network is 0.5  $\mu\text{Sv/h}$ , the second (alert) level is 1  $\mu\text{Sv/h}$ . The EMS provides measurement results every four hours. The results are recorded, but not published anywhere, and are summarized in the JNRC annual report.

In line with Article 7 of Law 43/2007, the JNRC is responsible for radiation monitoring performed by portal ambient dose rate monitors at nine border crossings (red dots in Fig. 5) [25]. One of the border controls is located at the single harbour of Jordan (Aqaba), others are at road crossings. There are no portal radiation monitors in international airports of Jordan (Amman and Aqaba). Only random control of goods takes place by manual devices. Operators of portal detectors are trained and equipped to detect and manage radioactive material.

The conventional notification system in Jordan is based on the 911 service providing by the MoI. The 911 notification and dispatcher centre is responsible for notifying and activating national authorities in the event of a radiological emergency that may happen in the radiation facility, or in the event of a radiological traffic accident. The centre is responsible for immediate answering of incoming calls, and promptly directs the calls to the appointed local response forces: police, civil defence, intelligence service, etc. If information of a nuclear or radiological emergency is received, it will be automatically dealt with as the highest priority.

The EPREV team concludes that the basis for identifying, notifying, and activating with regard to emergencies related to activities in hazard category IV should be further developed. For example:

- First responders, including medical and civil protection ambulance, paramedics, fire fighters and police, are not trained to recognize if a conventional (transport, fire, etc.), accident may have radiological implications, and they do not have procedures and equipment to cope with such a situation.
- Scrap metal yards and scrap metal processing facilities are not required to monitor incoming or outgoing scrap metal shipments for radioactivity or orphan sources. The scrap metal processing facilities do not have guidance on how to proceed if a suspected radioactive source is identified. The JNRC performs only random inspections in these facilities.
- A Regulation 33/2003 [26] requires the submission of an emergency plan attached to the license application of the practice, but no specific arrangements are required in terms of content of plan, procedures for identification, notification and activation.
- A draft specific regulation on transport of radioactive material in Ref. [30] requires the submission of an emergency plan attached to the license application of the given type of transport, but no specific arrangements are required in terms of content of plan, procedures for identification, notification and activation.

### **3.4.2. Situation in relation to commissioning JRTR**

The EPREV team concludes that the regulatory basis for identifying, notifying, and activating with regard to emergencies related to facilities in hazard category I and II is not yet fully developed in Jordan. A draft emergency plan for the JRTR [37] and DRNEPP [28] provide some guidelines about identifying, notifying, and activating in the event of an emergency at JRTR.

1. According to Article 9 of DRNEPP the operator of hazardous facility is required to promptly identify and classify an emergency situation and send notification to the notification point. This arrangement is described in the draft emergency plan for the JRTR.
2. Article 61 of the draft regulation on the safety of research reactors [27] specifies that the emergency arrangements of the facility should provide for identification and classification of emergencies, conditions under which an emergency should be declared, a list of persons empowered to declare an emergency and a description of suitable warning procedures or devices. It also requires that a mechanism for the notification of authorities is in place.
3. Article 6 and Appendix 3 of DRNEPP stipulates that the emergency classification system should be introduced in Jordan and will use the classes (alert, facility emergency, site emergency and general emergency) in agreement with the IAEA recommendations. The EPREV team was informed that emergency classification system for JRTR is currently under development by JAEC and during a visit to JAEC, the EPREV team was provided



with a demonstration of a computer tool for classification of emergencies at the JRTR [38]. The tool applies to JRTR classification principles developed in Refs [12, 43].

4. According to Ref. [37], in order to control a radiation accident, a room or an appropriate place in JRTR will be used as an emergency control centre. In this centre, all information during any accident will be collected and assessed. This emergency facility should be designed to support emergency management functions under emergency conditions, and should be integrated into the incident command and control system.
5. According to Ref. [37], an accident response would start with the declaration of the class of emergency under the command of the emergency director. He/she is then responsible for initiating the emergency actions to be taken and for alerting the off-site organizations, which are responsible for countermeasures to protect the public. The station is permanently manned in such a way that a site emergency response organization can be set up immediately. Additional key station staff is available on call.
6. According to Ref. [37], if the monitors indicate that a discharge of radioactivity has occurred outside the reactor building, emergency warnings will be given by emergency alarms in the control room or in the vicinity. The siren system and a fire-alarm system using a deep-voice horn will be installed on the site, while sirens and phone alarms will be deployed for off-site warning.
7. Article 9 of DRNEPP [28] defines in sufficient detail the requirements for the off-site authorities to respond. However, these off-site responsibilities are not assigned yet in regard to JRTR.

### **3.4.3. Good practice**

ME4(G1) The EPREV team recognized the development of a tool for declarations of all alerts/emergency cases for the JRTR performed by JAEC as a good practice, notable also because the facility is two years from operation.

### **3.4.4. Recommendations**

- ME4(R1) The Government should ensure that the responsibilities of operators of radiation facilities for notification of off-site authorities are clearly defined in the regulations.
- ME4(R2) The Government should ensure that arrangements are in place to monitor scrap metal yards to detect potential orphan sources or metal pieces contaminated with radioactive materials. The training, equipment and procedures for the operators of the scrap metal yards should also be provided.
- ME4(R3) The Government should establish radiation control of the border crossing in international airports of Jordan.

## **3.5. Main element 5. Taking mitigatory action**

This element concerns the development of capabilities for the implementation of mitigatory actions to meet requirements from GS-R-2 §4.32–§4.40 [2].

Implementation of guidelines and recommendations is based on:

- GS-G-2.1 §4.1–§4.10 [3];
- EPR-METHOD [5];
- EPR-EMBARKING [6];
- EPR-FIRST RESPONDERS [11];
- EPR-RESEARCH REACTOR [12];

- IAEA-TECDOC-955 [43];
- IAEA Safety Report No. 48 [44].

This element contains, but is not limited to, the following parts, which need to be considered by Jordan for the establishment of a nuclear power programme in line with the guidelines in EPR-EMBARKING [6]:

- ME5.1. Arrangements and procedures for on-call advice to assist first responders to an emergency at a facility of hazard category I and II (response organizations) and local authorities;
- ME5.2. Arrangements and procedures for supporting the local authority, including the process for obtaining prompt assistance through the IAEA;
- ME5.3. Arrangements and procedures for taking mitigating actions for an emergency at a facility of hazard category I and II.

### 3.5.1. Current situation

In this section, nuclear emergencies are not to be considered as nuclear facilities do not lie within Jordan’s territory.

There are, however, facilities in Jordan that can be classified as hazard category III. The JSA is also in that category. In principle, the operators of hazard category III facilities are responsible for taking mitigatory actions within the facility and they should have established adequate procedures, which are checked during licensing.

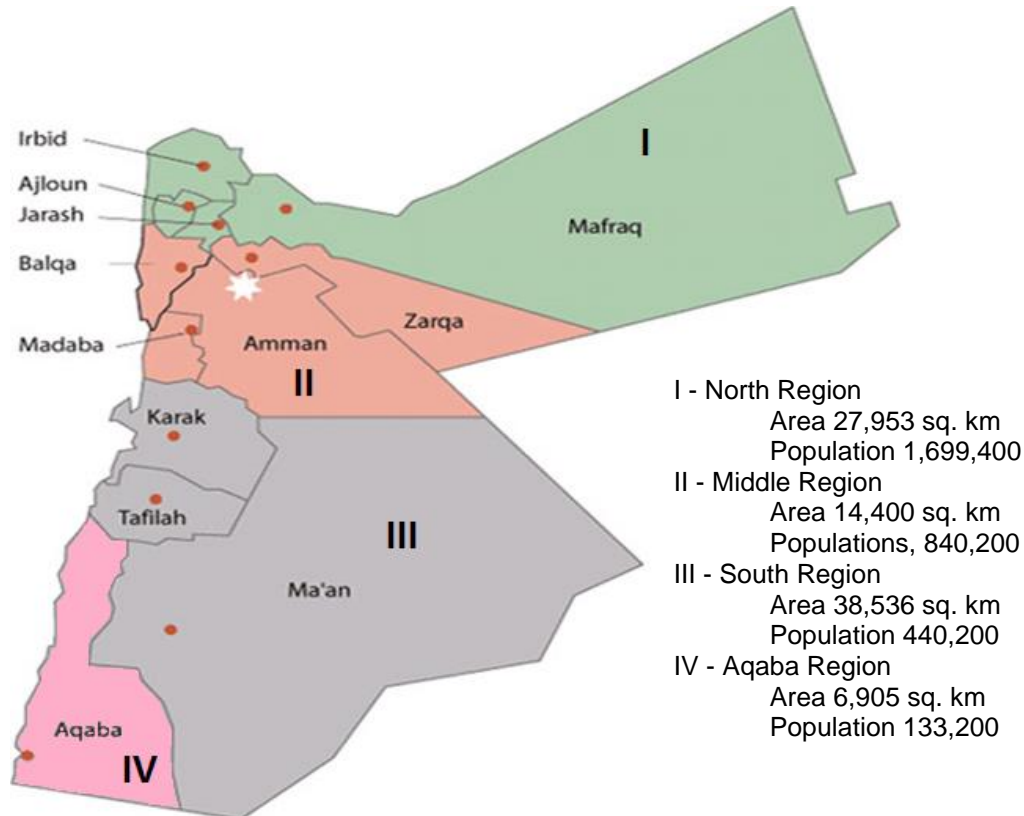


Fig. 6. Civil Defence regions of Jordan

The EPREV team was informed that the GCDD has four Hazardous Materials and Items (HAZMAT) teams with 122 staff members who could provide field inspection and evaluation of contaminated areas in an emergency related to activities in hazard category IV, e.g., contamination related to a dirty bomb event. They are located at four civil defence regions as shown in Fig. 6 [32]. Each of these regions has one HAZMAT team equipped and trained to respond to chemical, biological or radiological hazards, from the identification of the hazards to the decontamination of the accident site. The EPREV team was informed that the JAF also has 10 small Chemical, Biological, Radiological, and Nuclear (CBRN) teams with about 40 staff members, equipped with survey meters for identification of the presence of radiation. Their main task now is the CBRN control of the numerous refugees arriving to the country.

The EPREV team was briefed that the JAF has legal responsibilities to control the borders and screen refugees coming from neighbouring countries. The JAF are trained for radiation field monitoring along the Jordanian borders and for screening the population. In case of a radiological emergency, JAF's units have the following main functions:

- Cooperation with national institutions in radioactive decontamination operations resulting from the incident;
- Survey and radiation measurements;
- Participation with human resources necessary to cope with the incident and mitigation of its consequences;
- Participation in evacuation actions, logistics, support and sheltering;
- Provision of helicopters to transport injured people;
- Decontamination of vehicles and people.

The major objective of these teams is the civil protection of the public or military staff in case of military conflict. Effectiveness of their work will depend on the same operational intervention levels for implementation of protective actions being used during emergencies and response to radiation emergencies.

### **3.5.2. Situation in relation to commissioning JRTR**

The EPREV team was informed that, until now, the vendor of the JRTR did not provide JAEC with a list of design based accidents (DBA). The vendor will provide analysis of DBA in the facility safety assessment report. This has slowed down the development of mitigatory actions and concept of operations for an emergency at the JRTR. The current list of DBA and beyond design based accidents (BDBA) for JRTR is based on the expertise of the JNRC.

### **3.5.3. Recommendations**

ME5(R1) The JNRC should ensure through effective licensing conditions and processes that operators of facilities in hazard category I, II and III have capabilities in place and arrangements for implementation of mitigatory actions.

## **3.6. Main element 6. Taking urgent protective action**

This element concerns the development of capabilities for the implementation of urgent protective actions to meet requirements from:

- GS-R-2 §4.41 – §4.52, §4.61 §4.62 [2];
- CODEOC §8(d), §22(e), §20(o,v), §22(f), §22(o) [20].
-

Implementation of guidelines and recommendations is based on:

- GS-G-2.1 §4.11–§4.31, §4.54 and Appendix V – Appendix VIII [3];
- GSG-2 §3.1–§3.12, Appendix II – Appendix IV [4];
- EPR-METHOD [5];
- EPR-EMBARKING [6];
- EPR-FIRST RESPONDERS [11];
- EPR-RESEARCH REACTOR [12];
- IAEA-TECDOC-955 [43];
- SSG-16 [10].

This element contains, but is not limited to, the following parts, which need to be considered by Jordan for the establishment of a nuclear power programme in line with the guidelines in EPR-EMBARKING [6]:

- ME6.1. Arrangements for effectively making and implementing decisions on urgent protective actions to be taken off-site;
- ME6.2. Arrangements to ensure the safety of all persons on-site in the event of a radiation emergency;
- ME6.3. Review, in cooperation with stakeholders, proposals for potential sites for the nuclear power plant, and other nuclear installations in relation to requirements for EPR;
- ME6.4. Arrangements and procedures for obtaining local, national and international support for an operator of hazard category I and II facilities.

### **3.6.1. Current situation**

The EPREV team recognized that, while Jordan has a regulatory basis for conventional emergencies, the regulatory basis for the management of off-site urgent protective actions in case of a radiation emergency related to facility in hazard categories I, II or III is not yet fully developed.

The Regulation 33/2003 [26] and DRNEPP [28] require the licensee to provide only an on-site emergency plan. The EPREV team was provided with the on-site facility emergency plans for the JAEC radioactive waste facility and irradiator.

### **3.6.2. Situation in relation to commissioning JRTR**

The DRNEPP [28] encourages nuclear facilities in hazard category I and II to have arrangements in place to make and implement decisions on urgent protective actions. The operator of a nuclear facility in hazard category I, II, or III should make arrangements to ensure the safety of all persons on the site in the event of a nuclear or radiological emergency. Decisions on the initiation of protective actions should be taken following a careful analysis of the emergency conditions. The analysis should be based on the available actual information (state of the facility, radiation monitoring data, and weather conditions) and should take into account the relevant intervention and action levels. Local and national response organizations should make arrangements to perform immediate urgent protective actions within the precautionary action zone (PAZ) and urgent protective action planning zone (UPZ) upon the initiation by the decision maker, and according to the provisions of the respective nuclear and radiological emergency response plans.

The potential for offsite urgent protective action in relation to the JRTR is provided for in both the DRNEPP and the DNERP [36]. Indeed, the JUST, which is the closest population centre to the JRTR, has plans in place for evacuation as needed for other non-nuclear emergencies. However, because the safety analysis for the JRTR is not complete, the detailed needs for plans for offsite protective actions are unclear [25, 38, 37, 39]. For example, the JAEC staff explained that they would communicate directly with the University for urgent protective actions, while the National Plan instructs decision making through JRTR and the Supreme Council.

The EPREV team was informed that the Government provided consultations with stakeholders about siting the first NPP. Some sites, e.g., one near Aqaba, were rejected because of their site characteristics. Now two locations are considered by the Government as possible sites for building the first NPP in Jordan. Evaluation of feasibility of protective actions at the chosen site for the NPP has not yet been completed, and is recommended through EPR-EMBARKING [6]). The EPREV team recognized that this work is in progress and similar work is being done for the JRTR [45].

### **3.6.3 Recommendation**

ME6(R1) The JNRC should complete its review of the JRTR safety analysis, and complete arrangements with the University and the Governor of the region for urgent protective actions.

ME6(R2) The Government should ensure that an evaluation of feasibility of protective actions at the chosen site for the nuclear power plant is carried out in line with IAEA guidance in the EPR-EMBARKING.

## **3.7. Main element 7. Providing information, issuing warnings and instructions to the public**

This element concerns the development of capabilities for providing information and issuing instructions and warnings to the public to meet requirements from GS-R-2 §4.53–§4.55 [2].

Implementation of guidelines and recommendations is based on:

- GS-G-2.1 §4.32–§4.36, and Appendix VI, Appendix VII [3];
- EPR-FIRST RESPONDERS [11];
- EPR-METHOD [5];
- EPR-EMBARKING [6];
- EPR-PUBLIC COMMUNICATIONS [17].

This element refers to specific guidance on providing instructions to the population within the emergency planning zones around facilities having off-site emergency plans. This element contains, but is not limited to, the following parts, which need to be considered by Jordan for the establishment of a nuclear power programme in line with the guidelines in EPR-EMBARKING [6]:

ME7.1. Arrangements and procedures for providing coordinated, useful, timely, accurate, and consistent information to the public in the event of a radiation emergency;

ME7.2. Arrangements and procedures to provide prompt warning and instruction to the permanent, transient and special population groups within the area potentially affected by a radiation emergency.

### **3.7.1. Current situation**

Under existing Law 18/1999 [31], the HCCD provides instructions to the public in an emergency. Under the DNERP [36], the NECRA has primary responsibility for communicating with the public and providing information with regard to radiation and nuclear emergencies. According to the DNERP, the NECRA should collect information on the cause of the radiation hazard and prepare information for the media. It should also gather information from Jordanian authorities. However, the EPREV team was informed that the NCSCM will take the place of the NECRA for this purpose [34].

The EPREV team was informed that when issuing information to the population at risk under a hazard category IV event, it is expected that the number of people needing instructions would be relatively low (i.e., not more than 100 people), and that these people could be informed directly (i.e., by emergency workers going door to door, or by using loudspeakers).

### **3.7.2. Situation in relation to commissioning JRTR**

The EPREV team was informed that in the case of activation of response at the national level, when more than one governorate is affected, the HCCD shall be activated and the public communication would automatically be within its purview. However, responsibilities for communication for emergencies at the local or facility level that would lead to an activation of the HCCD, have not yet been clearly assigned.

The EPREV team was informed that for the JSA at JUST, no specific off-site communication plans have been developed for nuclear or radiation accidents. However, JUST has an existing emergency management plan for general emergencies and a communications system, which would be used in the case of a radiation emergency at the JSA, and for giving instructions to university students and personnel [46].

The EPREV team was informed that the JRTR, when it operates, will require the development of more extensive off-site plans, and thus a more comprehensive mechanisms for informing the public. In an emergency at JRTR, the alarm strategy is proposed. The off-site alarm will comprise a siren and phone alarm for any potential hazard to the population centres around the JRTR, in particular JUST and Cyber city [37, 38, 39].

### **3.7.3. Recommendation**

- ME7(R1) The Government should clarify the relationship between the NCA (to be designated), the HCCD and the NCSCM for the application the “one voice” approach for communication with the public in case of an emergency.
- ME7(R2) The NCA should ensure that pre-prepared template statements (press releases) are in place in order to facilitate the prompt communication of information and minimize confusion during an emergency in hazard category IV or in facilities at threat categories III (e.g., JSA), II (the JRTR) and I (the NPP).
- ME7(R3) The NCA should exercise the public warning system, once implemented, in a realistic scenario to clarify roles and responsibilities and to ensure that all stakeholders have the same view regarding public communication.

## **3.8. Main element 8. Protecting emergency workers**

This element concerns the development of capabilities for protecting emergency workers to meet the requirements from:

- GS-R-2 §4.56 – 4.65 [2];
- SF-1 §3.36 [19].

This also needs to include capabilities for a plain language explanation of results from individual monitoring of emergency workers to workers, decision makers and other stakeholders. Implementation of guidelines and recommendations is based on:

- GSG-2 §4.1–§4.7 [4];
- EPR-EMBARKING [6];
- EPR-FIRST RESPONDERS [11].

This element contains, but is not limited to, the following parts, which need to be considered by Jordan for the establishment of a nuclear power programme in line with the guidelines in EPR-EMBARKING [6]:

- ME8.1 Regulations on the protection of emergency workers;
- ME8.2 Arrangements for the application of a graded approach on the restriction of the exposure of emergency workers based on the assignment of tasks;
- ME8.3 Arrangements for the use of personal protective equipment by first responders and emergency workers;
- ME8.4 Arrangements for the efficient dose control of emergency workers.

### **3.8.1. Current situation**

The EPREV team recognized that the regulatory basis for protection of emergency workers is not yet developed in Jordan. There are no provisions for the protection of the first responders and emergency workers against radiological hazards. The system does not provide dosimeters for first responders and emergency workers. First responders do not have basic knowledge about radiation hazards, procedures and personal protective equipment.

In the DRNEPP [28], the emergency worker is recognized as a worker who may be exposed in excess of the occupational dose limits, while performing actions to mitigate the consequences of an emergency for human health and safety, quality of life, property and the environment.

The need for defining the respective dose limits and intervention levels is also recognized in Article 6 of DRNEPP. Article 7 addresses the situations warranting the need for protection of emergency workers in the hazard assessment. The EPREV team was informed, that an annual dose limit of 20 mSv is used de-facto for limitation of occupational exposure in a planned exposure situation. However, the EPREV team was not provided with established regulations addressing dose limits for workers and members of the public in planned and emergency exposure situation.

The DNERP [36, 42] defines that the incident commander is the person responsible for giving on-the-scene tasks to emergency workers and should lead the first response on the scene by:

1. Coordinating the response from an incident command post near the scene;
2. Evaluating all available information; retracing the sequence of events; being aware of the possibility of criminal acts;
3. If warranted, requesting the national radiation assistance team (radiological assessor) to perform monitoring if contamination or public exposure is suspected;

4. Implementing actions to protect the public, workers, responders, and the economy from actual or perceived radiological risks, by implementing actions consistent with international standards.

In accordance to Article 4 of Regulation 33/2003 [26], the JNRC should issue a personal license to a person to act as radiation protection officer in radiological emergencies. According to Article 10 of DRNEPP the operator should make arrangements to ensure the safety of all persons on the site in the event of a nuclear or radiological emergency. In the case of an emergency in a facility, the operator or the JNRC as a TSO should provide a radiation protection officer to assess doses and provide radiation dosimetry for emergency workers.

### **3.8.2. Situation in relation to commissioning JRTR**

The EPREV team concludes that the DRNEPP [28] could be an appropriate basis for the implementation of the protection of workers in the JRTR. The JAEC and KDC are working with development of the radiation protection plan for the JRTR. In addition to DRNEPP, Article 61 of draft regulation on the safety of research reactors [27] specifies that guidance on limits on the doses due to exposure of personnel performing rescue missions, or missions to mitigate the consequences of an emergency, should be included in the emergency arrangements. This regulation, if approved, is sufficient to implement the emergency preparedness of the JRTR in this respect.

### **3.8.3. Recommendations**

- ME8(R1) The Government should ensure that regulation for protection of emergency workers is in place. The IAEA guidance in GSG-2 and GS-R-2 should be taken into account for the protection of emergency workers and first responders.
- ME8(R2) The Government should ensure that the regulations contain clear requirements on training and exercise for emergency workers.
- ME8(R3) The Government should ensure that radiation protection requirements and arrangements for emergency workers are clearly addressed in regulation and in plans, including, for example, training, dose registry and appropriate medical examination if needed.

## **3.9. Main element 9. Assessing the initial phase**

This element concerns the development of capabilities for the evaluation of human exposure in an emergency exposure situation in terms of adequate dosimetric quantities and the risks to meet requirements from:

- GS-R-2 §2.1–§2.3, §4.78, §4.79, §4.88–§4.93 [2];
- SF-1 §3.36 [19].

This also should include capabilities for a plain language explanation of monitoring results to decision makers and stakeholders. Implementation of guidelines and recommendations is based on:

- GS-G-2.1 Appendix VI; [3];
- GSG-2 §3.1–§3.12, §3.13–§3.17, §3.18–§3.25, and §3.26–§3.31, and §4.1–§4.7, and §5.1–§5.13, Appendix I – Appendix III [4];
- IAEA-TECDOC-955 [43];



- EPR-EMBARKING [6];
- EPR-RESEARCH REACTOR [12];
- EPR-MEDICAL [13];
- EPR-D-VALUES [14].

This element contains, but is not limited to, the following parts, which need to be considered by Jordan for the establishment of a nuclear power programme in line with the guidelines in EPR-EMBARKING [6]:

- ME9.1. Arrangements and procedures for radiation protection of the public, workers and first responders based on plant conditions, off-site radiation measurements and observations at the scene in emergency at facilities in hazard category I and II;
- ME9.2. Capabilities for assessing the dose of emergency exposure off-site and on-site in an emergency at facilities in hazard category I and II;
- ME9.3. Capabilities for on-line radiation monitoring of the PAZ and the UPZ of facilities in hazard category I and II;
- ME9.4. Capabilities for monitoring contamination in soil, air, foodstuff and water in the PAZ and UPZ of facilities in hazard category I and II;
- ME9.5. Plant specific EALs based on event classification and on plant conditions at facilities in hazard category I and II;
- ME9.6. Site-specific OILs for radiation emergencies at the facilities in hazard category I and II.

### **3.9.1. Current situation**

In accordance with Law 43/2007 [24], the JNRC has the responsibility for radiation protection of the public, workers and first responders, for assessing the dose for emergency exposure, monitoring and contamination of the environment and for establishing intervention levels. The EPREV team was informed that Jordan is in the process of developing capabilities to assess the early phase of a nuclear or radiological emergency at JRTR in terms of the EALs [37, 38, 39, 42]. The DNERP [36] is the regulation containing default OILs from international guidance in GSG-2 [4]. Establishment of the concept of operations for protection of the public based on concept of EALs and OILs is not yet completed.

In addition to stationary facilities of monitoring system presented in section 3.4, the JNRC has four mobile radiation detection vans that are currently used for border monitoring and a laboratory is used to process environmental samples. The mobile laboratories will be used for environmental monitoring and sampling in case of an off-site emergency contamination.. The team reviewed the facilities at JNRC for processing environmental samples in the case of an accident. The systems are basic, with a small number of alpha, and gamma counting and identification systems. No wet laboratories for chemical processing are present.

The EPREV team was informed that as the JRTR is a category II facility, it will be surrounded by an UPZ [37]. As indicated in [45], there are nearly 230 000 people within 10 kilometres of the JRTR site who are living in Irbid, Mafraq and Jarash governorates. Therefore, the preparations are under development to promptly shelter JUST staff and students, to perform environmental monitoring and to implement urgent protective actions on the basis of the results of monitoring within a few hours following a release from JRTR.

The EPREV team was not provided with information about procedures for evaluation of the public emergency exposure in JNRC. The JAEC, as operator of the JRTR, has in place computer code for projecting off-site release in case of a severe accident in the reactor.

### **3.9.2 Situation in relation to commissioning JRTR**

The EPREV team was informed that the JAEC develops capabilities for assessing the dose of emergency exposure off-site and on-site in an emergency at JRTR. The establishment of online monitoring system and laboratory base for monitoring environmental contamination in the vicinity of the JRTR is planned. The JAEC in cooperation with the KDC is developing facility-specific EALs and OILs for the JRTR.

### **3.9.3. Recommendations**

- ME9(R1) The Government should ensure that a full set of OILs , some of which are already in the draft plans, are consistent with GSR-2, and those guidelines in EPR-RESEARCH REACTOR and EPR-NPP PUBLIC PROTECTIVE ACTIONS, are included in relevant regulation on EPR. The NCA should ensure that these OILs are included in radiation emergency response plans at all levels of response.
- ME9(R2) The Government should ensure that a full set of emergency planning zones, consistent with GS-G-2.1 and guidelines in EPR-RESEARCH REACTOR and EPR-NPP PUBLIC PROTECTIVE ACTIONS are included in relevant EPR regulations and plans.
- ME9(R3) The JNRC should improve its ability to predict, monitor and evaluate releases from the JRTR, in particular its laboratory facility processing environmental samples, and ability to evaluate the public emergency exposure before the JRTR is commissioned.

### **3.10. Main element 10. Managing medical response**

This element concerns the development of capabilities for medical support of the emergency response to meet requirements from:

- GS-R-2 §4.74–§4.81 and §4.94–§4.95 [2];
- NS-R-2 §2.33(4) [21];
- CODEOC §20(e,v) [20].

Implementation of guidelines and recommendations is based on:

- GS-G-2.1 §2.2–§2.11, §4.37–§4.46 and Appendix V [3];
- GSG-2 §3.1–§3.12, Appendix I, Appendix II [4];
- EPR-EMBARKING [6];
- EPR-MEDICAL [13];
- EPR-FIRST RESPONDERS [11];
- EPR-D-VALUES [14];
- EPR-BIODOSIMETRY [47].

This element contains, but is not limited to, the following parts, which need to be considered by Jordan for the establishment of a nuclear power programme in line with the guidelines in EPR-EMBARKING [6]:

- ME10.1. Designation of hospitals and qualified medical professionals to assist during a radiation emergency;
- ME10.2. Arrangements and procedures for the awareness of medical practitioners of the medical symptoms and outcomes of radiation exposure and of the appropriate notification procedures;
- ME10.3. Arrangements and procedures to obtain international assistance in the treatment of overexposed persons if required;
- ME10.4. Capabilities to initially treat exposed and contaminated patients;
- ME10.5. Arrangements for performing measures for the medical protection of the public, workers and responders.

### **3.10.1. Current situation**

The EPREV team was informed that, in accordance with Law 18/1999 [31] the MoH has established a Crisis Management Centre for solving all health emergencies in the country. The Crisis Management Centre is connected to the emergency on-call service 911 and to the network of hospitals under subordination. Although the emergency doctors are experienced in providing first aid and urgent medical treatments, they are not knowledgeable in medical response in case of radiation emergencies. Training and equipment is needed for the personnel operating the emergency departments of the hospitals.

According to the MoH representative, it is planned, that the Al Bashir Governmental Hospital will be responsible for handling and treating exposed and/or contaminated casualties in the future. The EPREV team was also informed that it is planned that JUST's hospital will be the designated hospital in the event of an emergency at JSA and JRTR. The DNERP [36] suggests the King Abdullah Hospital as the designated hospital for radiation emergencies. Currently there are no designated hospitals in Jordan to deal with the treatment of contaminated injuries, or to decontaminate such patients.

The EPREV team was informed by the MoH representative that systematic refresher training of the medical symptoms of radiation exposure for general practitioners has not been addressed in Jordan. In general, the ambulance services are aware of the fact that lifesaving actions and treatment of serious injuries should receive priority, even if radiation hazards exists or can be assumed in the emergency. Nevertheless, the basic rules to follow on how to avoid further unnecessary contamination of the personnel and equipment (ambulance car, hospital facilities, etc.), and radiation protection of the medical personnel during the treatment are not laid out.

To have a clear understanding of potential national capabilities for medical response to radiation emergencies, the EPREV team visited the Nuclear Medicine Department and the Brachytherapy Unit of the KHCC. As a result of this visit, the team concluded that the knowledge, skills and experience of the KHCC staff are in line with the IAEA recommendations in Ref. [13].

The KHCC is otherwise well prepared in terms of procedures, equipment and training on how to proceed and respond if an incident happens during a radiation therapy treatment. This was demonstrated by the response during an incident two years ago. A new radiation source was stuck in the delivery tube during source replacement. The personnel made an assessment of the situation, planned and carried out the response action without unduly endangering personnel. An incident report was written and the experience was shared within the hospital, but not at the country level.

This knowledge and experience, shared by the KHCC staff, would assist the assigned hospitals in the development of procedures for patient reception and initial check-up, before patients are transported to more specialized hospital(s), if required. This capability could also be used to teach staff at other country hospitals regarding the procedures on how to deal with overexposed and/or contaminated patients.

For preparing the future NREP, the use of the IAEA guidelines publication on medical response to an emergency [13] is recommended. Arrangements in the future NREP need to take into account requests for assistance (e.g., sending patients abroad for medical treatment) through the Assistance Convention [1].

### **3.10.2. Recommendations**

- ME10(R1) The Government should ensure that KHCC, Al Bashir Governmental Hospital, and Hospital of JUST are included in the national arrangements for medical response in the event of a nuclear or radiation emergency as designated hospitals. These arrangements should be described in the NREP.
- ME10(R2) The MoH, in cooperation with the JNRC, should begin programmes on basic medical training and refresher training on the treatment of potentially contaminated patients for medical staff who may first encounter these patients.
- ME10(R3) The MoH, in cooperation with the JNRC, should begin programmes to raise awareness among general practitioners of the medical symptoms of radiation exposure. Programmes should aim at providing appropriate lectures during the basic training of future physicians (before they obtain their medical degree), and also through the credit system when physicians need to undertake refresher courses.
- ME10(R4) The JNRC, in cooperation with the MoH, should assist in developing procedures for decontamination and triage of overexposed and/or contaminated patients.
- ME10(R5) The Government should consider sending patients with severe radiation injuries for medical treatment abroad. The JNRC, in cooperation with the MoH, should develop appropriate procedures for a prompt assistance request from the IAEA, if needed.
- ME10(R6) The NCA, in cooperation with the MoI and JAF, should develop arrangements for decontamination of a large number of people in event of large-scale radiation emergency. These arrangements should be outlined in the NREP.

### **3.11. Main element 11. Keeping the public informed**

This element concerns the development of capabilities for keeping the public informed to meet the requirements of GS-R-2 §4.82–§4.84 [2].

Implementation of guidelines and recommendations is based on:

- GS-G-2.1 §4.32–§4.36 [3];
- EPR-EMBARKING [6];
- EPR-PUBLIC COMMUNICATIONS [17];
- EPR-FIRST RESPONDERS [11];
- EPR-METHOD [5].

This element contains, but is not limited to, the following parts, which need to be considered by Jordan for the establishment of a nuclear power programme in line with the guidelines in EPR-EMBARKING [6]:

- ME11.1 Arrangements for continuous, reliable communication in advance of a radiation emergency;
- ME11.2 Arrangements for responding to requests for information from the public and from mass media.

### **3.11.1. Current situation**

Law 18/1999 [31] contains a general requirement that “each and every person has the right to receive full and timely information about all hazards of disasters, as well as possibilities, manners, measures and activities of protection and measures.” However, it has no specific provision for the coordination of information to the media and the public during an emergency and no provision for a nuclear or radiation emergency. In this case, it is not clear who would coordinate the information to the media and the public.

According to Article 10 of Law 43/2007 [24], the JNRC is responsible for raising public and media awareness of radiation protection, and to promote a safety and security culture. The EPREV team was informed that the JNRC representative to the HCCD takes part in preparing statements and press releases for the public in the event of a radiological emergency [32]. The task for this person is to provide concise and technically sound information, while the public relation specialists (e.g., spokespersons) should provide a plain language explanation to the public. The EPREV team was not provided with templates of press releases or instructions to the public in case of radiological emergencies related to facilities in hazard category III and activities in hazard category IV or V. The EPREV team informed the counterpart that such templates are available in Arabic in Refs [5, 11].

The JNRC, in this respect, has good relations with the media; they provide the public with regular information on the latest news, regulations and licensing actions of importance. The JNRC is a member of the public awareness committee, led by the JAEC. In the committee the JNRC is tasked with increasing the awareness of the public about radiation and nuclear safety. Still, the use of the JNRC website would be practical to publish documents about the potential dangers of radiation and expected emergency actions for the public, especially around nuclear facilities. The JAEC and JNRC websites could also be used for public information in the event of an emergency.

### **3.11.2. Situation in relation to commissioning JRTR**

The EPREV team was informed that JUST management is aware of the need to provide information regarding JSA and the JRTR to students and staff of the University [46].

The JNRC does not have its own public relations services. For nuclear emergencies at JRTR or JSA, the commission does not have a pre-prepared template of press release. For radiological emergencies the commission also does not have a pre-prepared template of press release (e.g., for the event of a lost source or large scale contamination).

### **3.11.3. Recommendations**

ME11(R1) The Government should ensure that the NREP addresses public information coordination at all response levels. Arrangements and capabilities for emergency public information have to be tested during exercises or specific drills. Due consideration should be given to the IAEA EPR-PUBLIC COMMUNICATION.

ME11(R2) The JNRC should consider using its homepage to increase awareness of the public in relation to potential dangers of radiation, nuclear safety and expected emergency actions for the public.

### **3.12. Main element 12. Taking agricultural countermeasures against ingestion and longer term protective actions**

This element concerns the development of capabilities for implementation of agricultural countermeasures to meet the requirements from GS-R-2 §4.85–§4.93 [2].

Implementation of guidelines and recommendations is based on:

- GS-G-2.1 §4.47–§4.51 [3];
- GSG-2 Appendix II [4];
- EPR-EMBARKING [6];
- EPR-METHOD [5];
- IAEA-TECDOC-955 [43].

This element contains, but is not limited to, the following parts, which need to be considered by Jordan for the establishment of a nuclear power programme in line with the guidelines in EPR-EMBARKING [6]:

- ME12.1. Capabilities for monitoring contamination in soil, air, foodstuff and water in the emergency zones associated with a facility of hazard category I and II;
- ME12.2. Arrangements and procedures to implement actions to protect the public from consumption of contaminated local foods in case of a radiation emergency at a facility of hazard category I and II.

#### **3.12.1. Current situation**

The EPREV team was informed that the present countermeasures for protection of the food chain within Jordan refer to the control of food on the market, including imported food. However, there are no arrangements for monitoring of radiation levels in the food production process. There are also no procedures addressing the types of agricultural products, the areas in which they are grown, soil sampling methods, patterns (frequency, location) for taking samples of soil and products, etc. There is no draft or enacted regulation establishing the OILs that would be used for controlling radioactive contamination of foodstuff in case of an emergency.

#### **3.12.2. Situation in relation to commissioning JRTR**

The EPREV team was informed that the JAEC conducts an investigation of land use and occupancy of the 10 km zone around JRTR. Natural radiation background around the JRTR site is under evaluation. The presence of artificial radionuclides in soil and produce in that area is also assessed [45].

Article 8 of Law 18/1999 [31] states that, in case of any crisis situation, the will distribute food and all the materials needed to ensure the stability of life and management of living for the affected people and territory. The NREP could build on this provision.

### **3.12.3. Recommendations**

ME12(R1) The Government should establish a regulation on OILs of radionuclides in foodstuff, in case of a radiation emergency, that are consistent with current international guidance in GSG-2.

ME12(R2) The Government should develop a comprehensive concept of operations for agricultural countermeasures, including the use of laboratories of authorized TSO, as well as of the mobile radiation monitoring unit(s) for monitoring of radioactivity in foodstuff and water. Special measures for protection of water supplies should be considered.

### **3.13. Main element 13. Mitigating the non-radiological consequences of emergency and response**

This element concerns the development of capabilities for mitigating the non-radiological consequences of the radiation emergency, and the response to meet requirements from GS-R-2 §4.94–§4.96 [2].

Implementation of guidelines and recommendations is based on:

- GS-G-2.1 §4.52–§4.53, and Appendix VI, Appendix VII [3];
- EPR-METHOD [5];
- EPR-FIRST RESPONDERS [11];
- EPR-MEDICAL [13];
- EPR-NPP PUBLIC PROTECTIVE ACTIONS [15];
- EPR-PUBLIC COMMUNICATIONS [17].

This element contains, but is not limited to, the following parts, which need to be considered by Jordan for the establishment of a nuclear power programme in line with the guidelines in EPR-EMBARKING [6]:

ME13.1 To provide the public during a potential or actual radiation emergency with a plain language explanation of hazards, potential risks and required protective actions, which would prevent or minimize development of non-radiological consequences of the radiation emergency and the response;

ME13.2 To make arrangements for responding to public concern during a potential or actual radiation emergency.

#### **3.13.1. Current situation**

The international requirements in GS-R-2 and guides in GS-G-2.1 mention a mitigation of non-radiological consequences of an emergency as an important element of the national framework for EPR. The IAEA guidelines in Refs [5, 11, 13, 15, 17] provide practical suggestions about implementation of a concept for mitigation of non-radiological consequences.

Law 18/1999 [31] has no provisions about mitigating the non-radiological consequences of conventional emergency and response. The EPREV team was not informed about the arrangements or strategy for addressing the non-radiological consequences of an emergency in Jordan. The DNERP [36] does not address either non-radiological consequences of radiation emergencies.

### **3.13.2. Recommendations**

ME13(R1) The Government should ensure that a concept or strategy for mitigating the non-radiological consequences of radiation emergencies and response to emergencies is established, and meets international requirements in GS-R-2 and the IAEA guidelines.

### **3.14. Main element 14. Conducting recovery operations**

This element concerns development of capabilities for establishing arrangements for the transition from emergency phase operations to routine long term recovery operations, to meet the requirements of GS-R-2 §4.97–§4.100 [2].

Implementation of guidelines and recommendations is based on:

- GS-G-2.1 §6.6 [3];
- EPR-EMBARKING [6];
- EPR-METHOD § 4.2.12 [5].

This element contains, but is not limited to, the following parts, which need to be considered by Jordan for the establishment of a nuclear power programme in line with the guidelines in EPR-EMBARKING [6]:

- ME14.1 To plan and implement the transition from the emergency phase to longer term recovery operations, and the resumption of normal social and economic activity in an orderly manner and in accordance with international standards and guidance;
- ME14.2 To fulfil all requirements for planned exposure situations for workers undertaking recovery operations.

#### **3.14.1 Current situation**

The draft emergency regulation [28] contains in Article 12, a requirement that preparation for transition and recovery operations should be planned in the NREP, and that decisions to cancel restrictions in response to a nuclear and radiological emergency should be made through a formal process.

Article 61 of draft regulation on the safety of research reactors [27] requires that provisions should be included in the emergency plan for the termination of and recovery from the emergency.

Capabilities for conducting recovery operations exist. For instance, there are HAZMAT teams in GCDD and CBRN units in JAF who are responsible for recovery if nuclear or other radioactive material is found in of Jordan. The JAEC has teams, which could be used for handling orphan sources.

#### **3.14.2. Recommendations**

ME14(R1) The Government should ensure that a practical concept for the management of post-emergency recovery operations, and transition from an emergency situation to an existing exposure situation, is in place and meets international requirements in GS-R-2.



### 3.15. Main element 15. Requirements for infrastructure

The process for ensuring emergency response is based on establishing a quality assurance programme which can be verified through the surveying and review of plans, procedures and infrastructure (preparedness). The ability to carry out the required response actions needs to be evaluated through surveys and reviews of past performance, and most commonly through training opportunities, drills and exercises.<sup>3</sup>

This element concerns the development of processes to ensure and manage the quality assurance programme. This is done by means of training responders and the demonstration of feasibility and adequacy of emergency plans and procedures to meet the requirements from:

- GS-R-2 §5.3, §5.6–§5.9, §5.10–§5.12, §5.13 –§5.39 [2];
- CODEOC §10, §20(e,v) [20];
- NS-R-2 §2.38 [21].

Implementation of guidelines and recommendations is based on:

- GS-G-2.1 §5.1–§5.6 [3],
- EPR-EMBARKING [6];
- EPR-EXERCISE [16];
- IAEA-TECDOC-1254 [48];
- SSG-16 [10].

This element contains, but is not limited to, the following parts, which need to be considered by Jordan for the establishment of a nuclear power programme in line with the guidelines in EPR-EMBARKING [6]:

- ME15.1. Emergency plans at all levels for on-site and off-site response at hazard category I and II facilities;
- ME15.2. Off-site emergency facilities for managing the response to a radiation emergency at hazard category I and II facilities;
- ME15.3. Arrangements and procedures for off-site precautionary and urgent protective actions in a radiation emergency at hazard category I and II facilities;
- ME15.4. Arrangements and procedures for on-site response in a radiation emergency at the facilities of hazard category I and II;
- ME15.5. Adequate tools, computer codes, instruments, supplies, equipment, communication systems, facilities and documentation for performing response functions on-site and off-site;
- ME15.6. Application of the Systematic Approach to Training (SAT), in order to identify duties for all positions and competences for all parties involved in the response to emergencies at facilities of hazard category I and II;
- ME15.7. Designing training courses according to applied SAT for all parties involved in the response to emergencies at facilities of hazard category I and II, and

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<sup>3</sup> Drills are defined as small scale, which may be focused on one or more parts of the emergency plan while exercises are all inclusive.

establishing and carrying out a continuous programme to train the staff of all involved parties in accordance with roles and responsibilities;

- ME15.8. Establishing and running a continuous programme for staffing of all parties involved in the response to emergencies at facilities of hazard category I and II in accordance with applied SAT, to ensure duties are maintained regardless of changes in organizations and staff;
- ME15.9. Designing exercises in accordance to exercise scope and objectives and establishing and carrying out a continuous exercising programme;
- ME15.10. Designing scope and objectives for testing equipment and communications, and establishing and carrying out a continuous testing programme in accordance with the scope and objectives for testing equipment and communications;
- ME15.11. Establishing and carrying out the framework of reporting results of exercises, training and testing for feeding information to the national coordinating authority to identify improvements of the framework for preparedness and response to a radiation emergency.

### **3.15.1 Current situation**

#### **Emergency plans**

The regulatory basis for radiation emergency management and operations is contained in Law 43/2007 [24], Law 18/199 [31], and Regulation 33/2003 [26]. It provides generic requirements for the development of the NREP. Law 43/2007 does not give specific direction with regard to preparedness for a nuclear or radiological emergency. Some general guidance is also included in the draft emergency regulations in Refs [29, 28].

The DNERP [36] is a significant step in the development of comprehensive national radiation emergency management and operations in line with international requirements. The DNERP was prepared on the basis of a previous National Plan issued in 2003 and the international requirements, guidance and guidelines in Refs [2, 3, 4, 5]. The DNERP has been sent by JAEC in 2013 for comments and analysis to all involved parties. Its table of content includes:

- Description of integrated planning concept;
- Description of basis for hazard assessment and emergency planning for radiation emergencies;
- Description of roles and responsibilities of operators and governmental organizations in case of radiation emergencies;
- Description of three levels of response (operator, local authorities, national organizations) to radiation emergencies;
- Description of role of the NECRA in the decision making process;
- Concept of operation and instructions for response to radiological incidents;
- Concept of operation and instructions for response to nuclear emergencies;
- Definition of generic intervention and action levels for implementation of urgent and long term protective actions;
- Definition of hazard categories hazard assessment procedure;
- Definition of emergency classes and classification procedure;
- Definition of dose guidance levels for emergency workers.

The vulnerability of the DNERP [36] is that it is not supported by regulations and incorporates several clauses appropriate for a regulatory document, but not always appropriate for a plan on emergency management and operations. In its current shape, the draft plan is a compendium of criteria, rather than an operational emergency plan. The EPREV team was informed that writing the future NREP is currently a demanding task for JNRC and the DNERP will provide a basis for this job.

One of the objectives of EPREV is to provide recommendations and suggestions to the Jordanian authorities to take further steps towards developing a comprehensive NREP. The main steps for writing the NREP, starting from the DNERP, are suggested in Appendix V.

In accordance with Articles 15 and 26 of Law 43/2007 [24] and Regulation 33/2003 [26], all authorization holders of radiation practices have to set-up an emergency plan proportionate with the nature of the work of the establishment. No specific requirements on the plan's contents are included in the specific legislative acts regulating the radiation practices in the country. The EPREV team visited Jordan Radioactive Waste Storage Facility at the JAEC premises, the Brachytherapy Unit and the Nuclear Medicine Department of the KHCC, and the JSA in JUST. In all cases, on-site emergency plans are in place and in the event of a radiation emergency, require the operator to notify JNRC without any delay. Physical protection systems and radiation monitoring equipment are installed in the above mentioned facilities. The staff of KHCC, JAEC and JSA are regularly trained to be involved in response activities in the event of radiation emergencies. The JSA in JUST has, in addition to the emergency response plan, instructions on how to link and cooperate with the other departments of JUST in case of radiation incidents. Both the JSA and the Jordan Radioactive Waste Storage Facility have arrangements in place for receiving support from local authorities (civil defence teams) in case of emergency situations.

The EPREV team was informed that, in line with Law 18/1999, the GCDD has established and runs operative centres under Governorate Civil Defence Committees. The centres have to be used in any emergency situation, including radiation emergencies. In normal situations, the operative centres are dispatch centres for receiving emergency notifications. In line with Law 18/1999, the Ministerial Crisis Management Centres are established at ministries for coping with emergencies and disasters in their particular areas of responsibility.

### **Emergency facilities and equipment**

The EPREV team was briefed that the Ministry of Environment is legally responsible for the disposal of hazardous wastes and currently its role in EPR is limited to that function. No significant changes are envisaged for the future.

The EPREV team was briefed that the MoH has a general legal responsibility for the protection of health and welfare of the population of Jordan. There are 31 hospitals under the MoH, each of them with an emergency department and a dedicated number of ambulances.

The EPREV team was informed that the system of first response is mainly arranged under the forces of the GCDD of the MoI [32]. The GCDD is responsible for providing radiological surveillance for emergency workers and for the public. It is also responsible for providing rescue services, first aid services, evacuation and transportation for the affected public. In event of radiation emergency the GCDD will cooperate with JAEC and other involved parties. In addition, the GCDD operates urgent ambulance units (also including a helicopter team).

The GCDD has HAZMAT teams and JAF also has CBRN units, which could be used in response to a radiation emergency. The major role of these teams, located at special bases, is the civil protection of the public or military staff in case of military conflict. They are not first

responders but could support first responders in a radiological emergency. They will be activated through GCDD or JAF and will be used for special tasks, e.g., decontamination.

The EPREV team was informed that currently neither the JNRC in its role as a Regulatory Body, nor JAEC as a Competent Authority in the use of atomic energy, have in place an emergency response organization for managing their roles in a radiation emergency at hazard category I and II facilities. The EPREV team was informed that currently no tools, computer codes, instruments, supplies, equipment, communication systems, facilities or documentation for performing response functions on-site are yet available, as the construction of the research reactor has just started.

The EPREV team was informed that the draft emergency plan of JRTR [37, 42] includes arrangements for implementation of off-site urgent protective actions in a radiation emergency at JRTR. The EPREV team appreciates the coordination of that plan with the local civil defence organization.

The EPREV team was informed [32] that currently the operations centres and crisis management centres of the national system, and also the first responders, have most of the necessary supplies, equipment, communication systems, and facilities for responding to conventional emergencies, which could be used for response to radiation emergencies. Availability and reliability of this equipment is regularly tested and some part of it (fire response, rescue at transport accident) is used daily. There is, however, a lack of special equipment for radiation detection. Also, personal protective equipment is needed for those teams with first response roles in case of radiation emergencies.

When the legislative framework is completed and when roles and responsibilities of all response organizations are clearly allocated, the needs for supplies, equipment, communication systems, facilities, etc., should be analysed and included in the future NREP. To the extent possible, arrangements and contracts for providing support to the emergency response capability of the future research reactor should be concluded as soon as possible.

### **Capacity building**

The EPREV team was informed [34] that the NCSCM intends to adopt the SAT concept for all positions and competences of all parties involved in the response to emergencies. The EPREV team considers this a very good opportunity and special consideration should be addressed in the near future, at the governmental level, for initiating training programmes for first responders and other response organizations to address appropriate handling of radiation emergencies at JRTR, under the NCSCM coordination.

During EPREV mission visits, special needs for training have been raised by all responsible organizations (medical facilities, GCDD, JAF) in relation to radiation emergency response and management.

The EPREV team was informed [46] that a systematic educational programme on nuclear safety and security has been initiated and is under development at Jordan University of Science and Technology, often abbreviated JUST. The JUST is a comprehensive, State-supported university located at Ar Ramtha in northern Jordan Irbid Governorate. The JUST comprises 12 faculties, including engineering, medicine and computer and information technology, among others.

To support Jordan's nuclear programme, a Bachelor of Science programme in nuclear engineering was established in JUST in 2007. In 2010 a national steering committee was formed by JAEC for the establishment of a Centre of Excellence for Energy and Mega Projects in JUST. The mission of the Nuclear Engineering Department of JUST (NED-JUST)

is to be Jordan's Centre of Excellence in nuclear engineering education and research, to lead Jordan's efforts to develop its nuclear infrastructure, and to introduce nuclear power as part of the nation's energy mix. The NED-JUST runs the first and only nuclear engineering programme in Jordan. The NED-JUST has four faculty members and operates the:

- High Performance Computing Laboratory;
- Radiation Detection and Measurement Laboratories;
- Internet Reactor Laboratory;
- Jordan Subcritical Assembly (to be commissioned in 2013).

The goal of NED-JUST is the education of specialists in the nuclear engineering and safety fields for the future operation of I and II hazard category nuclear facilities in Jordan. The programme consists of a number of fundamental courses, e.g., Nuclear Reactor Safety (NE521). The curriculum of that course is given in Appendix V. In total there are 112 students in the nuclear engineering programme, and the first 49 students graduated in 2011 and 2012. Most of them were employed in JAEC and JUST. On 1 November 2010, the JUST inaugurated the first internet reactor laboratory in the country. The reactor laboratory links the university's nuclear engineering department with the U.S. PULSTAR research reactor at North Carolina State University. The laboratory enables JUST nuclear engineering students to use the PULSTAR reactor and observe the reactor's behaviour under certain conditions via a virtual control panel. This education programme will be extended after commissioning the JRTR.

During the visit to JUST laboratories, the EPREV team recognized the professionalism of NED-JUST staff, which could be used by governmental organizations as support for designing and conducting training courses for all parties involved in the response to emergencies at facilities of hazard category I and II.

The EPREV team was informed that in addition to JUST, Jordan University has a medical physics programme, and the Al-Balqa' Applied University has a nuclear physics programme.

### **Emergency exercises**

The EPREV team was not provided with specific information on the scheduling and organization of emergency exercises. No radiation emergency response exercise has been run in Jordan in the last seven years. The previous exercise that included a radiological component was conducted in 2006 and simulated a dirty bomb event.

### **Quality assurance**

The EPREV team was not informed about a quality assurance programme for EPR being in place at the national or other response levels. Law 18/199 [31], Regulation 33/2003 [26] and the DRNEPP do not require development of such a programme by the operator of radiation facility or response organization.

### **3.15.2. Situation in relation to commissioning JRTR**

Draft planning at the national level for the management of radiation emergencies at hazard category II facilities has been initiated by JAEC in DNERP [36]. The DNERP has to be revised taking into account the expected changes in the legislation, and keeping in mind future allocation of roles and responsibilities in case of radiation emergencies.

The JAEC is preparing a Draft Emergency Response Plan for JRTR [37, 38, 39], including on-site and off-site components. The EPREV team was informed that, by the end of 2013, KAERI, the vendor of the JRTR, will provide JAEC with the list of DBA (as a part of facility safety assessment report) and BDBA that should be considered in emergency plans.

JNRC and JAEC have plans for establishing their own emergency response centres, as technical support facilities for the decision making process in case of radiation emergencies at hazard category I and II facilities.

### **3.15.3. Good practice**

ME15(G1) The EPREV team recognized as a good practice the establishment of the nuclear engineering programme in Jordan University of Science and Technology associated with the national power programme, medical physics programme in Jordan University, and the nuclear physics programme in Al-Balqa' Applied University, as a capacity building base for a nuclear power programme. This shows that Jordan has a central institute for the education of future key specialists involved in the EPR programme.

### **3.15.4. Recommendations**

ME15(R1) The Government should continue its efforts to complete the draft NREP of Jordan in a manner that is consistent with international requirements in GS-R-2.

ME15(R2) The JAEC, in cooperation with the Korean Atomic Energy Research Institute as a vendor of JRTR, should complete the Emergency Response Plan for the JRTR as soon as possible. The Government should ensure that the local authorities are involved in the development of off-site emergency plan for JRTR.

ME15(R3) The JAEC should complete a long term agreement with KAERI and IAEA on technical support in case of a severe accident.

ME15(R4) The Government should ensure that, at least one year before commissioning of the research reactor JRTR, a comprehensive radiation emergency exercise is conducted with the involvement and participation of all on-site and off-site organizations at both the local and national levels. The lessons learned from conducting the exercise should be incorporated into future development and enhancement of the national system for the management of radiation emergencies.

ME15(R5) The NCA , with support from the JNRC , should evaluate the needs for radiation detection and personal protective equipment for all first responder teams (civil defence, medical, armed forces, police, and gendarmerie). The training of the first responders on the use of that equipment must also be provided.

ME15(R6) The NCA , with support from the JNRC and JAEC, should develop long term, sustainable programmes for training and staffing of all organizations involved in the response to radiation emergencies before commissioning the JRTR. A long term training programme for all organizations taking part in the emergency response, including first responders, should be implemented. These programmes should be coordinated with the IAEA's long term (regional) training programme.

ME15(R7) The Government should ensure that a quality assurance programme is established for all organizations having a role in the response to radiation emergencies.

#### 4. SUGGESTIONS REGARDING ACTION PLAN OF ESTABLISHING CAPABILITIES AND ARRANGEMENTS FOR PREPAREDNESS AND RESPONSE TO A RADIATION EMERGENCY IN JORDAN

Table 2 presents integrated guidance for establishing capabilities and arrangements for preparedness and response to a radiation emergency at the first nuclear facility of Jordan. The actions are derived from the description of the main elements in EPR-EMBARKING [6]. The principal points in the development of capabilities and arrangements for EPR to a radiation emergency in Jordan were defined in Section 2 and Section 3.

The boxes below with the sign ■ in the table, indicate the period of planned actions to address objectives in the main elements. The box with the sign □ reflects the need to further develop additional capabilities and arrangements for emergency response. This process lasts throughout the lifetime of operation of the JRTR, to ensure the level of response that meets the requirements of the IAEA for EPR to radiation emergencies. Table 2 addresses all major parties, which should be involved in establishing the capabilities for emergency response at the different levels of responsibility. The capabilities and arrangements for preparedness and response to a radiation emergency at JRTR have to be completed before the first delivery of the nuclear fuel to the JRTR site.

Table 2. Action plan for the period 2013–2016 for establishing capabilities and arrangements for preparedness and response to a radiation emergency at JRTR in Jordan.

Main elements of a framework of preparedness and response to a radiation emergency	Involved party <sup>4</sup>	Year		
		2013	2014 – 2015	2015– 2016
<b>Main element 1. Basic responsibilities</b>		□	■	■
1.1. Allocation of functions among governmental agencies and jurisdictions involved in preparedness and response to emergencies at JRTR	G (C, B)	□	■	■
1.2. Operation of a NCA for developing, maintaining and coordinating arrangements for preparedness and response to emergencies at JRTR	G (B)	□	■	■
1.3. Participation in international conventions relevant to EPR area	G (C, B)	□	■	■
1.4. Development of relevant regulations for JRTR on EPR to emergencies	G (C, B)	□	■	■
<b>Main element 2. Assessment of hazards</b>		□	■	■
2.1 Regulations about the assessment of radiological hazards in Jordan	G (B, C)	□	■	■
2.2 Threat assessment in a State, performed in accordance with the IAEA Safety Standards GS-R-2 and GS-G-2.1	C (B, G)	□	■	■
2.3 Periodic reassessment of hazards	C (B, G)	□	■	■

<sup>4</sup> Involved parties are: G – Government, B – JNRC, C – NCA, L – Governor or/and MoI, O – JAEC.

Main elements of a framework of preparedness and response to a radiation emergency	Involved party <sup>4</sup>	Year		
		2013	2014 – 2015	2015– 2016
<b>Main element 3. Establishing emergency management and operations</b>		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
3.1. Assignment of functions, allocation of responsibilities, establishment of coordination and provision of resources for EPR at all levels	C (L, O, B, G)	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
3.2. Acting in accordance with the NREP	C (L, O, G)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.4. Evaluation of feasibility of protective actions at the chosen site for the JRTR	B (L, O, C)	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<b>Main element 4. Identifying, notifying and activating</b>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.1. Operation of a single National Warning Point for contact with the IAEA and to other States in compliance with Assistance and Early Notification Conventions	G (C)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
4.2. Awareness of the response organizations (local authority, operators, the public and potential first responders to an emergency at JRTR) to the indicators of a potential radiation emergency, notifications and other immediate actions	C (O, L, G)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.3. Arrangements and procedures for the notification of involved parties and initiation of response at all levels, in a timely, accurate and appropriate manner	G (C, O, L, B)	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
4.4. Arrangements and procedures for immediate and effective actions of first responders and other response organizations to an emergency at JRTR	L (C)	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
4.5. Arrangements and procedures for notifying neighbouring countries and the IAEA in case of a radiation emergency associated with JRTR	G (O, C)		<input type="checkbox"/>	<input type="checkbox"/>
4.6. Arrangements and procedures for assessing the initial phase of the reactor accident at JRTR by the operator	O (C, B)		<input type="checkbox"/>	<input checked="" type="checkbox"/>
4.7. Arrangements and procedures for promptly initiating an on-site and off-site response in the event of a radiation emergency at JRTR	C (O, L)		<input type="checkbox"/>	<input checked="" type="checkbox"/>
<b>Main element 5. Taking mitigatory actions</b>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.1. Arrangements and procedures for on-call advice to assist first responders to an emergency at JRTR, other response organizations and local authorities	C (G, B, L)	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
5.2. Arrangements and procedures for supporting the local authority including the process for obtaining prompt assistance through the IAEA	G (C, B)	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
5.3. Arrangements and procedures for taking mitigating actions for an emergency at JRTR	C (L, G)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Main element 6. Taking urgent protective actions</b>		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>



Main elements of a framework of preparedness and response to a radiation emergency	Involved party <sup>4</sup>	Year		
		2013	2014 – 2015	2015– 2016
6.1. Arrangements for effectively making and implementing decisions on urgent protective actions to be taken off-site	C (G, L, O)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.2. Arrangements to ensure the safety of all persons on-site in the event of a radiation emergency	C (G, L, O)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.3. Arrangements and procedures for providing local, national and international support to the operator of the JRTR in event of radiation emergency	C (G, L, O)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Main element 7. Providing information and issuing instructions and warnings to the public</b>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.1. Arrangements and procedures for providing coordinated, useful, timely, accurate, and consistent information to the public in the event of a radiation emergency	G (B, C, O, L)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.2. Arrangements and procedures to provide prompt warning and instruction to the permanent, transient and special population groups within the area potentially affected by a radiation emergency	L (C, O, G)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Main element 8. Protecting emergency workers</b>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8.1 Regulations on the protection of emergency workers	B (G, C)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8.2 Arrangements for the application of a graded approach to the restriction of exposure of emergency workers based on the assignment of tasks	G (B, C, O)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8.3 Arrangements for the use of personal protective equipment by first responders and emergency workers	C (O)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8.4 Arrangements for the efficient dose control of emergency workers	C (O)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Main element 9. Assessing the initial phase</b>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9.1. Arrangements and procedures for radiation protection of the public, workers and first responders based on plant conditions, off-site radiation measurements and observations at the scene in an emergency at JRTR	G (B, C)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9.2. Capabilities for assessing the dose of emergency exposure off-site and on-site in an emergency at JRTR	G (B, C)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9.3. Capabilities for on-line radiation monitoring of UPZ of JRTR	G (L, C, B)		<input type="checkbox"/>	<input type="checkbox"/>
9.4. Capabilities for monitoring contamination in soil, air, foodstuff and water in UPZ of JRTR	G (B, O, C)		<input type="checkbox"/>	<input type="checkbox"/>
9.5. Plant specific EALs based on event classification and on plant conditions at JRTR	G (B, O, C)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9.6. Site-specific OILs for radiation emergencies at JRTR	G (B, O, C)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Main element 10. Managing the medical response</b>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Main elements of a framework of preparedness and response to a radiation emergency	Involved party <sup>4</sup>	Year		
		2013	2014 – 2015	2015– 2016
10.1. Designation of hospitals and qualified medical professionals to assist during a radiation emergency	L (C, G)	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
10.2. Arrangements and procedures for the awareness of medical practitioners of the medical symptoms and outcomes of radiation exposure and of the appropriate notification procedures	G (B, C, L)	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
10.3. Arrangements and procedures to obtain international assistance in the treatment of overexposed persons if required	G	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10.4. Capabilities to initially treat exposed and contaminated patients	G (L)	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
10.5. Arrangements for performing medical protection of the public, workers and responders	G (B, C, L)	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<b>Main element 11. Keeping the public informed</b>		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
11.1 Arrangements for reliable communications in advance of a radiation emergency	G (B, C, O, L)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
11.2 Arrangements for responding to requests for information from the public and mass media	G (B, C, O, L)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<b>Main element 12. Taking agricultural countermeasures, countermeasures against ingestion and longer term protective actions</b>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12.1. Capabilities for monitoring contamination in soil, air, foodstuff and water in the UPZ of JRTR	L (C, G, B)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12.2. Arrangements and procedures to implement actions to protect the public from consumption of contaminated local foods in case of a radiation emergency at JRTR	G (B, L)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Main element 13. Mitigating the non-radiological consequences of the radiation emergency and the response</b>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13.1 Providing the public during a potential or actual radiation emergency with a plain language explanation	G (B, C, O, L)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13.2 Making arrangements for responding to public concern during a potential or actual radiation emergency	G (B, C, O, L)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Main element 14. Conducting recovery operations</b>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14.1 Planning and implementing the transition from the emergency phase to longer term recovery operations and the resumption of normal social and economic activity in an orderly manner and in accordance with international standards and guidance	G (B, C, O, L)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14.2 Fulfilling all requirements for planned exposure situations for workers undertaking recovery operations	G (B, C, O, L)		<input type="checkbox"/>	<input type="checkbox"/>

Main elements of a framework of preparedness and response to a radiation emergency	Involved party <sup>4</sup>	Year		
		2013	2014 – 2015	2015– 2016
<b>Main element 15. Requirements for infrastructure</b>		☐	☐	■
15.1. Emergency plans at all levels for on-site and off-site response at JRTR	C (O)	☐	☐	■
15.2. Off-site emergency facilities for managing the response to a radiation emergency at JRTR	G (C, L)	☐	☐	■
15.3. Arrangements and procedures for off-site protective actions in a radiation emergency at JRTR	G (B, C, O, L)	☐	☐	■
15.4. Arrangements and procedures for on-site response in a radiation emergency at JRTR	O (B, C, G, L)		☐	■
15.5. Adequate tools, computer codes, instruments, supplies, equipment, communication systems, facilities and documentation for performing response functions on-site and off-site	C (B, L)	☐	☐	■
15.6. Application of the SAT, in order to identify duties for all positions and competences for all parties involved in the response to emergencies at JRTR	G (C, B, O, L)	☐	☐	■
15.7. Designing training courses according to the SAT for all parties involved in the response to emergencies at JRTR, and establishing and carrying out a continuous programme to train staff of all involved parties in accordance with roles and responsibilities	G (B, C, O, L)	☐	☐	■
15.8. Establishing and running a continuous programme for staffing of all parties involved in the response to emergencies at JRTR in accordance with the SAT, to ensure duties are maintained regardless of changes in organizations and staff	G (C, B, O, L)	☐	☐	■
15.9. Designing exercises in accordance with exercise scope and objectives, and establishing and carrying out a continuous exercise programme	C (B, O, L)	☐	☐	■
15.10. Designing scope and objectives for testing equipment and communications, and establishing and carrying out a continuous testing programme in accordance with the scope and objectives for testing equipment and communications	C (B, O, L)	☐	☐	☐
15.11. Establishing and carrying out the framework of reporting results of exercises, training and testing for feeding information to the NCA to identify improvements of the framework for preparedness and response to a radiation emergency	C (B, O, L)	☐	☐	■

## 5. SUGGESTIONS REGARDING THE DEVELOPMENT OF A NATIONAL RADIATION EMERGENCY PLAN FOR JORDAN

The NCA for EPR to all hazards should be defined in Jordanian legislation and should take the lead and outline a concept of actions, which would focus on achieving the NREP. This concept should consider the following:

- (a) The future NREP should cover both nuclear and radiological emergencies;
- (b) A legal base for development of the future NREP and its position in the national legislative system should be defined by the Government before the start of development of the NREP. When developed, the NREP needs to be approved by the Government as a high level regulation.
- (c) The NCA for EPR to all hazards should be established and appointed by the Government as the major party in development and implementation of the NREP.
- (d) Inter alia, the future NREP should guarantee that in the case of any emergency, protective actions will be implemented without any delay and be based on:
  - An all hazard approach to EPR;
  - An incident command and control system, and allocation of responsibilities provided by national regulation;
  - The categorization of hazards and a graded approach to emergency management depending on the hazard category;
  - The categorization of emergencies depending on hazard category of facility or activity;
  - A concept of operations depending on hazard category of facility or activity.

This is just a broad concept and many details need to be kept in mind, such as choosing the right template for the future NREP, foreseeing interfaces with lower level plans (at the governorate level), etc.

The structure and content of the NREP should meet current international requirements [2, 9], guidelines [3, 4] and guidance [5, 15, 6, 11, 14, 13, 12, 17, 16]. An example structure and content of the NREP for a country without nuclear facilities in hazard categories I and II is given in Appendix IV.

The initial materials for the NREP, which should to be prepared by JNRC in cooperation with the JAEC, need to be discussed with the main stakeholders, i.e., the major authorities mentioned in section 1.5.2 of DNERP [36]. It is important not to involve too many stakeholders in order to make this task manageable. These stakeholders should be asked to make appropriate amendments if they disagree with the initial proposal; in so doing, their active role in writing the NREP will be achieved. One of the important characteristics of the NREP is defining the roles and responsibilities of all stakeholders in the emergency preparedness and response. As mentioned, the concept of operations assists in understanding and defining the responsibilities of the stakeholders – these concepts should serve as additional clarification in the case of disputes about roles. The major national stakeholders should also assist in clarifying the interfaces with local and county level organizations, which will need to be addressed in the phase when the other stakeholders will need to make their contribution to the NREP.

Achieving a common understanding is important in order to develop a feeling of ownership among stakeholders. All partners in EPR should be aware that the NREP is a consensus document. Therefore, all individuals taking part do not express their own opinion but represent the position of their respective organizations. They should not hesitate to discuss the draft NREP proposals with senior officials within their organizations to ensure that their feedback and comments are relevant and valuable. This dialogue will ensure that the various responsibilities and the concept of operations are well understood by all stakeholders.

The final stage is submission of the draft NREP for approval. If the draft has been reconciled with all national stakeholders, and addresses interfaces at the local and national levels, submission is an easy task. The future NREP should be the document that aligns with the international requirements, as clearly described in EPR-METHOD [5].

Once the NREP is adopted, it must be tested in an exercise. One could say that training is needed before testing of the emergency response capability. However, in developing an emergency response capability, training needs to be focused on the concept of operations, so that participants understand their roles in the event of an emergency and build on the skills they already possess. Conducting an exercise based on a comprehensive NREP will be important to test the understanding of roles and responsibilities in practice. A comprehensive training programme will be developed at a later stage. The absence of a comprehensive training programme should by no means delay organization of an exercise for testing the NREP. The exercise will provide valuable feedback to assess the appropriateness of the resources allocated (including manpower, equipment and communications). The exercise analysis will also assess the concept of operations that was used to develop the NREP. The exercise will reveal other details, i.e., non-compliances in procedures, compatibility, bottlenecks, a consistent understanding of messages among various stakeholders, and other valuable elements that will feed into successful emergency preparedness.

## 6. SUGGESTIONS REGARDING THE DEVELOPMENT OF A REGULATORY FRAMEWORK FOR EPR IN JORDAN

The Government of Jordan should develop the following regulations in line with international requirements in GS-R-2 and put them in force prior to the delivery of the first nuclear fuel to the JRTR site.

1. Regulations on governmental infrastructure for preparedness and response to a radiation emergency, providing, inter alia, the allocation of responsibilities at all levels of response, cooperation, coordination, and the assignment of functions among all involved parties and integration of them through an incident command and control system into an effective response capability;
2. Regulations on management of EPR, containing inter alia:
  - Regulation for hazard assessment of radiation and nuclear facilities and practices which could give rise to public exposure in case of an emergency, and categorization of radioactive sources;
  - Regulation for organization and operation of a national registry of radiation sources, radiation and nuclear facilities and practices which could give a rise of public exposure in case of emergency;
  - Regulation for classification of radiation emergencies at facilities and practices in hazard categories I-V;
  - Regulation for the content of on-site emergency plans for facilities in hazard categories I, II, and III and for a graded approach to licensing based on hazard assessment;
  - Regulation for the content of emergency plans of practices in hazard categories IV and V;
  - Regulation for the content of emergency plans of local authorities for the protection of the public in emergencies at facilities in hazard categories I, II, and III, and practices in hazard categories IV and V;
  - Regulations for the declaration of an emergency, the transition from an emergency exposure situation to an existing exposure situation and the termination of the emergency.
3. Regulations on protection of the public in an emergency exposure situation in line with international requirements and guidelines, containing inter alia:
  - Guidelines and criteria for taking precautionary, urgent and mitigatory protective actions in response to a nuclear or radiological emergency;
  - Criteria for design of emergency planning zones around a nuclear or radiation facility in hazard category I, II, and III;
  - OILs for implementation of precautionary, urgent and early<sup>5</sup> protective actions for off-site facilities in hazard category I, II, and III.
4. Regulation on protection of emergency workers in an emergency exposure situation, in line with international requirements and guidelines, containing inter alia:
  - Criteria for limitation of exposure of emergency workers;
  - Guidelines for categorization of emergency workers;
  - Guidelines for employer on radiation protection of the emergency workers;
  - Guidelines for emergency workers on self protection;

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<sup>5</sup> This includes, among others, measures relating to food production, gardens, forest products, fishing, and water supplies.

- Guidelines for individual dosimetry of emergency workers;
  - Guidelines for record keeping and dose registry of emergency workers;
  - Guidelines for appropriate medical examination of emergency workers.
5. Considerations for EPR have to be addressed through inter alia:
- Regulations on transport of nuclear and radioactive materials;
  - Regulations on handling radioactive wastes.

## APPENDIXES

### **Appendix I. Terms of reference of an IAEA Emergency Preparedness and Response Review (EPREV) mission to the Hashemite Kingdom of Jordan**

#### **BACKGROUND:**

The IAEA Emergency Preparedness Review (EPREV) mission will be performed based on a request of the Jordanian Atomic Energy Commission from 14 November 2012, in order to facilitate national efforts on establishing an effective EPR infrastructure in the Hashemite Kingdom of Jordan. The mission goal is to support with technical expertise the development in Jordan of EPR capabilities and arrangements consistent with IAEA requirements and IAEA guidance for a Member State embarking on a nuclear power programme. The mission's results will be considered also by Integrated Work Plan (IWP) for IAEA support to the nuclear power infrastructure of Jordan for the period of 2013–2015.

**DATES:** From 7 to 16 May 2013.

**VENUE:** Amman, the Hashemite Kingdom of Jordan.

#### **MISSION OBJECTIVES:**

1. To compare the EPR arrangements of Jordan as a Member State embarking on a nuclear power programme with current international standards and best practices.
2. To provide an assessment of the Jordanian legislation, arrangements and capabilities, in order to determine if the legal framework has ensured an appropriate set of arrangements for all types of facilities, reflecting the full range of risks to which they apply.
3. To ensure that the embarking State has effectively implemented arrangements consistent with the milestones of the EPREV mission where practical within the constraints of the local conditions and that can be implemented effectively. This will include suggested steps that can be taken immediately to better use the existing capabilities and will cover detailed recommendations on developing a National Radiation Emergency Plan (NREP), as well as recommendations for developing a longer-term programme to enhance the emergency response capabilities in conformance with international requirements and IAEA guidance for a Member State embarking on a nuclear power programme.
4. To highlight the strong and weak aspects of the arrangements and to prioritize the aspects requiring improvement, recognizing limited resources.

#### **SCOPE:**

The review will examine emergency arrangements and capabilities at local and national levels in the following areas:

- (a) Emergency management;
- (b) Emergency preparedness;
- (c) Legal basis and regulations for EPR;
- (d) Protection of emergency workers;
- (e) Medical response;
- (f) Public information;
- (g) Infrastructure for EPR;
- (h) Emergency training and exercising.



## **EPREV MISSION TEAM:**

Ms. BACIU Adriana, Romania  
Mr. KUTKOV Vladimir, IAEA (Coordinator)  
Mr. PETOFI Gabor, Hungary  
Mr. STERN Warren, USA

## **HOST:**

Jordan Nuclear Regulatory Commission,  
Jordan Atomic Energy Commission.

## **COUNTERPARTS:**

- (1) Jordan Nuclear Regulatory Commission (JNRC);
- (2) Jordan Atomic Energy Commission (JAEC);
- (3) National Centre for Security and Crisis Management (NCSCM);
- (4) Jordan Armed Forces (JAF);
- (5) Ministry of Interior (MoI);
- (6) Ministry of Foreign Affairs (MoFA);
- (7) Ministry of Health (MoH);
- (8) Ministry of Environment (MoE);
- (9) General Intelligence Directorate (GID);
- (10) Civil Defence Directorate (GCDD);
- (11) Public Security Department (PSD);
- (12) Jordan Gendarmerie;
- (13) Jordan Customs;
- (14) Jordan University of Science and Technology (JUST);
- (15) King Hussein Cancer Centre (KHCC).

## **CONDUCT OF MISSION**

The review mission will cover all aspects of arrangements for EPR and include on-site (facility), off-site (local) and national EPR arrangements for all radiation emergencies that may affect the territory of Jordan. During the mission, the current status of national EPR arrangements will be assessed, including the status of hazard assessment and development of the NREP. Detailed recommendations on the actions to be performed in order to have EPR arrangements consistent with international requirements and IAEA guidance for a Member State embarking on a nuclear power programme will be provided in the mission's report (see chapter "Output").

The mission team will be composed of four members, selected based on the condition and needs of Jordan. They will review status of national capabilities and arrangements against IAEA guidance to Member States being at phase 2 of embarking on a Nuclear Power Programme.

The review will consist of:

- Reviewing and verifying the statements (Performance Indicators) made by the Jordanian counterpart by filling out the self-assessment questionnaires;
- Determining if the legislation and arrangements for preparedness and response for radiation emergencies within Jordan were in conformance with the international requirements of GS-R-2 [A1] and IAEA guidance [A2 - A6];

- Identifying good practices, methods and means of meeting the international requirements in the short term, as well as in the longer term.

## **OUTPUT**

A formal report to Jordan will provide for each of the ‘functional’ and ‘infrastructure’ requirements in GS-R-2 (Ref. [A1]):

- (a) A general description of the existing situation;
- (b) Recommendations and/or suggestions for actions that should be performed in the short term in order to enhance the capabilities of Jordan to respond to radiation emergencies. Specific recommendations and/or suggestions will be provided in the content of the report for actions to be performed in order to develop an adequate NREP consistent with international practices and IAEA guidance. Recommendations will be based on IAEA standards and guidance in Refs [A2 - A6]. Suggestions would be based on good international practice;
- (c) Recommendations and/or suggestions for interim actions that should be taken to improve the ability to respond in a medium term;
- (d) Recommendations and/or suggestions for long term actions that should be taken to meet international requirements (Ref. [A1]) and IAEA guidance for Member States in phase 2 of embarking on a nuclear power programme (Ref. [A6]);
- (e) Identification of good practices;
- (f) Identification of areas in which target specific assistance would be required in, e.g., carrying hazard assessment, revision of specific parts of the NREP, etc.

## **LOGISTICS**

For the duration of the mission, Jordan will provide or arrange for the following:

- All internal transportation;
- An English speaking counterpart for each visit;
- A workroom during the mission for team members’ discussions and preparation of technical notes;
- Access to international telephone lines, e-mail, a PC, projector, printer and copier, and Internet;
- Assistance in making hotel arrangements.

The IAEA will assume costs of travel and accommodations for the experts participating in the mission.

## **BRIEFING**

The Jordanian counterpart will provide an initial overview briefing of the current situation (to include responsibilities, regulations, criteria, etc.), for response to a nuclear or radiological emergency, including national plans for response to any emergency.

## **INTERVIEW/FACILITY ACCESS**

Jordan will make arrangements and provide a schedule for the expert team to interview officials of the following authorities and/or have access to the following areas/facilities.

*To review capabilities and arrangement at national and local levels:*

- Government bodies (ministries, commissions, agencies, centres) that would provide national response are the following:

- National decision making (crisis management and coordinated response);
- National emergency notification and Contact Points;
- Disaster management and relief;
- Law enforcement/criminal investigation;
- Military response;
- Medical treatment of exposed/contaminated people;
- Control of contaminated goods and products;
- Public information;
- Taking agricultural countermeasures;
- Requesting international assistance;
- Training of local first responders;
- Mitigating non-radiological consequences
- Operating the Radiological Monitoring and Assessment Centre;
- Protecting emergency workers/first responders;
- Assessing the situation.

***To review capabilities and arrangement at facility level:***

- Operators of radiation and nuclear facilities in hazard category III.

**SELF-ASSESSMENT QUESTIONNAIRE**

As part of the methodology, a Self-Assessment Questionnaire (check list) will be filled out, addressing the main issues and requirements of GS-R-2 [A1] and IAEA guidance in EPR-EMBARKING [A6]. When completing the check list, the Jordanian Counterpart should make references to national legislative documents (laws, rules, norms). These references have to be set in a comments column. The completed check list is to be sent to the EPREV team coordinator at latest two months before the mission.

**BASIC DOCUMENTS**

The Member State will make available to the mission:

- An inventory of radiation sources and activities with an evaluation of their hazard category against GS-R-2 [A1];
- A list of persons met, and organizations visited translated to English;
- Laws or decrees and international instruments adhered to by the country relative to:
  - Emergency preparedness and response,
  - Radiation safety/nuclear energy, as applicable to emergency preparedness and response.

The documents have to be provided in Word file or pdf format in the national language, with English translation (unofficial tentative translation of the document is valid).

The IAEA can provide the country with relevant safety standards and guidance, referred to as [A1 – A6] (also available on the IAEA homepage [www.iaea.org](http://www.iaea.org)).

**Briefing Pack for the EPREV Team**

Document	Responsibility
List and description of individual organizations taking part in the EPR specifying their responsibilities and capabilities to perform critical tasks (p. 26, EPR-Method, Ref [A4])	Host

List of legislation in the area of EPR together with the available English translation	Host
Non-legal policy documents covering response to emergencies including or relevant to nuclear or radiological emergencies	Host
Past emergency reports	Host
EPR Country Profile	IAEA

The documents available in English are to be sent to the IAEA coordinator one month before the mission. Especially, this concerns those documents referred to in the answers to the Self-Assessment Questionnaire.

#### **REPORT CONFIDENTIALITY:**

The report's initial distribution is restricted to the authorities concerned, the contributors to the report and responsible IAEA staff. In the interest of openness, however, countries are encouraged to make their report public. Therefore, the final report of the EPREV mission will be derestricted after 90 days, unless the host country specifically requests that the report remains restricted.

Any technical notes or other information that identify vulnerabilities will be treated as confidential information according to the Agency confidentiality regime.

#### **REFERENCES**

- A1. Preparedness and Response for a Nuclear or Radiological Emergency, Safety Requirements No. GS-R-2, IAEA, Vienna (2002).
- A2. Arrangements for Preparedness for a Nuclear or Radiological Emergency, Safety Standard Series No. GS-G-2.1, IAEA, Vienna (2007).
- A3. Criteria for Use in Preparedness and Response for a Nuclear or Radiological Emergency, Safety Standard Series No. GSG-2, IAEA, Vienna (2011).
- A4. INTERNATIONAL ATOMIC ENERGY AGENCY, Method for Developing Arrangements for Response to a Nuclear or Radiological Emergency, EPR-METHOD, IAEA, Vienna (2003).
- A5. Manual for First Responders to a Radiological Emergency, Emergency Preparedness and Response Series EPR-FIRST RESPONDERS, IAEA, Vienna (2006).
- A6. Considerations in Emergency Preparedness and Response for a State Embarking on a Nuclear Power Programme, EPR-EMBARKING 2012, IAEA, Vienna (2012).

## **Appendix II. Mission team composition**

Adriana Baciú	Romania;
Vladimir Kutkov	Team Leader, IAEA;
Gábor Petofi	Hungary;
Warren Stern	USA.

**Appendix III. List of participants at the IAEA EPREV mission briefings**

No.	Name	Institution	E-mail	7 May	8 May	9 May	12 May	13 May	14 May	15 May	16 May
1	H.E. Mohamed Ali Daher	MoFA, Secretary General									
2	Ms. Saja Majali	MoFA, Director of International Relations and Organizations Dept.									
3	Mr. Hamzen M. Ali-Omari	MoFA, Assistant to Director of International Relations and Organizations Dept.									
4	Dr. Majd Hawarri	JNRC, Chairman									
5	Mr. Tamer Kasht	JNRC, Director of International Cooperation	Tamer.Kasht@jnrc.gov.jo								
6	Mr. Ahmed Al-Salman	JNRC, Nuclear Safety and Security Directorate	a.salman@jnrc.gov.jo								
7	Mr. Bashar Al-Ja'afreh	JNRC, Nuclear Safety and Security Directorate	Bashar.j@jnrc.gov.jo								
8	Prof. Kamal J. Araj	JAEC, Vice Chairman	karaj@jaec.gov.jo								
9	Ms. Dala Amawi	JAEC, Director of International Cooperation	dala.amawi@jaec.gov.jo								
10	Mr. Eyad Qutishat	JAEC, Director of Nuclear Safety Directorate	Eyad.Qutishat@jaec.gov.jo								

No.	Name	Institution	E-mail	7 May	8 May	9 May	12 May	13 May	14 May	15 May	16 May
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12	Eng. Shiran Al-Shaqran	JAEC, Emergency Preparedness and Environmental Monitoring Dept.	Shiran.alshaqran@jaec.gov.jo								
13	Mr. Mohammad Al-Otoom	JAEC, Irradiation Facility									
14	Eng. Zaid Al-Isis	JAEC, JRTR, Operations									
15	Ms. Shafa Aljbour	JAEC, JRTR, Health Physics Dept.									
16	Mr. Khaleel Awad	JAEC, Radwaste Storage Facility									
17	Mr. Abdalla Ababneh	JAF, Nuclear Cell									
18	Col. Eng. Hussein Faouri	JAF, Nuclear Cell									
19	Col. Eng. Mazen Kh. Rahahlen	JAF, Chemical Support Unit	Mazen77101@yahoo.com								
20	Brig. General Omar Al-Khalidi	JAF, Chief of Staff of Strategic Planning	khaldi@jaf.mil.jo								
21	Mr. Majed Al-Sharkawi	Jordan Custom									
22	Mr. Moutasem Mahdi Abu-Shattal	Jordan Gendarmerie									
23	Col. Hani Al-Mahamid	GCDD/MoI									

No.	Name	Institution	E-mail	7 May	8 May	9 May	12 May	13 May	14 May	15 May	16 May
24	Mr. Suleiman Al-Neimat	General Intelligence Directorate									
25	Eng. Ahmed S. Nassereddin	MoEnv									
26	Eng. Samah Badri Mohammed Abdel Al-Rohan	MoEnv									
27	Ms. Indira Al-Dahabi	MoEnv									
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31	Mr. Wasfi Al-Adwan	HCCD/MoI									
32	Mr. Mohammed Moani	Special Branch/Public Security Department (Police), MoI									
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36	Dr. Mahmoud Tohary	JUST, Nuclear Engineering Dept.									



No.	Name	Institution	E-mail	7 May	8 May	9 May	12 May	13 May	14 May	15 May	16 May
37	Eng. Hakam Falah Saleh Al-Shorman	JUST, Nuclear Engineering Dept.									
38	Dr. Salaheddin Malkawi	JUST, Nuclear Engineering Dept., Chairman	salahm@just.edu.jo; salah_malkawi@hotmail.com								
39	Eng. Amjad Shakatreh	JUST, Nuclear Engineering Dept., Safety Manager of JUST									
40	Prof. Omar Al-Jarrah	JUST, Vice President	aljarrah@just.edu.jo								
41	Dr. Akram Ibrahim	KHCC, Nuclear Medicine Department, Head									
42	Dr. Abdaalla Al-Poshdan	KHCC, Radiation Oncology Department, Head									
43	Dr. Shada Wadi-Ramahi	KHCC, Radiation Oncology Department, Medical Physicist									
44	Mr. Inad Hadadin	KHCC, Radiation Protection Officer									
45	Mr. Al-Sharif Nasser Bin Nasser	Middle East Scientific Institute for Security, Managing Director	shnasser@miesis.jo								

## **Appendix IV. Table of contents of example national radiation emergency plan for a State without nuclear facilities in hazard categories I and II**

This Appendix provides a table of contents of the plan for protection of the population in the case of a radiation emergency in the Former Yugoslav Republic of Macedonia [49], which could be used as an example of the NREP.

### **1. GOALS, RESPONSIBLE INSTITUTIONS, LEGISLATION AND REGULATIONS, AND OTHER RELEVANT DOCUMENTS**

#### 1.1 Goals

#### 1.2 Responsible institutions, organizations and other bodies

#### 1.3 Legislation and regulations, and other relevant documents

### **2. BASIS OF PLANNING**

#### 2.1 Assessment of hazards

##### 2.1.1 Sources of ionizing radiation in the Republic of Macedonia

##### 2.1.2 Possible emergency scenarios

##### 2.1.3 Categories of radiation hazards

###### 2.1.3.1 Category 3 of radiation hazards in the Republic of Macedonia

###### 2.1.3.2 Category 4 of radiation hazards in the Republic of Macedonia

###### 2.1.3.3 Category 5 of radiation hazards in the Republic of Macedonia

##### 2.1.4 Possible consequences from the assessed radiation hazards

###### 2.1.4.1 Possible consequences from Category 3 of radiation hazards

###### 2.1.4.2 Possible consequences from Category 4 of radiation hazards

###### 2.1.4.3 Possible consequences from Category 5 of radiation hazards

#### 2.2 Roles and responsibilities of the user of sources of ionizing radiation and separate institutions

##### 2.2.1 General responsibilities

###### 2.2.1.1 User of sources of ionizing radiation

###### 2.2.1.2 Directorate of Radiation Safety

###### 2.2.1.3 Crisis Management Centre

###### 2.2.1.4 Directorate of Protection and Rescue

###### 2.2.1.5 Ministry of Health

###### 2.2.1.6 Ministry of Interior

###### 2.2.1.7 Ministry of Defence

###### 2.2.1.8 Ministry of Finance - Customs Administration of the Republic of Macedonia

###### 2.2.1.9 Ministry of Agriculture, Forestry and Water Management and the Hydrometeorological Department

- 2.2.1.10 Ministry of Environment and Physical Planning
- 2.2.1.11 Ministry of Foreign Affairs
- 2.2.1.12 Ministry of Economy
- 2.2.1.13 Ministry of Transport and Communications
- 2.2.1.14 Food and Veterinary Agency
- 2.2.1.15 Institute of Public Health of Republic of Macedonia
- 2.2.1.16 National Coordination Centre for Border Protection
- 2.2.1.17 Fire Protection Units in the Territory of the Republic of Macedonia
- 2.2.1.18 Commission on Radiation Safety

#### 2.2.2 Specific responsibilities

- 2.2.2.1 User of sources of ionizing radiation
- 2.2.2.2 Directorate of Radiation Safety
- 2.2.2.3 Crisis Management Center
- 2.2.2.4 Directorate of Protection and Rescue
- 2.2.2.5 Ministry of Health
- 2.2.2.6 Ministry of Interior
- 2.2.2.7 Ministry of Defence
- 2.2.2.8 Ministry of Finance - Customs Administration of the Republic of Macedonia
- 2.2.2.9 Ministry of Agriculture, Forestry and Water Management and the Hydrometeorological Department
- 2.2.2.10 Ministry of Environment and Physical Planning
- 2.2.2.11 Ministry of Foreign Affairs
- 2.2.2.12 Ministry of Economy
- 2.2.2.13 Ministry of Transport and Communications
- 2.2.2.14 Food and Veterinary Agency
- 2.2.2.15 Institute of Public Health of Republic of Macedonia
- 2.2.2.16 National Coordination Centre for Border Protection
- 2.2.2.17 Fire Protection Units in the Territory of the Republic of Macedonia
- 2.2.2.18 Commission on Radiation Safety

#### 2.3 Available emergency facilities

#### 2.4 Method and means for communication in case radiation emergency

#### 2.5 Maintenance of logistics / resources

#### 2.6 Concept of operations

- 2.6.1 Concept of operations for Category 3 of radiation hazards
- 2.6.2 Concept of operations for Category 4 of radiation hazards
  - 2.6.2.1 Source related emergencies
    - 2.6.2.1.1 Lost or stolen dangerous source
    - 2.6.2.1.2 Emergency with mobile dangerous source
    - 2.6.2.1.3 Radioactive contamination in a facility in Category 4 of radiation hazards
  - 2.6.2.2 Mass radioactive contamination
  - 2.6.2.3 Radiation emergencies with contaminated products
  - 2.6.2.4 Radiation emergency during transport
  - 2.6.2.5 Serious overexposure
  - 2.6.2.6 Terroristic threats or criminal activities
- 2.6.3 Concept of operations for Category 5 of radiation hazards

### 3. RESPONSE TO RADIATION EMERGENCY

- 3.1 Notifying, activating and requesting for help
- 3.2 Managing a radiation emergency
  - 3.2.1. Managing radiation emergency at Category 3 of radiation hazards
  - 3.2.2. Managing radiation emergency at Category 4 of radiation hazards
    - 3.2.2.1 Source related emergencies
      - 3.2.2.1.1 Lost or stolen dangerous source
    - 3.2.2.2 Mass radioactive contamination
    - 3.2.2.3 Radiation emergency with contaminated products
    - 3.2.2.4 Radiation emergency during transport
    - 3.2.2.5 Serious overexposure
    - 3.2.2.6 Terroristic threats or criminal activities
  - 3.2.3. Managing radiation emergency at Category 5 of radiation hazards
- 3.3 Mitigation of radiation emergency
- 3.4 Taking urgent protective actions
- 3.5 Warning and giving instructions to the general public
- 3.6 Protection of persons acting in case of radiation emergency
- 3.7 Providing medical assistance
- 3.8 Assessing initial phase
- 3.9 Informing the public (media relations) and mitigating nonradiological consequences
- 3.10 Agricultural countermeasures, ingestion protection and long term countermeasures

3.11 Conducted operations to restore normal conditions (recovery operations)

3.12 Record keeping and data/information management

#### 4. PREPAREDNESS FOR RADIATION EMERGENCY

4.1 Coordination and planning

4.2 Training

4.3 Exercises

4.4 Quality assurance

#### ANNEXES

Annex I. Scheme of emergency organization

Annex II. NPPs in 1000 km radius from border of the Republic of Macedonia

Annex III. Review on categories of radiation hazards presented

Annex IV. Radii of cordoned areas

Annex V. Emergency facilities available/foreseen. Available methods for communication per institutions. Available resources per institutions.

Annex VI. Operational Intervention Levels

Annex VII. Urgent protective actions in response to emergency in facility in treat category 3.

Annex VIII. Reference levels for emergency workers

Annex IX. Early Warning System

## **Appendix V. The curriculum of the Nuclear Reactor Safety course in JUST**

Jordan University of Science & Technology  
Faculty of Engineering  
Department of Nuclear Engineering

Course Title: Nuclear Reactor Safety (NE521)

Credit Hours: 3

Prerequisite: Nuclear Power Plants Systems and Operations I (NE 451)  
Nuclear Reactors Theory (NE 340)

Lecturer: Dr. Salaheddin R. Malkawi

### Catalogue Data:

Nuclear reactor safety and probabilistic risk assessment. Analysis and evaluation applied to reactor design for accident prevention and mitigation; protective systems and their reliability, containment design; emergency cooling requirements; reactivity excursions and the atmospheric dispersion of radioactive material.

### Course Contents

Chapter 1: Introduction

Chapter 2: Inventory and localization of radioactive products in the plant

Chapter 3: Safety systems and their functions

Chapter 4: The classification of accidents and a discussion of some examples

Chapter 5: Severe accidents

Chapter 6: The dispersion of radioactivity releases

Chapter 7: Health consequences of releases

Chapter 8: The general approach to the safety of the plant-site complex

Chapter 9: Defence in depth

Chapter 10: Quality assurance

Chapter 11: Safety analysis

Chapter 12: Safety analysis review

Chapter 13: Classification of plant components

Chapter 14: Notes on some plant components

Chapter 15: Earthquake resistance

Chapter 16: Tornado resistance

Chapter 17: Resistance to external impact

Chapter 18: Nuclear safety criteria

Chapter 19: Nuclear safety research

Chapter 20: Operating experience

Chapter 21: Underground location of nuclear power plants

Chapter 22: The effects of nuclear explosions

Chapter 23: Radioactive waste

Chapter 24: Fusion safety

Chapter 25: Safety of specific plants and of other activities

Chapter 26: Nuclear facilities on satellites

Chapter 27: Erroneous beliefs about nuclear safety

Chapter 28: When can we say that a particular plant is safe?

Chapter 29: The limits of nuclear safety: the residual risk

## DEFINITIONS

**arrangements (for emergency response):** The integrated set of infrastructure elements necessary to provide the capability for performing a specified function or task required in response to a nuclear or radiological emergency. These elements may include authorities and responsibilities, organization, coordination, personnel, plans, procedures, facilities, equipment, or training. [50]

**dangerous source:** A source that could, if not under control, give rise to an exposure sufficient to cause severe deterministic health effects. This categorization is used for determining the need for emergency response arrangements and is not to be confused with categorizations of sources for other purposes. [50]

**deterministic effect:** A health effect of radiation for which generally a threshold level of dose exists, above which the severity of the effect is greater for a higher dose. Such an effect is described as a ‘severe deterministic effect’ if it is fatal or life threatening, or results in a permanent injury that reduces quality of life. [50]

**emergency:** A non-routine situation or event that necessitates prompt action, primarily to mitigate a hazard or adverse consequences for human health and safety, quality of life, property or the environment. This includes nuclear or radiological emergencies and conventional emergencies such as fires, release of hazardous chemicals, storms, or earthquakes. It includes situations for which prompt action is warranted to mitigate the effects of a perceived hazard. [50]

**emergency action level:** A specific, predetermined, observable criterion used to detect, recognize and determine the emergency class. [50]

**emergency class:** A set of conditions that warrant a similar immediate emergency response. The term used for communicating to the response organizations and the public the level of response needed. The events that belong to a given emergency class are defined by criteria specific to the installation, source or practice which, if exceeded, indicate classification at the prescribed level. For each emergency class, the initial actions of the response organizations are predefined. [50]

**emergency classification:** The process whereby an authorized official classifies an emergency in order to declare the applicable level of emergency class. Upon declaration of the emergency class, the response organizations initiate the predefined response actions for that emergency class. [50]

**emergency plan:** A description of the objectives, policy, and concept of operations for the response to an emergency and the structure, authorities and responsibilities for a systematic, coordinated, and effective response. The emergency plan serves as the basis for the development of other plans, procedures, and checklists. [50]

**(emergency) preparedness:** The capability to take action that will effectively mitigate the consequences of an emergency for human health, safety, quality of life, property, and the environment. [50]

**emergency procedures:** A set of instructions describing in detail actions to be taken by response personnel in an emergency. [50]

**(emergency) response:** The performance of actions to mitigate the consequences of an emergency on human health and safety, quality of life, property, and the environment. It may also provide a basis for the resumption of normal social and economic activity. [50]

**emergency services:** The local off-site response organizations that are generally available and that perform emergency response functions. These may include police, fire and rescue brigades, ambulance services, and control teams for hazardous materials. [50]

**emergency worker:** A worker who may be exposed in excess of occupational dose limits while performing actions to mitigate the consequences of an emergency for human health and safety, quality of life, property, and the environment. [50]

**emergency zones:** The precautionary action zone and/or the urgent protective action planning zone. [50]

**exposure:** The act or condition of being subject to irradiation. Exposure can be either external exposure (irradiation by sources outside the body) or internal exposure (due to a source within the body). [50]

**first responders:** The first members of an emergency service to respond at the scene of an emergency. [50]

**generic intervention level:** The level of avertable dose at which a specific protective action is taken in an emergency or situation of chronic exposure. [50]

**generic action level:** The concentration (Bq/g) of specific isotopes in food or water at which consumption should be restricted if replacement food or water is available. [50]

**hazard assessment:** See *threat assessment*.

**initial phase:** The period of time from the detection of conditions warranting the implementation of response actions that must be taken promptly in order to be effective until those actions have been completed. These actions included taking mitigatory actions by the operator and urgent protective actions on and off the site. [50]

**intervention:** Any action intended to reduce or avert exposure or the likelihood of exposure to sources which are not part of a controlled practice or which are out of control as a consequence of an accident. [50]

**intervention level:** The level of avertable dose at which a specific protective action is taken in an emergency or situation of chronic exposure. [50]

**longer term protective action:** A protective action which is not an urgent protective action. Such protective actions are likely to be prolonged over weeks, months, or years. These include measures such as relocation, agricultural countermeasures, and remedial actions. [50]

**national co-ordinating authority:** A governmental body or organization whose function, among others, is to co-ordinate the assessment of the threats within the State and to co-ordinate the resolution of differences and incompatible arrangements between the various response organizations. This authority should ensure that the functions and responsibilities of operators and response organizations as specified in these requirements are clearly assigned and are understood by all response organizations, and that arrangements are in place for achieving and enforcing compliance with the requirements. (From Ref. [3] para. 3.4.)

**non-radiological consequences:** Effects on humans or the environment that are not deterministic or stochastic effects. These include effects on health or the quality of life resulting from psychological, social, or economic consequences of the emergency or the response to the emergency. [50]

**notification:**



1. A report submitted to a national or international authority providing details of an emergency or potential emergency, for example as required by the Convention on Early Notification Convention of a Nuclear Accident; or
2. A set of actions taken upon detection of emergency conditions, with the purpose of alerting all organizations with responsibility for taking emergency response actions in the event of such conditions. [50]

**notification point:** A designated organization with which arrangements have been made to receive notification (meaning 2 in this glossary) and to initiate promptly the predetermined actions to activate a part of the emergency response. [50]

**nuclear or radiological emergency:** An emergency in which there is, or is perceived to be a hazard due to:

- The energy resulting from a nuclear chain reaction or from the decay of the products of a chain reaction; or
- Radiation exposure. [50]

**off-site:** Outside the site area.

**on-site:** Within the site area.

**operational intervention level (OIL):** A calculated level, measured by instruments or determined by laboratory analysis, that corresponds to an intervention level or action level. OILs are typically expressed in terms of dose rates or activity of radioactive material released, time-integrated air concentrations, ground or surface concentrations, or activity concentrations of radionuclides in environmental, food, or water samples. An OIL is a type of action level that is used immediately and directly (without further assessment) to determine the appropriate protective actions on the basis of an environmental measurement. [50]

**operator (or operating organization):** Any organization or person applying for authorization or authorized and/or responsible for nuclear, radiation, radioactive waste, or transport safety when undertaking activities or in relation to any nuclear facilities or sources of ionizing radiation. This includes private individuals, governmental bodies, consignors or carriers, licensees, hospitals, and self-employed persons. This also includes those who are either directly in control of a facility or an activity during use (such as radiographers or carriers) or, in the case of a source not under control (such as a lost or illicitly removed source or a re-entering satellite), those who were responsible for the source before control over it was lost. [50]

**practice:** Any human activity that introduces additional sources of exposure or exposure pathways or extends exposure to additional people, or modifies the network of exposure pathways from existing sources, so as to increase the exposure or the likelihood of exposure of people or the number of people exposed. [50]

**precautionary action zone:** An area around a facility for which arrangements have been made to take urgent protective actions in the event of a nuclear or radiological emergency to reduce the risk of server deterministic health effects off the site. Protective actions within this area are to be taken before or shortly after a release of radioactive material or exposure on the basis of the prevailing conditions at the facility (EALs). [50]

**protective action:** An intervention intended to avoid or reduce doses to members of the public in emergencies or situations of chronic exposure. [50]

**radiation emergency:** A nuclear or radiological emergency. [50]

**radiological emergency:** An emergency involving an actual or perceived risk from activities that could give rise to a nuclear or radiological emergency at an unforeseeable location. These include non-authorized activities, such as activities relating to dangerous sources obtained illicitly. They also include transport and authorized activities involving dangerous mobile sources such as industrial radiography sources, radio thermal generators, or nuclear powered satellites. [50]

**radiological dispersal device:** A device constructed by terrorists to spread radioactive materials using conventional explosives or other means. [50]

**regulatory body:** An authority or a system of authorities designated by the government of a State as having legal authority for conducting the regulatory process, including issuing authorizations, and thereby regulating nuclear, radiation, radioactive waste and transport safety. [50]

**response organization:** An organization designated or otherwise recognized by a State as being responsible for managing or implementing any aspect of a response. [50]

**significant transboundary release:** A release of radioactive material to the environment that may result in doses or levels of contamination beyond national borders from the release which exceed international intervention levels or action levels for protective actions, including food restrictions and restrictions on commerce. [50]

**site area:** A geographical area that contains an authorized facility, activity or source, within which the management of the authorized facility or activity may directly initiate emergency actions. This is typically the area within the security perimeter fence or other designated property marker. It may also be the controlled area around a radiography source or a cordoned off area established by first responders around a suspected hazard. [50]

**source:** Anything that may cause radiation exposure (such as by emitting ionizing radiation or by releasing radioactive substances or materials) and can be treated as a single entity for protection and safety purposes. For example, materials emitting radon are sources in the environment, a sterilization gamma irradiation unit is a source for the practice of radiation preservation of food, an X-ray unit may be a source for the practice of radio diagnosis. A nuclear power plant is part of the practice of generating electricity by nuclear fission, and may be regarded as a source (e.g., with respect to discharges to the environment) or as a collection of sources (e.g., for occupational radiation protection purposes). A complex or multiple installations situated at one location or site may, as appropriate, be considered a single source for the purposes of application of international safety standards. [50]

**stochastic effect (of radiation):** A radiation induced health effect, the probability of occurrence of which is greater for a higher radiation dose and the severity of which (if it occurs) is independent of dose. Stochastic effects may be somatic effects or hereditary effects, and generally occur without a threshold level of dose. Examples include thyroid cancer and leukaemia. [50]

**threat assessment:** The process of analysing systematically the hazards associated with facilities, activities, or sources within or beyond the borders of a State in order to identify:

1. Those events and the associated areas for which protective actions and emergency countermeasures may be required within the State; and
2. The actions that would be effective in mitigating the consequences of such events. [50]

**transnational emergency:** A nuclear or radiological emergency of actual, potential or perceived radiological significance for more than one State. This includes:

1. A significant transboundary release of radioactive material. (However, a transnational emergency dose not necessarily imply a significant transboundary release of radioactive material.);
2. A general emergency at a facility or other event that could result in a significant transboundary release (atmospheric or aquatic) of radioactive material;
3. A discovery of the loss or illicit removal of a dangerous source that has been transported across or is suspected of having been transported across a national border;
4. An emergency resulting in significant disruption to international trade or travel;
5. An emergency warranting the taking of protective actions for foreign nationals or embassies in the State in which it occurs;
6. An emergency resulting in or potentially resulting in severe deterministic health effects and involving a fault and/or problem (such as in equipment or software) that could have implications for safety internationally;
7. An emergency resulting in or potentially resulting in great concern among the population of more than one State owing to the actual or perceived radiological hazard. [50]

**urgent protective action:** A protective action that, in the event of an emergency, must be taken promptly (normally within hours) in order to be effective, and the effectiveness of which will be markedly reduced if it is delayed. The most commonly considered urgent protective actions in a nuclear or radiological emergency are evacuation, decontamination of individuals, sheltering, respiratory protection, iodine prophylaxis, and restriction of the consumption of potentially contaminated foodstuff. [50]

**urgent protective action planning zone:** An area around a facility for which arrangements have been made to take urgent protective actions in the event of a nuclear or radiological emergency to avert doses off the site in accordance with international standards. Protective actions within this area are to be taken on the basis of environmental monitoring or, as appropriate, prevailing conditions at the facility. [50]

## ACRONYMS

BDBA	Beyond Design Basis Accident
CBRN	Chemical Biological Radiological and Nuclear
DBA	Design Basis Accident
DNERP	Draft National Emergency Response Plan [36]
DRNEPP	Draft Regulation on Nuclear Emergency Preparedness and Planning [28]
EAL	Emergency Action Level
EPR	Emergency Preparedness and Response
EPREV	Emergency Preparedness and Response Review
GCDD	General Civil Defence Directorate of the MoI
GID	General Intelligence Directorate of the MoI
HAZMAT	Hazardous Materials and Items
HCCD	Higher Council of Civil Defence
IAEA	International Atomic Energy Agency
JAEC	Jordan Atomic Energy Commission
JAF	Jordan Armed Forces
JNRC	Jordan Nuclear Regulatory Commission
JNSC	Jordan Nuclear Security Commission
JRTR	Jordan Research and Training Reactor of JAEC
JSA	Jordan Subcritical Assembly of JUST
JUST	Jordan University of Science and Technology
KAERI	Korean Atomic Energy Research Institute
KDC	Consortium of Korean Atomic Energy Research Institute and Daewoo
KHCC	King Hussein Cancer Centre
Law 18/1999	Law on Civil Defence [31]
Law 43/2007	Law on Radiation Protection and Nuclear Safety and Security [24]
MoEnv	Ministry of Environment
MoFA	Ministry of Foreign Affairs
MoH	Ministry of Health
MoI	Ministry of Interior
NCA	National Coordinating Authority
NCSCM	National Centre for Security and Crisis Management
NECRA	National Emergency Centre for Nuclear Accidents
NPP	Nuclear Power Plant
NREP	National Radiation Emergency Plan
OIL	Operational Intervention Level
PAZ	Precautionary Action Zone
PSD	Public Security Department of MoI
Regulation 33/2003	Regulation of Cabinet of Ministers No. 33 of 2003 [26]
SAT	Systematic Approach to Training
TSO	Technical Support Organization
UPZ	Urgent Protective Action Planning Zone

## REFERENCES

- 1 INTERNATIONAL ATOMIC ENERGY AGENCY, Convention on Early Notification of a Nuclear Accident and Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, Legal Series No. 14, IAEA, Vienna (1987).
- 2 FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL LABOUR ORGANISATION, OECD NUCLEAR ENERGY AGENCY, PAN AMERICAN HEALTH ORGANIZATION, UNITED NATIONS OFFICE FOR THE COORDINATION OF HUMANITARIAN AFFAIRS, WORLD HEALTH ORGANIZATION, Preparedness and Response for a Nuclear or Radiological Emergency, Safety Standards Series No. GS-R-2, IAEA, Vienna (2002).
- 3 FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL LABOUR OFFICE, PAN AMERICAN HEALTH ORGANIZATION, UNITED NATIONS OFFICE FOR THE CO-ORDINATION OF HUMANITARIAN AFFAIRS, WORLD HEALTH ORGANIZATION, Arrangements for Preparedness for a Nuclear or Radiological Emergency, Safety Standards Series No. GS-G-2.1 IAEA, Vienna. (2007).
- 4 FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL LABOUR OFFICE, OECD NUCLEAR ENERGY AGENCY, PAN AMERICAN HEALTH ORGANIZATION, UNITED NATIONS OFFICE FOR THE CO-ORDINATION OF HUMANITARIAN AFFAIRS, WORLD HEALTH ORGANIZATION, Criteria for Use in Preparedness and Response for a Nuclear or Radiological Emergency, Safety Standards Series No. GSG-2, IAEA, Vienna (2011).
- 5 INTERNATIONAL ATOMIC ENERGY AGENCY, Method for Developing Arrangements for Response to a Nuclear or Radiological Emergency. Emergency Preparedness and Response Series EPR-METHOD, IAEA (2003).
- 6 INTERNATIONAL ATOMIC ENERGY AGENCY, Considerations in Emergency Preparedness and Response for a State Embarking on a Nuclear Power Programme, Emergency Preparedness and Response Series EPR-EMBARKING, IAEA, Vienna, (2012)
- 7 INTERNATIONAL ATOMIC ENERGY AGENCY, Emergency Preparedness Review (EPREV) Guidelines, Emergency Preparedness and Response Series EPR-EPREV, IAEA, Vienna (2011).
- 8 INTERNATIONAL ATOMIC ENERGY AGENCY, Governmental and Regulatory Framework of Safety, IAEA Safety Standards Series No. GSR Part 1, IAEA, Vienna (2010).
- 9 INTERNATIONAL ATOMIC ENERGY AGENCY, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards. Interim edition, General Safety Requirements Part 3, Safety Standard Series No. GSR Part 3 (Interim), IAEA, Vienna (2011).
- 10 INTERNATIONAL ATOMIC ENERGY AGENCY, Establishing the Safety Infrastructure for a Nuclear Power Programme, IAEA Safety Standards Series No. SSG-16, IAEA, Vienna (2011).

- 11 COMITE TECHNIQUE INTERNATIONALE DE PRÉVENTION ET D'EXTINCTION DU FEU, INTERNATIONAL ATOMIC ENERGY AGENCY, PAN AMERICAN HEALTH ORGANIZATION, WORLD HEALTH ORGANIZATION, Manual for First Responders to a Radiological Emergency, Emergency Preparedness and Response Series EPR-FIRST RESPONDERS 2006, IAEA, Vienna (2006).
- 12 INTERNATIONAL ATOMIC ENERGY AGENCY, Generic Procedures for Response to a Nuclear or Radiological Emergency at Research Reactors, Emergency Preparedness and Response Series EPR-RESEARCH REACTOR, IAEA, Vienna (2011).
- 13 INTERNATIONAL ATOMIC ENERGY AGENCY, WORLD HEALTH ORGANIZATION, Generic procedures for medical response during a nuclear or radiological emergency, Emergency Preparedness and Response Series EPR-MEDICAL, IAEA, Vienna (2005).
- 14 INTERNATIONAL ATOMIC ENERGY AGENCY, Dangerous Quantities of Radioactive Material, Emergency Preparedness and Response Series EPR-D-VALUES, IAEA, Vienna (2006).
- 15 INTERNATIONAL ATOMIC ENERGY AGENCY, Actions to Protect the Public in an Emergency due to Severe Conditions at a Light Water Reactor, Emergency Preparedness and Response Series EPR-NPP PUBLIC PROTECTIVE ACTIONS, IAEA, Vienna (2013).
- 16 INTERNATIONAL ATOMIC ENERGY AGENCY, Preparation, Conduct and Evaluation of Exercises to Test Preparedness for a Nuclear or Radiological Emergency, Emergency Preparedness and Response Series EPR-EXERCISE, IAEA, Vienna (2005).
- 17 INTERNATIONAL ATOMIC ENERGY AGENCY, Communication with the Public in a Nuclear or Radiological Emergency, Emergency Preparedness and Response Series EPR-PUBLIC COMMUNICATIONS, IAEA, Vienna (2012).
- 18 GOVERNMENT OF THE HASHEMITE KINGDOM OF JORDAN, INTERNATIONAL ATOMIC ENERGY AGENCY. Country Programme Framework 2012-2016. IAEA Department of Technical Cooperation, IAEA, Vienna (2009).
- 19 EUROPEAN ATOMIC ENERGY COMMUNITY, FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL LABOUR ORGANIZATION, INTERNATIONAL MARITIME ORGANIZATION, OECD NUCLEAR ENERGY AGENCY, PAN AMERICAN HEALTH ORGANIZATION, UNITED NATIONS ENVIRONMENT PROGRAMME, WORLD HEALTH ORGANIZATION, Fundamental Safety Principles, IAEA Safety Standards Series No. SF-1, IAEA, Vienna (2006).
- 20 INTERNATIONAL ATOMIC ENERGY AGENCY, Code of Conduct on the Safety and Security of Radioactive Sources, IAEA/CODEOC/2004, IAEA, Vienna (2004).
- 21 INTERNATIONAL ATOMIC ENERGY AGENCY, Safety of Nuclear Power Plants: Operation, IAEA Safety Standards Series No. NS-R-2, IAEA, Vienna (2000).
- 22 INTERNATIONAL ATOMIC ENERGY AGENCY, Organization and Staffing of the Regulatory Body for Nuclear Facilities, IAEA Safety Standards Series No. GS-G-1.1, IAEA, Vienna (2002).

- 23 INTERNATIONAL ATOMIC ENERGY AGENCY, Operations Manual for Incident and Emergency Communications, Emergency Preparedness and Response Series EPR-IEComm, Attachment 1, IAEA, Vienna, (2012)
- 24 HASHEMITE KINGDOM OF JORDAN, Law on Radiation Protection and Nuclear Safety, and Security. Law No. 43 of 2007.
- 25 Ahmed Al-Salman, JNRC. Presentation on Jordan Nuclear Regulatory Commission (2013-05-07).
- 26 HASHEMITE KINGDOM OF JORDAN, Regulation of CM on Basis and Conditions for Granting Licenses and Permits for the Radiation Facilities and Practices. Regulation No. 33 of 2003.
- 27 HASHEMITE KINGDOM OF JORDAN, Regulation on the Safety of Research Reactors, JNRC, Draft of 2012-09-17.
- 28 HASHEMITE KINGDOM OF JORDAN, Regulation on Nuclear Emergency Preparedness and Planning, JNRC, Draft of 2012-09-17.
- 29 HASHEMITE KINGDOM OF JORDAN, Regulation on Conditions and Procedures for Establishing Special Statutory Areas around Nuclear Facilities. Draft of 2012-09-17, JNRC (2012).
- 30 HASHEMITE KINGDOM OF JORDAN, Regulation on Packaging and Transport of Radioactive Substances, JNRC, Draft of 2012-09-17.
- 31 HASHEMITE KINGDOM OF JORDAN, Law on Civil Defence. Law No. 18 of 1999.
- 32 Hani Al-Mahamid, GDCD. Presentation on the General Directorate of Civil Defence (2013-05-13).
- 33 Brig. General Omar Al-Khaldi, Presentation on Roles and Responsibilities of the Jordan Nuclear Security Commission (2013-05-09).
- 34 Reda Btoush, NCSCM. Presentation on Vision, Goals, Roles and Responsibilities of the National Centre for Security and Crisis Management (2013-05-09).
- 35 HASHEMITE KINGDOM OF JORDAN, Law on Atomic Energy. Law No. 42 of 2007.
- 36 HASHEMITE KINGDOM OF JORDAN, National Emergency Response Plan to Nuclear or Radiation Accidents, JAEC, NEP/001, Draft of 2013.
- 37 Shiran Al-Shaqran, JAEC. Presentation on Emergency Plan of Jordan Research and Training Reactor JRTR (2013-05-08).
- 38 Shiran Al-Shaqran, JAEC. Presentation on Emergency Cases and Alerts for Jordan Research and Training Reactor, JRTR (2013-05-08).
- 39 Shiran Al-Shaqran, JAEC. Presentation on Emergency Evacuation Diagram of JRTR - Training Centre (2013-05-08).
- 40 INTERNATIONAL ATOMIC ENERGY AGENCY, Categorization of Radioactive Sources, IAEA Safety Standards Series No. RS-G-1.9, IAEA, Vienna (2005).
- 41 INTERNATIONAL ATOMIC ENERGY AGENCY, Site Evaluation for Nuclear Installations, IAEA Safety Standards Series No. NS-R-3, IAEA, Vienna (2003).
- 42 Abed Al-Baset Rababa, JAEC. Presentation on Content of National Emergency Plan (2013-05-07).

- 43 INTERNATIONAL ATOMIC ENERGY AGENCY, Generic Assessment Procedures for Determining Protective Actions during a Reactor Accident, IAEA-TECDOC-955, IAEA, Vienna (1997).
- 44 INTERNATIONAL ATOMIC ENERGY AGENCY, Development and review of plant specific emergency operating procedures, Safety Reports Series No. 48, IAEA, Vienna (2006).
- 45 HASHEMITE KINGDOM OF JORDAN, Current Status of Agricultural Land within a 10 km radius of Jordan Research and Training Reactor. Draft of 2013-05-07, JAEC (2013).
- 46 Salaheddin Malkawi, JUST. Presentation on Jordan University of Science and Technology's Efforts in Support of Jordan's Nuclear Energy Program (2013-05-12).
- 47 INTERNATIONAL ATOMIC ENERGY AGENCY, PAN AMERICAN HEALTH ORGANIZATION, WORLD HEALTH ORGANIZATION, Cytogenetic Dosimetry: Applications in Preparedness for and Response to Radiation Emergencies, Emergency Preparedness and Response Series EPR-BIODOSIMETRY, IAEA, Vienna (2011).
- 48 INTERNATIONAL ATOMIC ENERGY AGENCY, Organization and Staffing of the Regulatory Body for Nuclear Facilities, IAEA Safety Standards Series No. GS-G-1.1, IAEA, Vienna (2002).
- 49 FORMER YUGOSLAV REPUBLIC OF MACEDONIA, Plan for protection of population in the case of radiation emergency in republic of Macedonia. Sluzeben vestnik No. 84 (2011).
- 50 INTERNATIONAL ATOMIC ENERGY AGENCY, IAEA Safety Glossary. Terminology Used in Nuclear Safety and Radiation Protection (2007 Edition), IAEA, Vienna (2007).