MISSION REPORT

ON

THE INTEGRATED NUCLEAR INFRASTRUCTURE REVIEW (INIR) – PHASE 3

Counterpart:

Ministry of Foreign Affairs and International Cooperation and Federal Authority for Nuclear Regulation

24 June – 1 July 2018

Abu Dhabi, United Arab Emirates

DISCLAIMER

It should be noted that the findings of an INIR mission should not be taken in any way as an endorsement or confirmation of the adequacy or otherwise of the Member State's nuclear power infrastructure, nor as certification [by the IAEA] of the quality and completeness of the work done by the country concerned.

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EXECUTIVE SUMMARY

The UAE established its nuclear policy in 2008 and initiated a major programme of work to implement its policy. It has developed a legal and regulatory framework and established and staffed the required organizations, in particular an independent regulatory body and an operating organization. The UAE has utilized international expertise and has also implemented a significant programme to ensure that national staff develops competences for the nuclear power programme.

A Pre-INIR mission was conducted in April 2018 and the final self-evaluation report (SER) was submitted to the International Atomic Energy Agency (IAEA) on 25 May 2018.

The INIR mission team was led by Mr Milko Kovachev, Section Head of the Nuclear Infrastructure Development Section, and consisted of staff from the IAEA Departments of Nuclear Energy, Nuclear Safety and Security and the Office of Legal Affairs as well as international experts recruited by the IAEA.

The INIR mission and associated activities were funded through a combination of a cost-sharing contribution from the Government of the United Arab Emirates and an extrabudgetary contribution through a Peaceful Uses Initiative (PUI) Project entitled *Strengthening Nuclear Power Infrastructure Development in Member States*.

The INIR mission was conducted from 24 June to 1 July 2018. The meetings were held in Abu Dhabi. The main interviews were conducted over five days. The UAE counterparts were well prepared for the mission and managed its participation in the review effectively. During the interviews, the UAE counterparts provided an update on the status of issues where progress had been made since the SER was finalized, and provided additional supporting documentation requested by the INIR team.

The INIR team concluded that the UAE is close to completing the required nuclear power infrastructure for starting the operation of its first nuclear power plant (NPP). It has established competent organizations and the legal and regulatory framework, and has plans for achieving operational readiness.

In order to assist the UAE in completing and maintaining its infrastructure development, the INIR team made 9 recommendations and 8 suggestions. The INIR team also identified 7 good practices that may benefit other countries implementing a nuclear power programme.

Based on the recommendations and suggestions, the key areas for further action are summarized below:

- **The Emirates Nuclear Energy Corporation (ENEC)/Nawah Energy Company (Nawah) needs to finalize all necessary arrangements required to reach Operational Readiness before the fuel load of the first Unit**

ENEC and Nawah have undertaken considerable work to develop the capabilities and arrangements to ensure safe, secure and reliable operation of Barakah NPP. Nawah needs to finalize all necessary operating procedures and complete the necessary training and certification of all key personnel. Before operations begin, adequate arrangements for maintenance need to be in place. Achievement of operational readiness will require the fully aligned and focused

attention of senior management from both ENEC and Nawah. While achieving this, ENEC needs to ensure that it retains the necessary capability to maintain its oversight role on the remaining construction activities for Units 2, 3 and 4.

- **The UAE needs to approve and implement all the appropriate arrangements for radioactive waste management**

In December 2016 the UAE prepared its draft Policy on the Long-term Management and Disposal of Spent Nuclear Fuel and Radioactive Waste which reinforced its 2008 commitment to manage its radioactive waste and spent nuclear fuel in a responsible manner, and in accordance with its international obligations.

The UAE needs to approve its draft 2016 Policy to enshrine its commitment to responsible radioactive waste and spent fuel management. This, together with approval of the Cabinet Resolution to establish the Decommissioning Trust Fund, would allow the finalization of regulations, the creation of the relevant bodies, and the development of strategies and plans to implement the policy.

- **The UAE needs to continue to implement the arrangements required to ensure the long-term sustainability of the nuclear power programme**

The UAE has developed its nuclear infrastructure, including a legal and regulatory framework. It has established and staffed the required organizations, in particular an independent regulatory body and an operating organization. Reaching this point for such a major programme is a significant achievement for the country. The UAE recognizes that the nuclear power programme entails a long-term commitment lasting at least one hundred years. It is important that the UAE strengthens arrangements and processes to ensure the long-term sustainability of the programme. Areas to be considered include: the proactive coordination of future programme developments at a national level; the continuing review and revision of the legal and regulatory framework as necessary; and the establishment of a research and development programme to enhance national capabilities.

1. INTRODUCTION

On 13 March 2018 the International Atomic Energy Agency (IAEA) received a letter from the Permanent Representative of the United Arab Emirates (UAE) to the IAEA and international organizations in Vienna, requesting the IAEA to carry out a Phase 3 Integrated Nuclear Infrastructure Review (INIR) mission in the UAE. On 6 April 2018, the IAEA agreed to conduct the INIR Phase 3 mission, and requested that a self-evaluation report (SER) be prepared using the document entitled *Evaluation of the Status of National Nuclear Infrastructure Development at Milestone 3*. A meeting was organized in Vienna from 21 to 23 March 2018 to include the IAEA contribution to the SER based on the existing information from review mission reports and national reports from the UAE to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management and on the Convention on Nuclear Safety. A Pre-INIR mission was conducted in April 2018 and the final SER was submitted to the IAEA on 25 May 2018. The INIR Phase 3 mission was conducted from 24 June to 1 July 2018 in Abu Dhabi, UAE based on the agreed terms of reference.

Mr Christer Viktorsson, Director General of the Federal Authority for Nuclear Regulation (FANR), and Mr Dohee Hahn, Director of the IAEA Division of Nuclear Power in the Department of Nuclear Energy, delivered opening remarks for the INIR mission. The UAE presented an update on the status of the nuclear power programme.

The INIR mission team was led by Mr Milko Kovachev, Section Head of the Nuclear Infrastructure Development Section, and consisted of staff from the IAEA Departments of Nuclear Energy, Nuclear Safety and Security and the Office of Legal Affairs as well as international experts recruited by the IAEA.

The INIR mission and associated activities were funded through a combination of a cost-sharing contribution from the Government of the United Arab Emirates and an extrabudgetary contribution through a Peaceful Uses Initiative (PUI) Project entitled “Strengthening Nuclear Power Infrastructure Development in Member States”.

The UAE conducted reviews of specific areas of its nuclear power programme through IAEA review and advisory services. These included the Site and External Events Design (SEED), Integrated Regulatory Review Service (IRRS), IRRS Follow-up, Emergency Preparedness Review (EPREV), International Physical Protection Advisory Service (IPPAS), International State System of Accountancy and Control Advisory Service (ISSAS) and Pre-Operation Safety Review Team (OSART). Those services provided recommendations and suggestions to the UAE for further improvement on the respective areas of review. The UAE may consider follow-up missions to verify the status of implementation of those recommendations and suggestions.

2. OBJECTIVES OF THE MISSION

The main objectives of the INIR mission were to:

— Evaluate the development status of the national infrastructure to support the nuclear power programme according to the IAEA Nuclear Energy Series publication entitled *Milestones in the Development of a National Infrastructure for Nuclear Power (*NG-G-3.1 (Rev.1)) and

the evaluation methodology described in the IAEA Nuclear Energy Series publication *Evaluation of the Status of National Nuclear Infrastructure Development at Milestone 3*;

— Identify areas needing further actions to reach Milestone 3; and

— Provide recommendations and suggestions which can be used by the Government of the UAE and national institutions to prepare an action plan.

3. SCOPE OF THE MISSION

The INIR mission evaluated the status of the infrastructure in the UAE covering all of the 19 infrastructure issues relative to the conditions identified in the above publication for Phase 3.

4. WORK DONE

Prior to the mission, the INIR team reviewed the SER and supporting documents. The INIR team sought input from IAEA staff members with relevant expertise working with the UAE. INIR team meetings were conducted prior to the mission in Vienna on 21 to 22 June 2018 and in Abu Dhabi on 23 June 2018.

The INIR mission was conducted from 24 June to 01 July 2018. The meetings were held in Abu Dhabi. The main interviews were conducted over five days. The UAE counterparts were well prepared for the mission and managed its participation in the review effectively. During the interviews, the UAE counterparts provided an update on the status of issues where progress had been made since the SER was finalized, and provided additional supporting documentation requested by the INIR team.

The preliminary draft report was prepared by the INIR team and discussed with the counterparts. The main mission results were presented to representatives of the Government in an exit meeting on 01 July 2018. The preliminary draft report was delivered to the counterparts during the exit meeting.

The results of the mission are summarized in Section 5 and presented in tabular form in Section 6 for each of the 19 infrastructure issues in Phase 3. Appendix 1 provides the evaluation results for each issue.

5. MAIN CONCLUSIONS

The INIR mission was conducted in a cooperative manner. The mission was coordinated on the UAE side by FANR with participation from other organizations involved in the nuclear power programme and corresponding infrastructure development. The full list of participants is in Appendix 2.

The INIR phase 3 mission reviewed the status of the infrastructure in the UAE against the conditions defined in the IAEA document entitled *Evaluation of the Status of National Nuclear Infrastructure Development at Milestone 3*.

The INIR team concluded that the UAE is close to completing the required nuclear power infrastructure for starting the operation of its first nuclear power plant (NPP). It has established competent organizations and the legal and regulatory framework, and has plans for achieving operational readiness.

In order to assist the UAE in completing and maintaining its infrastructure development, the INIR team made 9 recommendations and 8 suggestions. The INIR team also identified 7 good practices that may benefit other countries implementing a nuclear power programme.

Based on the recommendations and suggestions, the key areas for further action are summarized below:

- **The Emirates Nuclear Energy Corporation (ENEC)/Nawah Energy Company (Nawah) needs to finalize all necessary arrangements required to reach Operational Readiness before the fuel load of the first Unit**

ENEC and Nawah have undertaken considerable work to develop the capabilities and arrangements to ensure safe, secure and reliable operation of Barakah NPP. Nawah needs to finalize all necessary operating procedures and complete the necessary training and certification of all key personnel. Before operations begin, adequate arrangements for maintenance need to be in place. Achievement of operational readiness will require the fully aligned and focused attention of senior management from both ENEC and Nawah. While achieving this, ENEC needs to ensure that it retains the necessary capability to maintain its oversight role on the remaining construction activities for Units 2, 3 and 4.

- **The UAE needs to approve and implement all the appropriate arrangements for radioactive waste management.**

In December 2016 the UAE prepared its draft Policy on the Long-term Management and Disposal of Spent Nuclear Fuel and Radioactive Waste which reinforced its 2008 commitment to manage its radioactive waste and spent nuclear fuel in a responsible manner, and in accordance with its international obligations.

The UAE needs to approve its draft 2016 Policy to enshrine its commitment to responsible radioactive waste and spent fuel management. This, together with approval of the Cabinet Resolution to establish the Decommissioning Trust Fund, would allow the finalization of regulations, the creation of the relevant bodies, and the development of strategies and plans to implement the policy.

- **The UAE needs to continue to implement the arrangements required to ensure the long-term sustainability of the nuclear power programme.**

The UAE has developed its nuclear infrastructure, including a legal and regulatory framework. It has established and staffed the required organizations, in particular an independent regulatory body and an operating organization. Reaching this point for such a major programme is a significant achievement for the country. The UAE recognizes that the nuclear power programme entails a long-term commitment lasting at least one hundred years. It is important

that the UAE strengthens arrangements and processes to ensure the long-term sustainability of the programme. Areas to be considered include: the proactive coordination of future programme developments at a national level; the continuing review and revision of the legal and regulatory framework as necessary; and the establishment of a research and development programme to enhance national capabilities.

Recommendations

R-1.1.1 ENEC as Nuclear Energy Programme Implementing Organization (NEPIO) should take a more proactive coordination role in setting relevant strategies needed for the long-term sustainability of the programme.

R-2.1.1 ENEC and Nawah should ensure that leadership and decision making by senior management supports the achievement of the operational readiness.

R-3.1.1 Nawah should complete the contractual arrangements to establish adequate long-term arrangements for the maintenance of the NPP.

R-3.2.1 Nawah should complete the certification of operating personnel as required by national regulations.

R-3.3.1 Nawah should ensure all operating procedures are finalized and staff trained in their use before fuel loading.

R-4.2.1 The UAE should approve the draft Cabinet Resolution to establish the Decommissioning Trust Fund and implement the necessary arrangements.

R-5.1.1 The UAE should amend its legislation to fully reflect the provisions of the Amendment to the Convention on Physical Protection of Nuclear Material (CPPNM). The UAE should also inform the depositary on its laws and regulations to give effect to the CPPNM and its Amendment as required by Article 14 of these instruments.

R-10.3.1 The UAE should develop a national programme on research and development (R&D) to support the ongoing nuclear power programme and implement it.

R-17.2.1 The UAE should approve the Policy on the Long-term Management and Disposal of Spent Nuclear Fuel and Radioactive Waste and develop a strategy for its implementation.

Suggestions

S-2.2.1 Nawah's management is encouraged to critically assess the effectiveness of the programmes to enhance safety culture.

S-5.1.1 FANR is encouraged to consider regular updates of the Federal Law by Decree No. 6 and other relevant legislation governing the nuclear power programme to take into account the lessons learned.

S-7.1.1 FANR is encouraged to include unannounced inspections in its inspection programme.

S-7.3.1 FANR is encouraged to continue the work to finalize regulations and guides required for the operational phase.

S-7.3.2 FANR is encouraged to strengthen its process for the periodic review and revision of its regulations and guides.

S-8.1.1 Nawah is encouraged to consider calibrating all radiation measuring instrumentation within the UAE.

S-15.1.1 ENEC and Nawah are encouraged to ensure that the Physical Protection System (PPS) is completed, tested and approved and the testing and maintenance procedures are in place.

S-15.4.1 ENEC and Nawah are encouraged to complete the Physical Protection Plan (PPP), including the contingency plan, for approval.

Good Practices

Good practices identified by other IAEA review and advisory services are not repeated in this report.

GP-2.1.1 The request by the regulatory body for an "Operational Readiness Report" prior to the issuance of the operating license, and the conduct by Nawah of an extensive self-assessment.

GP-2.4.1 The establishment of a strong engineering team within Nawah which will evolve to become the plant Design Authority, supported by design transfer arrangements and participation on Korea Electric Power Corporation's (KEPCO's) Design Interface Control Board.

GP-3.3.1 The establishment of visible and suitably accessible management systems within FANR, ENEC and Nawah which integrates all relevant areas aimed at achieving effective management, implementation and assessment of core processes.

GP-6.1.1: Implementation of a number of mechanisms to detect unauthorized activities involving nuclear material and other items subject to regulatory control for an effective implementation of safeguards provisions.

GP-8.1.1 Development of an accredited dosimetry service for both internal and external dose assessment.

GP-15.4.1 FANR technical reviews address the safety and security interfaces in the physical protection system, and the contingency and emergency plans.

GP-19.1.1 The development of a number of measures to prevent counterfeit, fraudulent and suspect items, including training, management, reinforcement, access to 'Operating Experience Feedback' network.

6. EVALUATION RESULTS FOR PHASE 3

For the purposes of the INIR mission results, the following definitions are used:

Significant* actions needed:

The review observations indicate that important work still needs to be initiated or completed to meet the condition.

Minor* actions needed:

The review observations indicate that some additional work or steps are needed to meet the condition or that plans for the next phase need to be enhanced.

No actions needed:

The available evidence indicates that all the work to meet the condition has been completed.

*The judgment whether the actions are significant or minor is based on the importance of the work to the overall programme and/or the resources needed to complete it. The classification is done through a consensus of the INIR team, and is not based solely upon the judgment of any individual team member.

Recommendations:

Recommendations are proposed when the expectations of the condition have not been met. A recommendation should:

— Emphasize 'what' needs to be done, not 'how';
— Be based on the IAEA Milestones Approach/Evaluation Methodology;
— Be succinct, self-explanatory and achievable;
— Be supported by the Review Observation text—a 'gap' must be identified; already planned work can still be a recommendation if it is required to reach the milestone.

Suggestions:

Suggestions propose the consideration of new or different approaches to develop infrastructure and enhance performance, or to point out better alternatives to current work. A suggestion:

— Should be clear and self-explanatory;
— Should be supported by the Review Observation text;
— May relate to work already under consideration for the next phase.

Good practices:

A good practice is identified in recognition of an outstanding practice or arrangement, superior to those generally observed elsewhere. It is more than fulfilment of the conditions or expectation, and worthy of the attention of other countries involved in the development of nuclear infrastructure as a model in the drive for excellence.

It should be noted that the results summarized in the following tables neither validate the country actions and programmes, nor certify the quality and completeness of the work done by a country.

1. National position	**Phase 3**		
Condition	**Actions Needed**		
	SIGNIFICANT	**MINOR**	**NO**
1.1. Government role assigned and effective		**x**	
1.2. National strategy successfully implemented			**x**
1.3. Long term support through international cooperation evident			**x**
2. Nuclear safety	**Phase 3**		
Condition	**Actions Needed**		
	SIGNIFICANT	**MINOR**	**NO**
2.1. Basis of safety understood		**x**	
2.2. Leadership and safety culture evident		**x**	
2.3. Action plan in place to address any outstanding licensing issues			**x**
2.4. Operating organisation design integrity process defined and effective			**x**
3. Management	**Phase 3**		
Condition	**Actions Needed**		
	SIGNIFICANT	**MINOR**	**NO**
3.1. Ongoing arrangements for support clear		**x**	
3.2. Structure and staffing of the operating organisation adequate for commissioning and operation		**x**	
3.3. Management system for operation developed	**x**		
3.4. Mechanisms for verification of construction and for handover of systems, structures and components from main supplier in place			**x**

4. Funding and financing	**Phase 3**		
Condition	**Actions Needed**		
	SIGNIFICANT	**MINOR**	**NO**
4.1. Adequate income to sustain operation obtained			**x**
4.2. Funding mechanisms in place for waste management, long term spent fuel management and decommissioning		**x**	
4.3. Civil liability for nuclear damage in place			**x**
5. Legal framework	**Phase 3**		
Condition	**Actions Needed**		
	SIGNIFICANT	**MINOR**	**NO**
5.1. Legal framework implemented and being reviewed as necessary		**x**	
6. Safeguards	**Phase 3**		
Condition	**Actions Needed**		
	SIGNIFICANT	**MINOR**	**NO**
6.1. An SSAC that is operational for the nuclear power programme			**x**
7. Regulatory framework	**Phase 3**		
Condition	**Actions Needed**		
	SIGNIFICANT	**MINOR**	**NO**
7.1. Competent and Independent regulatory body operating effectively		**x**	
7.2. Management system in place			**x**
7.3. Regulations, in place		**x**	
7.4. Arrangements in place for co-operation with regulatory bodies in other countries			**x**

8. Radiation protection	**Phase 3**		
Condition	**Actions Needed**		
	SIGNIFICANT	**MINOR**	**NO**
8.1. Equipment for dose monitoring and control in place		**x**	
8.2. Programmes to optimize doses from operation and maintenance in place			**x**
9. Electrical grid	**Phase 3**		
Condition	**Actions Needed**		
	SIGNIFICANT	**MINOR**	**NO**
9.1. Interface between operating organization and grid company effective			**x**
9.2 Plans for grid enhancement executed			**x**
9.3 Grid reliability demonstrated			**x**
10. Human resource development	**Phase 3**		
Condition	**Actions Needed**		
	SIGNIFICANT	**MINOR**	**NO**
10.1. Ongoing human resource development programme in the operating organisation effective			**x**
10.2. Ongoing human resource development programme in the regulatory body effective			**x**
10.3 National educational programmes and research and development to support capacity building implemented	**x**		
11. Stakeholder involvement	**Phase 3**		
Condition	**Actions Needed**		
	SIGNIFICANT	**MINOR**	**NO**
11.1. Transparent and open communications continue			**x**

12. Site and supporting facilities	**Phase 3**		
Condition	**Actions Needed**		
	SIGNIFICANT	**MINOR**	**NO**
12.1. Confirm/update site characterisation parameters and continue site monitoring			**x**
13. Environmental protection	**Phase 3**		
Condition	**Actions Needed**		
	SIGNIFICANT	**MINOR**	**NO**
13.1. Environmental limits and conditions defined			**x**
13.2. Environmental monitoring programmes in place			**x**
14. Emergency planning	**Phase 3**		
Condition	**Actions Needed**		
	SIGNIFICANT	**MINOR**	**NO**
14.1. Owner/operator emergency arrangements in place and tested			**x**
14.2. Government and Regulatory body arrangements in place and tested			**x**
14.3. Arrangements for regular training, drills and exercises in place			**x**
15. Nuclear security	**Phase 3**		
Condition	**Actions Needed**		
	SIGNIFICANT	**MINOR**	**NO**
15.1. Physical protection system demonstrated and approved		**x**	
15.2. Contingency plan approved		**x**	
15.3. Leadership and security culture evident (See also 2.2)			**x**
15.4. Preparation and approval of the security plan		**x**	

16. Nuclear fuel cycle	**Phase 3**		
Condition	**Actions Needed**		
	SIGNIFICANT	**MINOR**	**NO**
16.1. Arrangements for fuel supply in place			**x**
16.2. Spent fuel management arrangements in place			**x**
17. Radioactive waste management	**Phase 3**		
Condition	**Actions Needed**		
	SIGNIFICANT	**MINOR**	**NO**
17.1. Plans for decommissioning available			**x**
17.2. Arrangements for low and intermediate level waste in place	**x**		
17.3. Work to develop HLW disposal arrangements ongoing			**x**
18. Industrial involvement	**Phase 3**		
Condition	**Actions Needed**		
	SIGNIFICANT	**MINOR**	**NO**
18.1. Support for Industrial development established			**x**
19. Procurement	**Phase 3**		
Condition	**Actions Needed**		
	SIGNIFICANT	**MINOR**	**NO**
19.1. Procurement capability for operations available			**x**

APPENDIX 1: REVIEW OBSERVATIONS, RECOMMENDATIONS AND SUGGESTIONS FOR PHASE 3

1. National Position **Condition 1.1: Government role assigned and effective**	**Phase 3**
Summary of the condition to be demonstrated	Government entities have been assigned the on-going government responsibilities for the sustainability of the nuclear power infrastructure. There is an agreed mechanism for communication and co-operation among the key organizations.
Examples of how the condition may be demonstrated	1. Entities with clearly defined roles and responsibilities; 2. A close out report from the NEPIO showing how any on-going requirements will be met.

Observations

The Federal Ministry of Energy and Industry has defined an energy strategy until 2050 with interim strategic objectives for 2020. The strategy was approved by the Supreme Council. The Ministry has responsibilities in defining policies and coordinating the ongoing energy programme of the country.

The Department of Energy of Abu Dhabi (former Regulation and Supervision Bureau) is the energy regulator and is responsible for issuing electricity generation, distribution and supply licenses, required by Law No. 2, 1998 Concerning the Regulation of the Water and Electricity Sector in the Emirate of Abu Dhabi.

Federal Law by Decree No. 6 of 2009 concerning the Peaceful Uses of Nuclear Energy (Law No. 6) defines the responsibilities of the operator and functions and responsibilities of the regulatory body (FANR).

Law No. 21 Establishing Emirates Nuclear Energy Corporation (ENEC) (Art. 4) identifies the responsibilities of ENEC as a state-owned establishment. ENEC is responsible to develop, build, finance, operate, maintain, manage and possess nuclear reactors to be used for peaceful purposes for energy generation, water desalination, subject to Law No. 6. The Board of Directors is the highest authority in the Corporation and its members are appointed by the Cabinet. The Board of Directors reports to the State Council (Executive Council of Abu Dhabi). The Board of Directors has the competence inter alia to "develop and follow up the implementation of strategies, plans and programs of the Corporation in the manner that achieves its objectives".

Consistent with the policy objectives for the UAE Peaceful Nuclear Energy Program, ENEC retains the NEPIO function. It is important for the sustainability of the programme in the long-term that ENEC reinforces a mechanism of coordination involving all relevant stakeholders. Areas noted by the INIR team that will need a national coordination effort include a national R&D programme, future developments on the fuel cycle and waste

management strategies, sustainable involvement of local industries in the nuclear energy programme and fostering regional initiatives.

The long-term operation of the Barakah NPP Units will be undertaken by a joint venture (JV) between ENEC and KEPCO through the legal entities Barakah One Company PJSC and Nawah Energy Company PJSC (Nawah). Barakah One and Nawah, are owned (through intermediate holding companies) by ENEC (82%) and KEPCO (18%).

FANR ensures that ENEC and Nawah discharge their responsibilities for safety through the implementation of a comprehensive regulatory framework under the Law No. 6. The law assigns responsibilities to FANR to implement the following functions (i) standard-setting through regulations; (ii) authorization through licensing; (iii) inspection and monitoring of compliance; and (iv) enforcement.

The INIR team was informed that the National Emergency, Crisis and Disasters Management Authority (NCEMA) under Law No. 2 of 2011, is the national competent authority for developing national emergency response plans, coordinating response, and conducting exercises. NCEMA reports to the Supreme Council of National Security. FANR and NCEMA completed a Memorandum of Understanding (MOU) on 15 July 2012 relating to cooperation in the field of nuclear and radiological emergency preparedness and response (EPR). FANR will provide support in case of radiological or nuclear emergencies.

The Law No. 2 of 2011 is being reviewed to reflect the expanded role of NCEMA in defining the risk assessment, setting regulations, organizing exercises and undertaking evaluation.

The Critical Infrastructure and Coastal Protection Authority (CICPA) is responsible to protect all critical infrastructures in the UAE, including Barakah NPP. CICPA is providing to Nawah an armed Response Force for responding to nuclear security events, including the Design Basis Threat (DBT).

Areas for further action	**Significant**	
	Minor	Reinforcement of NEPIO's role

RECOMMENDATIONS

R-1.1.1 ENEC as Nuclear Energy Programme Implementing Organization (NEPIO) should take a more proactive coordination role in setting relevant strategies needed for the long-term sustainability of the programme.

SUGGESTIONS

GOOD PRACTICES

1. National Position	**Phase 3**

Condition 1.2: National strategy successfully implemented		
Summary of the condition to be demonstrated	The nuclear power programme has successfully met the national expectations for the introduction of nuclear power.	
Examples of how the condition may be demonstrated	A review of the implementation of the project against the national expectations covering for example: HR development, industrial involvement, financing, waste management.	

Observations

The Policy of the UAE on the Evaluation and Potential Development of Peaceful Nuclear Energy (hereinafter referred to as the Nuclear Policy) was adopted by the UAE Cabinet of Ministers in April 2008. The Nuclear Policy outlines the role of nuclear energy in the UAE's energy programme and establishes the priorities and expectations of the government in the nuclear power project.

Actions remain in certain areas as identified in other sections of this report, like the approval of the Radioactive Waste Management Policy by the Cabinet, and the establishment of the Decommissioning Trust Fund. It is noted that draft regulations (FANR-REG-22) are also developed and should be approved after the adoption of the policy.

The INIR team was informed that the nuclear power programme has successfully met the national expectations for the introduction of nuclear power.

Areas for further action	**Significant**	
	Minor	

RECOMMENDATIONS

SUGGESTIONS

GOOD PRACTICES

1. National Position **Condition 1.3: Long term support through international cooperation evident**	**Phase 3**
Summary of the condition to be demonstrated	Effective mechanisms are in place for provision of required support and exchange of information with other countries operating nuclear power and international organisations.

Examples of how the condition may be demonstrated	1. Participation in nuclear safety, security and non-proliferation regimes; 2. Participation in IAEA activities aimed at information sharing; 3. Intergovernmental agreements for provision of support from experienced countries; 4. Interagency agreements; 5. Participation in WANO activities.

Observations

The INIR team was informed that, in carrying out its activities to meet the objectives of the UAE policy for a peaceful nuclear energy programme, the UAE participates in international frameworks for safety, security and non-proliferation and is party to conventions and agreements planned in Phase 2 of the programme implementation. To ensure support and cooperation with experienced nuclear countries, FANR has also entered into several bilateral cooperation agreements, inter alia, with other regulatory bodies.

ENEC is a member of both the World Association of Nuclear Operators (WANO) (Atlanta Centre) and the Institute of Nuclear Power Operations (INPO). ENEC is a category 1 member of WANO and its subsidiary Nawah is a category 2 member.

In accordance with the Nuclear Policy, the UAE cooperates with the Gulf Cooperation Council (GCC) members to share experiences and information. In the emergency preparedness and response area, the GCC has established a disaster centre for a centralized response for emergency situations.

FANR has plans to propose cooperation with Saudi Arabia with regards to their nuclear power programme.

The INIR team was informed that over 90 % of the agreements are active and effective. The activities are reported on a quarterly basis to the FANR management.

Areas for further action	**Significant**	
	Minor	

RECOMMENDATIONS

SUGGESTIONS

GOOD PRACTICES

2. Nuclear Safety Condition 2.1: Basis of safety understood	Phase 3
Summary of the condition to be demonstrated	Safety analysis reports have been reviewed by the operating organization and approved by the regulatory body. Operational Limits and Conditions and other documents and programmes have been prepared by the operating organization and approved by the Regulatory Body.
Examples of how the condition may be demonstrated	1. A summary of the work undertaken by the operating organization to achieve the construction and operating license for the NPP; 2. A summary of the work undertaken to ensure the OL&C and other documents and programmes are understood by the technical and operating staff; 3. A summary of the work done by the regulatory body to review, assess and approve the above documents.

Observations

In December 2010, ENEC applied to FANR for a licence to construct the first two Units of the Barakah NPP. The application included a Preliminary Safety Analysis Report (PSAR). ENEC supplemented its initial application with an assessment of the lessons learned from the accident at Fukushima-Daiichi and identified a number of safety enhancements to be implemented.

FANR granted the construction licence in July 2012 after completing a thorough review and assessment of the application.

In March 2015, ENEC submitted an Operating License Application (OLA) to FANR on behalf of Nawah for the operation of Barakah Units 1 and 2. Nawah was established in 2016 and is in the process of developing the necessary capability to become the operating licensee.

ENEC oversees the prime contractor during the construction phase. Much of the initial Nawah organization was transferred from the Chief Nuclear Office (CNO) within ENEC. To ensure smooth transfer of information and responsibilities, transitional arrangements between ENEC and Nawah were put in place.

A recent review by Nawah of its operational readiness has identified a significant programme of work to be completed. The INIR team considers that completion of this work programme will require focused leadership by the ENEC and Nawah senior management to ensure appropriate and timely operational readiness of Barakah NPP.

The OLA for Units 1 and 2 includes the Final Safety Analysis Report (FSAR) and other supporting documents required by FANR for review and approval: Technical Specifications (Operating Limits and Conditions), Independent Safety Verification (ISV) and Independent Design Review (IDR), Nawah Quality Assurance Manual (NQAM), Safety Assessment Report for Barakah NPPs (Lessons Learned from the Fukushima-Daiichi Accident), Severe Accident Analysis Report (SAAR), Differences from Early Versions of Chapters 13 and 17 of FSAR and Commitments Associated with OLA.

The following documents were submitted to FANR separately: Physical Protection Plan (PPP) for Operations, On-Site and Off-Site Emergency Plans, Facility Safeguards Plan, Probabilistic Risk

Assessment (PRA) Summary Report, and the Initial Decommissioning Plan and Associated Funding Arrangement Plan.

The PSAR was developed based on the Shin-Kori 3 and 4 reference plant. For the PSAR, FANR made an assessment with significant involvement of external Technical Support Organizations (TSOs). FANR produced a number of Safety Evaluation Reports. The same process was followed for the FSAR review. This time FANR staff performed most of the reviews, although TSOs were involved in some specific topics. The review was divided into 10 work packages and currently there are 10 remaining open issues. FANR has a procedure for the development of Safety Evaluation Reports. This includes the integration of all inputs from FANR staff and TSOs and a four-step approval process involving the reviewer, the work package lead, the relevant manager and the relevant director.

The other application documents submitted by Nawah are also under review by FANR as part of the safety evaluation. FANR has requested additional information through Request for Additional Information (RAI) and is preparing comprehensive Safety Evaluation Reports based on their review and assessment.

FANR has also conducted a regulatory inspection programme to determine whether the facility is constructed in accordance with the established requirements and whether the operator is sufficiently ready to operate. FANR will summarize the results of these inspection programmes in two separate reports to determine (1) whether the facility is constructed in accordance with requirements, and (2) the readiness of operating arrangements and staff for operations.

The FANR programme of inspections has involved more than 130 inspections of construction and commissioning resulting in more than 430 inspection findings. The inspection of organizational operational readiness is still ongoing and will involve more than 70 inspections, covering control room crews, technical training of all disciplines, staffing arrangements and implementing procedures and programmes. FANR has a process to review corrective actions for all inspection findings prior to the issuance of an operating license.

The INIR team was informed that the inspection plan for the construction of Unit 1 is 95% complete. However, only 50% of organizational readiness inspections and assessments for operations are complete. There is a system in place for regular meetings between FANR, Nawah and ENEC to review progress on the closure of outstanding issues. Unresolved issues are escalated to higher management. The main issues which remain to be addressed are in operational readiness.

The scope of work for operational readiness for Nawah has been evaluated to determine the necessary tasks to ensure safe operations. FANR has fully defined the scope of safety assessments and inspections to complete the assessment of facility and organizational readiness before issuing the operating license for Unit 1.

As required by FANR, Nawah is preparing an Operational Readiness Report under the provisions of FANR-REG-14. The content of the report has been discussed and agreed and will consist of three elements: Safety Assessment, Constructed as Designed Assessment, and an Organizational Readiness Assessment.

The report will serve as a basis for supporting Nawah's readiness for the operating license and will be submitted to FANR to support their application.

The INIR Team was informed that FANR considers that there are two areas of the report which require further substantial work: Organisational Readiness and Constructed as Designed Assessment. Nawah considers that there are two specific areas on the critical path for achieving readiness: personnel training

and certification, and the finalization of operational and maintenance procedures and maintenance arrangements, including arrangements and procedures.

Recently Nawah performed an operational readiness review and announced an updated schedule to complete its preparation. Based on this critical assessment, a schedule was put in place for the start-up of Unit 1 at the end of 2019 / beginning of 2020. FANR has requested further inspections related to Unit 1 systems, structures and components preservation as a direct result of this announced delay.

Areas for further action	**Significant**	
	Minor	Operation readiness

RECOMMENDATIONS

R-2.1.1 ENEC and Nawah should ensure that leadership and decision making by senior management supports the achievement of the operational readiness.

SUGGESTIONS

GOOD PRACTICES

GP-2.1.1 The request by the regulatory body for an 'Operational Readiness Report' prior to the issuance of the operating license, and the conduct by Nawah of an extensive self-assessment.

2. Nuclear Safety **Condition 2.2: Leadership and safety culture evident (see also 15.3)**	**Phase 3**
Summary of the condition to be demonstrated	The senior management of all organizations provides effective leadership; a safety culture is evident throughout the owner/operator and its activities are verified and addressed by regulatory inspection.
Examples of how the condition may be demonstrated	1. Evidence of leadership behaviours to promote a safety culture; 2. Policies and actions with respect to error reporting, questioning attitude; 3. Review of regulatory inspections of processes and behaviours carried out; 4. Planned inspections for operating phase.

Observations

In the area of leadership, the Pre-OSART mission report states that Nawah has developed an extensive Leadership Development Programme which is well adapted to the multi-cultural, multi-national nature of the organization. The programme is a strategic initiative designed to harness the nuclear safety culture traits and leadership skills, and create robust organizational leadership capabilities.

The Pre-OSART mission identified issues that led to one recommendation and one suggestion, which, as the INIR team was informed, have been addressed.

Nawah uses various ways of driving improvement in safety performance and reinforcing safety and behaviour expectations. Examples of these initiatives were presented: Nuclear Safety Culture Management System (Process and Procedures), Awareness and Communication to include the NSC Fair and Traits and Actions initiatives, Measurement and Assessment such as NSC Steering Committee/Pulse survey's/ assessments and others, and Continuous Improvement.

Nawah has carried out a comprehensive safety culture assessment based on an internationally accepted safety culture framework, using tools such as surveys, interviews, focus-groups and observations. The assessment covered both the plant and corporate staff. The results have been reported back to management and reviewed in working groups. Findings were categorised into two levels: actions for department managers at the plant level with forward developing of Safety Culture enhancement plans. However, examples of the effectiveness of these measures were not provided during the discussions, because they were still being conducted at the moment while the INIR mission was taking place.

Nawah's Nuclear Safety Review Board (NSRB) and Committee of Nuclear Power (CNP) provides high level oversight on critical matters including safety, security and risk management, and helps to identify any barriers to excellence, with the core focus being on nuclear safety.

FANR is conducting a programme of inspections to verify the readiness of Nawah's organizational elements for operation of Barakah Unit 1. As part of this, the Nawah management system process that addresses safety culture has been inspected to verify that the procedures needed to implement it are ready.

Areas for further action	**Significant**	
	Minor	Safety Culture programme effectiveness

RECOMMENDATIONS

SUGGESTIONS

S-2.2.1 Nawah's management is encouraged to critically assess the effectiveness of the programmes to enhance safety culture.

GOOD PRACTICES

2. Nuclear Safety **Condition 2.3: Action plan in place to address any outstanding licensing issues**	**Phase 3**
Summary of the condition to be demonstrated	An action plan is in place and adequately resourced to address resolution of all outstanding issues identified by the regulatory body to be resolved before Milestone 3.

Examples of how the condition may be demonstrated	1. A list of issues with timescales for resolution agreed with the regulator with a corresponding action plan; 2. The process for managing and closing out actions.

Observations

FANR issues written inspection reports for each inspection which include any findings that require corrective action by the licensee. When ENEC/Nawah determines that sufficient actions have been taken to resolve the findings, they provide a package of information for FANR inspectors to review during a follow-up inspection.

FANR tracks the status of all findings for construction, commissioning and operational readiness of each Unit to ensure that all findings are closed before granting an operating license. Alternatively, it will evaluate any open findings to determine whether it is appropriate to grant the operating license with the finding still open.

All outstanding Operating License Application items are monitored and tracked in an OLA status report which is updated weekly. This report includes open inspection findings, open Unplanned Event reports and outstanding Requests for Additional Information. The ENEC/Nawah licensing department and FANR have weekly conference calls to discuss status issues and emergent items related to obtaining the operating license.

FANR and Nawah attend monthly 'work package lead' meetings at FANR headquarters to review the open items and ensure alignment on remaining activities requiring closure. Approximately every two months there is a senior management meeting. The status of the operating license review is discussed to ensure clarity of outstanding issues.

Areas for further action	**Significant**	
	Minor	

RECOMMENDATIONS

SUGGESTIONS

GOOD PRACTICES

2. Nuclear Safety **Condition 2.4: Owner/operator design integrity process defined and effective**	**Phase 3**
Summary of the condition to be demonstrated	The operating organisation has established an internal entity that will maintain the knowledge of the design and its configuration management (often called the design authority). The operating organization has agreed with the

	supplier country(s) how ongoing support for this design authority function will be provided in order to ensure nuclear safety.
Examples of how the condition may be demonstrated	1. Company or Department Manual defining where the entity is located; 2. Process description of how design integrity is maintained; 3. Evidence of interactions with other organisations operating similar plants; 4. Statements defining the required levels of support from the vendor and other bodies to act as authorised designers.

Observations

The Nawah Site Engineering Team has the role of ensuring the control of the plant's design basis; it will eventually become the plant design authority. The Site Engineering Team collaborates with ENEC's Engineering Group of the Chief Programme Office, and originated from ENEC's Chief Nuclear Officer Engineering Group.

The Site Engineering Team:

— Ensures alignment with top industry standards of equipment reliability to minimize equipment failures that could impact the safe, reliable and cost-effective operation of the plant;
— Establishes programmes and processes that verify, through monitoring, inspection and testing, that the plant structures, systems and components remain within their design limits and where appropriate, that allow the identification of actions to maintain adequate design margins;
— Establishes the programmes and processes required to ensure that design changes are performed in a controlled manner, that their impacts on the original design basis is assessed and documented, and that the plant configuration is maintained; and
— Maintains control of plant design, configuration management, and other programmes necessary to protect the safety of employees, the public, plant assets and the environment, and to meet regulatory commitments throughout the plant life cycle.

Nawah's design authority is defined in the Nawah Quality Assurance Manual (QA-MAN-0001), and the specific roles and responsibilities are documented in the design change control procedure ENG-PRC-CMP-0003. The configuration management process ENG-PSD-CMP-0005, and the referenced suite of design change control procedures referenced therein, defines how design integrity will be maintained. Currently KEPCO is the design authority and a transition plan to transfer this responsibility to Nawah's design authority is in place.

The design authority role and functions are under development, with a target of being fully established by Unit 1 operating license approval. The Site Engineering group currently consists of 48 engineers with an average experience of 20 years. There is a plan to increase the number of staff up to 78. An agreement between all design stakeholders has been concluded, whereby Nawah receives prior notification of proposed design changes to the Units under KEPCO design authority control, for operational impact input and assessment, e.g. revision and necessary updates to procedures, training, and the simulators, before such approved changes are implemented. For Unit 1, the Nawah shift manager must give final approval for physical changes to the Unit through the Site Work Request process.

KEPCO's Design Interface Control Board meets every two months with representatives from KEPCO, Korea Hydro and Nuclear Power (KHNP), ENEC and more recently Nawah. Nawah has access to design information and calculations, and is in the process of acquiring the full set of information.

Migration of construction data to Nawah's database is ongoing to complete the as built plant configuration.

Nawah has also concluded the APR-1400 Co-operation Agreement (ACA) with KHNP, which is aimed at ensuring operational information sharing with other APR-1400 operators—in particular, KHNP. The Lessons Learned process with KEPCO and KHNP also ensures that Nawah remains informed of design and operational changes at the APR-1400 reference plants in South Korea.

Training of Nawah engineering staff has been completed. The engineering team is involved in the review of procedures (see Issue 3).

The Pre-OSART mission identified that Nawah should enhance its configuration control over design changes implemented by the contractor and ensure that all design changes are reflected in its operations and maintenance, and training procedures.

The INIR team considers that the lessons learned from the construction of Unit 1 will be valuable in order to strengthen ENEC's oversight of the prime contractor. This will support the smooth transition of licensee responsibilities from ENEC to Nawah.

The Pre-OSART mission recommended that Nawah should establish rigorous configuration control over temporary modifications, equipment labelling and procedures. It was reported that this recommendation had been addressed. The actions resulting from the Pre-OSART, and related to the Nawah Design Authority, are documented in procedure ENG-REF-0003 (Nawah Design Authority).

In the role of responsible design authority, Nawah has concluded a long-term engineering agreement (LTEA) with the APR-1400 original designer, KEPCO Engineering organizations and its sub-contractors, e.g. KEPCO E&C Engineering Architecture (AE), KEPCO E&C System Design (SD), and KEPCO Nuclear Fuels (KNF) for design and technical support. KEPCO E&C, through the LTEA, will perform the role as a Nawah managed Responsible Design Agency.

This support includes the preparation of design change packages and the provision of up to 15 resident KEPCO E&C engineers at the Barakah NPP site for a renewable contractual period of 10 years. The total KEPCO engineering staff complement in South Korea, available to Nawah through LTEA, is in the region of 450 persons (not including the KEPCO sub-contractors such as Westinghouse, Doosan and Toshiba).

Areas for further action	**Significant**	
	Minor	

RECOMMENDATIONS

SUGGESTIONS

GOOD PRACTICES

GP-2.4.1 The establishment of a strong engineering team within Nawah, which will evolve to become the Plant Design Authority, supported by design transfer arrangements and participation on Korea Electric Power Corporation's (KEPCO's) Design Interface Control Board.

3. Management Condition 3.1: Ongoing arrangements for support clear		Phase 3
Summary of the condition to be demonstrated	The arrangements with the supplier to support on-going operation should be clear.	
Examples of how the condition may be demonstrated	1. Statements defining the required levels of support from the vendor and other bodies and mechanisms for information exchange, training, technical support, etc (Note: Design Authority requirements are covered by 2.4); 2. MoU or contractual arrangements between operating organization and suppliers.	

Observations

The long-term operation of the Barakah NPP Units will be undertaken by a joint venture between ENEC and KEPCO through their subsidiaries, Barakah One Company PJSC and Nawah.

Currently, KHNP is providing support to the Barakah NPP Project for the pre-operational tests and has about 100 engineers working at the plant.

Long-term operations support to Barakah Units is being negotiated with KHNP under a service agreement (Operations Support Services Agreement – OSSA). Under this agreement KHNP will provide staff for the control room operators and for engineering support at the plant.

Nawah is negotiating a long-term maintenance agreement that will include routine maintenance and outage support. The goal is to ensure that the Barakah NPP has competent, qualified maintenance support for all four Units for up to 10 years after initial operation. Nawah will have a supervisory role. Currently Nawah is in discussion with potential suppliers for such services. No final decisions have yet been made.

Nawah considers that the signature of the agreement is not necessary before the plant start-up since maintenance will be ensured by the EPC contractor until the plant achieves the status of 'substantial completion'. The INIR team was informed that the long-term maintenance agreement is expected to be concluded no later than a few months after initial start-up, now planned for end of 2019 or beginning of 2020. The INIR team considers that while the signed contract may not be required before start-up, the arrangements for long-term maintenance should be clear prior to start-up.

Korea Nuclear Fuel is the provider of nuclear fuel and fuel management for the four Units at Barakah NPP for the first and following two fuel cycles.

Areas for further action	**Significant**	
	Minor	Contractual arrangements for maintenance

RECOMMENDATIONS

R-3.1.1 Nawah should complete the contractual arrangements to establish adequate long-term arrangements for the maintenance of the NPP.

SUGGESTIONS	
GOOD PRACTICES	
3. Management **Condition 3.2: Structure and staffing of the operating organization adequate for commissioning and operation**	**Phase 3**
Summary of the condition to be demonstrated	The operating organization has developed the structures and staffing required for operation, including any certification process of its staff.
Examples of how the condition may be demonstrated	1. Organisational structure with clearly defined responsibilities; 2. Evidence that the organization is staffed for operation.

Observations

Nawah consists of 36 organizational functions responsible for adapting the Korean Model for the UAE at Barakah and preparing the organization to safely and reliably operate and maintain the Barakah NPP.

Nawah developed a systematic approach to ensure operational readiness. The activities include: ensuring the necessary plant equipment and qualified staff are in place, implementing the five Ps: Programmes, Processes, Procedures, People and Plant, ensuring that Nawah meets the WANO pre-start up performance objectives and properly evaluating and taking action on all active WANO Significant Operating Experience Reports.

Nawah is organized in a traditional structure covering operations, maintenance, engineering, work management, chemistry and radiation protection. Nawah has encountered challenges in adapting the Korean model, mainly due to cultural differences and differences in regulatory requirements. Nawah expects to have 1,810 staff at the time of fuel load for Unit 1.

Knowledge transfer of the design, construction and commissioning to Nawah staff was accomplished by participation in the commissioning activities and through the owner system of acceptance using the "Book of Knowledge" (BOK) approach. The ENEC Chief Program Office and Nawah Commissioning Oversight organizations developed a BOK to capture lessons learned during construction and especially commissioning. This BOK captures lessons learned from Shin Kori 3 — the Barakah Reference NPP — and Barakah NPP and is organized in two levels based upon importance and impact. There are also two reports that specifically capture lessons learned from all Barakah NPP Unit 1 Hot Functional Tests (HFTs) and Shin Kori 3 Power Ascension Testing (PAT). There are 347 HFT Lessons Learned and 74 Shin Kori 3 PAT Lessons Learned. Once Lessons Learned are recorded, they are implemented in follow-on or downstream tests to ensure the same mistake is not repeated. Due to its complexity, there is also a separate focus area on the Main Control Room Man Machine Interface System (MMIS). All of these reports and implementing actions are open for FANR review and inspection.

Nawah has not yet completed the qualification and certification process of operating personnel that is needed for Unit 1 to start nuclear commissioning. The required training programme has been approved

by FANR and training has been partially completed. FANR certification requires the submission of supporting documentation for all staff. Out of 85 operational positions requiring certification, 17 went through the full certification process and passed all necessary examinations. The INIR team was informed that the full certification process is planned to be completed by early 2019.		
Areas for further action	**Significant**	
	Minor	Certification of operating personnel
RECOMMENDATIONS		
R-3.2.1 Nawah should complete the certification of operating personnel as required by national regulations.		
SUGGESTIONS		
GOOD PRACTICES		

3. Management **Condition 3.3: Management system for operation developed**	**Phase 3**
Summary of the condition to be demonstrated	The operating organisation has a management system that defines responsibilities, lines of authority and interfaces with external organizations, describes processes for operation and qualification of suppliers and includes processes to assess the effectiveness of the system.
Examples of how the condition may be demonstrated	1. A documented management system addressing all the organisations drivers (e.g. health, quality, safety, security, safeguards, environment, economic), defining roles and responsibilities of each part of the organisation, identifying the processes of the organisation, and a process for review of its effectiveness; 2. The main processes for operation have been defined and are understood by relevant staff. They should include operations, demonstration of compliance with OL&C, maintenance and plant configuration, event reporting etc.; 3. The processes for commissioning have been defined, including definition of responsibilities and how test procedures and reporting of results will be approved; 4. Processes for qualification of suppliers; 5. An operational document management system.
Observations The Nawah management system is operational and documented. It implements Nawah's vision, mission and values through various elements including performance indicators, 5P operating model,	

programmes, processes, procedures, business plans and model of governance. It establishes the framework for all plant activities.

The 'Nawah Integrated Process Model' identifies 12 main (level 0) processes that are, or will be, implemented in Nawah. They are: configuration management, equipment reliability, independent oversight, loss prevention, management oversight, materials and services, nuclear fuel, operate plant, performance improvement, support services, talent management, work management. These processes represent 63 level 1 processes, can interface with programmes, are supported and implemented by procedures and listed in the controlled Integrated Management Systems (IMS) Process Catalogue document in the Enterprise Content Management System (ECMS).

The management system is reviewed on several levels: self-assessments of processes or programmes, management system audits by Nawah — the first audit will be held towards end of 2018, and ENEC internal audit.

Nawah is in the process of completing the operating procedures. Nawah received around 700 operating procedures from KEPCO. For each procedure a responsible reviewer and an appropriate department head was identified to review and revise it as required. A Nawah 'Writer's Guide' was developed and about 40 operating procedure writers were hired to support the process. These procedures are sent to KEPCO for review.

So far 500 procedures have been approved and the team was informed that the whole process is planned to be completed before fuel loading.

Nawah established a process to procure materials and services. Within the framework of this process the Quality Assurance (QA) department is responsible for the qualification of suppliers.

In the area of training on the management system, Nawah established several training modules. In the on-boarding training, face-to-face training is included on the structure and description of Nawah's management system. For the continuous training on the management system Nawah prepared several e-learning tools. It is a requirement for all Nawah staff, including the senior management, to go through the overview module which includes a test.

The Pre-OSART mission reviewed the management system and identified two issues. The INIR team was informed that actions are being taken to address them.

Areas for further action	**Significant**	Completion of operating procedures
	Minor	

RECOMMENDATIONS

R-3.3.1 Nawah should ensure all operating procedures are finalized and staff trained in their use before fuel loading.

SUGGESTIONS

GOOD PRACTICES

GP-3.3.1 The establishment of visible and suitably accessible management systems within FANR, ENEC and Nawah which integrate all relevant areas aimed at achieving effective management, implementation and assessment of core processes.

3. Management **Condition 3.4: Mechanisms for verification of construction and for handover of systems, structures and components from main supplier in place**	**Phase 3**
Summary of the condition to be demonstrated	The owner/operator has validated that the plant has been built consistent with the approved design. The mechanisms (procedural and contractual) for handover of systems, structures and components from the main supplier to the operating organization are clearly defined and in use.
Examples of how the condition may be demonstrated	1. Procedures for how the owner/operator has validated the plant construction and availability of reports to support the validation; 2. Hand over procedures available; 3. Examples of some systems handed over; 4. Commissioning manual/programme available.

Observations

As the manufacturing and construction of each individual system and component for Barakah are completed, it is turned over to Nawah through a formally established acceptance process as follows:

a) Completion of Construction Inspection and Test;
b) Turnover Process;
c) The Initial Test Programme.

In addition, there is a final verification that the requirements defined by licensing commitments, drawings, specifications, and other contract documents are reflected in the completed installation. It is also a time to verify that field modifications and other changes made and controlled during installation activities have been incorporated in the as-built documents. Checks are performed to verify that work items have been correctly installed and will function properly so that the initial starting and testing can proceed with a minimum amount of problems and delays. If construction or associated activity affects the results of these checks, the checks are repeated, if necessary, to ensure that the quality has not been adversely affected.

The Management System for the transition from fuel load to normal operations for both Units 1 and 2 at Barakah NPP has been established by Nawah and implemented in coordination with ENEC, KEPCO and KHNP. Nawah participated in the preparation of the commissioning programme.

Nawah has a commissioning oversight team led by the vice president of Commissioning Oversight who reports directly to the Chief Nuclear Office (CNO) of Nawah. It approves all commissioning procedures and oversees the testing and commissioning carried out.

A start up organization for Barakah NPP has been established. It includes ENEC, Nawah, KEPCO and KHNP. This organization is responsible for validation of construction of systems and for the handover of systems to the operating organization through an established acceptance process.

It verifies system completion through a formal turnover procedure. Before accepting a system or part of a system from a contractor, the start-up organization conducts a review to confirm the completion of testing of the system, its structures and components.

The start-up organization utilizes an exception item list system to identify, record and monitor correction of missing, damaged, incomplete or incorrectly installed items. Major deficiencies are documented using the non-conformance procedure, which includes reinspection or retesting to verify work completion and acceptability before the Exception Items are closed.

Out of 133 systems 125 have been handed over to the operating organization.

Areas for further action	**Significant**	
	Minor	
RECOMMENDATIONS		
SUGGESTIONS		
GOOD PRACTICES		

4. Funding and Financing Condition 4.1: Adequate income to sustain operation obtained	Phase 3
Summary of the condition to be demonstrated	The operating organization has sufficient income to provide adequate resources to sustain operation of the nuclear power plant and related facilities.
Examples of how the condition may be demonstrated	Information available will depend on the contractual model and arrangements (and may be confidential) but could include: 1. Evidence that the costs of operating have been assessed, budgets have been agreed, and a review mechanism is in place; 2. Information regarding the adequacy of resourcing and staffing of the operating organization (e.g. a regulatory review); 3. Evidence that tariffs will provide adequate returns or a compensatory mechanism is in place; 4. Evidence that operating costs include adequate funds for long-term maintenance costs.

Observations

The Barakah One Company houses the investment and financing portion of the BNPP joint venture. It is envisaged that it will consist of up to 30 staff to fulfil its responsibilities. Nawah has been established as the operating organization.

There is a plant services agreement (PSA) between Nawah and Barakah One Company. Under this PSA Barakah One Company is obligated to pay Nawah a fee to cover all operating costs.

There is a capacity based power purchase agreement (PPA) between Barakah One Company and the Abu Dhabi Water and Electricity Company (ADWEC) designed to recover the nuclear project's fixed costs and operational costs over the PPA's 60-year term.

For the first 5-year operating period, the PPA will reimburse the actual operating costs of Nawah based on audited costings at the end of the 5-year period. Thereafter Barakah One Company will receive fees based on a target cost of operations for the next 5 years. The target cost fee will be reviewed every 5 years. Any additional costs will need to be absorbed by Barakah One Company.

The capital costs to be reimbursed through the PPA will be set at the end of construction of the 4 Units based on the agreed true capital cost. Additional costs of interest arising from the recently announced revised schedule will not be met through the current structure of the PPA and will need to be absorbed by Barakah One Company.

Other potential cost variations, such as interest rate or exchange rate fluctuations are being addressed through hedging arrangements.

Nawah's budgeting process will include an element of contingency for unplanned maintenance. Any

major unplanned requirements will need to be covered by Barakah One Company. While the PPA does not have mechanisms to cover such costs, some such element could be planned for in following 5-year horizon projection.

The Nawah business plan is available to all Nawah personnel via an icon on the network-connected work station desktop and includes budgeted financial and human resources (HR). Nawah is committed to maintaining a 5-year view of its business objectives and plans, at both strategic and functional levels.

The Nawah budget also includes the cost of meeting all fuel management and storage requirements as well as fees that are required to be paid into the decommissioning fund under applicable regulations.

The Boards of ENEC, Nawah and Barakah One Company all share common UAE members, though Nawah and Barakah One Company also have Korean representation. As such they share common expectations for the safe, secure and efficient operation of the NPP and recognize the need for appropriate investment of resources to achieve them.

The INIR team was informed that once the NPP achieves commercial operation, the PSA allows for a 'balanced score card' approach in respect of key performance indicators (KPIs) to assess performance; and includes targets for performance akin to WANO Performance Indicators.

The CNP is responsible for overseeing and advising the Board of ENEC on issues of nuclear safety, security, reliability, regulatory, and environmental matters that relate to the construction and eventual operation of the BNPP Units.

The INIR team was informed that ENEC has an ongoing responsibility for the successful development of the UAE nuclear power programme. As part of this function, direct lines of communication exist between FANR and ENEC should they wish to raise any concerns with the owner organization.

Areas for further action	**Significant**	
	Minor	
RECOMMENDATIONS		
SUGGESTIONS		
GOOD PRACTICES		
4. Funding and Financing **Condition 4.2: Funding mechanisms in place for waste management, long-term spent fuel management and decommissioning**		**Phase 3**

Summary of the condition to be demonstrated	An appropriate funding plan has been implemented for waste, long-term spent fuel management and for the decommissioning of the nuclear power plant. The plan includes mechanisms for the regular review of the adequacy of the funding arrangements. *Note: Funding of government role and regulatory body covered under Issue 1 and Issue 7.*
Examples of how the condition may be demonstrated	1. Evidence that costs of waste management, spent fuel management and decommissioning have been estimated; 2. Evidence that a secure funding mechanism is in place to meet the cost estimates.

Observations

Nawah is responsible for the safe management and storage of radioactive waste generated from Barakah NPP until its delivery to the Radioactive Waste Management Organization (RWMO).

Article 42 of the Law No. 6 of 2009 establishes a legal regime for decommissioning of nuclear installations, including establishment of a Decommissioning Trust Fund (DTF) by the UAE Cabinet to be financed through fees collected from licensees. The fees are to cover the costs of construction, operation and closure of a radioactive waste management facility, decommissioning costs, costs of regulatory oversight and for management of the DTF.

FANR has prepared a proposed Cabinet Resolution for the establishment of the DTF. The resolution is awaiting approval. It is planned that FANR regulation FANR-REG-22 establishing the DTF will be completed by the time of commercial operation of the first Barakah NPP Unit. Once the resolution has been approved, UAE will put in place the appropriate arrangements to ensure the availability of funds when required.

Article 7 (6) of FANR-REG-21 requires that the cost estimate for decommissioning be updated every 3 years from the date of the Initial Decommissioning Plan (IDP). ENEC has prepared an IDP that included a preliminary decommissioning cost estimate for Barakah NPP. The preliminary decommissioning cost estimate is based on the decommissioning cost and radioactive waste disposal cost including the siting, construction, operation and post operation of a deep geological repository as indicated in FANR-REG-22 draft. FANR has reviewed the IDP, and all RAIs related to the IDP have been closed. FANR has drafted the DTF fee calculation, based on IDP inputs, and established the fee to be recovered to meet these costs based on a 60-year operating life of BNPP.

Nawah is arranging for a letter of guarantee from the Abu Dhabi Government to cover any shortfall in funds in the event of early closure of the facility. This letter will also guarantee any need for funds before the DTF is in place.

Areas for further action	**Significant**	
	Minor	Decommissioning Trust fund

RECOMMENDATIONS
R-4.2.1 The UAE should approve the draft Cabinet Resolution to establish the Decommissioning Trust Fund and implement the necessary arrangements.
SUGGESTIONS
GOOD PRACTICES

4. Funding and Financing **Condition 4.3: Civil liability for nuclear damage in place**	**Phase 3**
Summary of the condition to be demonstrated	Mechanisms are in place to implement the provisions of nuclear legislation on civil liability for nuclear damage.
Examples of how the condition may be demonstrated	1. Financial security arrangements for operator agreed; 2. Mechanisms in place to ensure contribution to international fund where appropriate.

Observations

The UAE acceded to the Protocol to Amend the Vienna Convention on Civil Liability for Nuclear Damage dated 12 September 1997 and established legislation on civil liability for nuclear damage associated with a nuclear incident, if such occurs, by Federal Law by Decree No. 4 of 2012 On the Civil Liability for Nuclear Damage ('the Nuclear Liability Law').

The Nuclear Liability Law requires that, inter alia, "the Operator of the Nuclear Installation shall obtain and maintain insurance or other financial security; insurance or other financial security shall be of such type and on such terms as approved by FANR and from any sources approved by the FANR within or outside of the State.; FANR shall be the competent authority with respect to implementation of the provisions of the Nuclear Liability Law".

Nawah has negotiated insurance arrangements with the UAE Nuclear Insurance Pool (made up from 5 large insurance companies in UAE). FANR has approved these insurance policies and the sources of insurance including the reinsurance arrangements with international insurance pools.

Regarding the Convention on Supplementary Compensation for Nuclear Damage (CSC), Article 4 of Decree No. 51 of 2014 provides that the Operator is liable to meet the UAE obligations as a contracting state. The INIR team was informed that Nawah will obtain insurance to cover the contribution that may be required, once the plant reaches commercial operation.

Areas for further action	**Significant**	
	Minor	

RECOMMENDATIONS
SUGGESTIONS
GOOD PRACTICES

5. Legal Framework Condition 5.1: Legal framework implemented and being reviewed as necessary	Phase 3
Summary of the condition to be demonstrated	All actions to implement the relevant international legal instruments (as identified in Phase 2) are being undertaken. Action plan to address any identified issues with the legal framework and amend it as necessary.
Examples of how the condition may be demonstrated	1. Demonstration of how each of the international legal instruments are implemented (e.g. identification of contact points/competent authorities, and participation in review meetings); 2. Identification of any issues arising in the implementation of the laws and how they are planned to be addressed.

Observations

The UAE is a party to the following relevant international legal instruments:

— The Convention on Early Notification of a Nuclear Accident;
— The Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency;
— The Convention of Physical Protection of Nuclear Material and its Amendment;
— The Convention on Nuclear Safety (CNS);
— The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (JC);
— The 1997 Protocol to Amend the Vienna Convention on Civil Liability for Nuclear Damage;
— The Joint Protocol relating to the Application of the Vienna Convention and the Paris Convention;
— The Convention on Supplementary Compensation for Nuclear Damage;
— Comprehensive Safeguards Agreement between the State and the IAEA;
— The Protocol Additional to the Agreement between the United Arab Emirates and the IAEA for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons.

The UAE enacted Federal Law by Decree No. 6 of 2009, concerning the Peaceful Uses of Nuclear Energy and the Federal Law by Decree No. 4 of 2012 concerning Civil Liability for Nuclear Damage. These laws intend to implement the relevant international legal instruments to which the UAE is a party and to determine, inter alia, the rights and obligations of the operator and the functions and responsibilities of the regulator. They address as well, safety, security, safeguards and civil liability for nuclear damage.

In addition to that, the INIR team noted that, in accordance with the international legal instruments to which it is a party, the UAE has consistently submitted its national reports as required by Article 5 of the CNS and Article 32 of the JC review meetings. The UAE has also participated in all meetings of the aforementioned conventions (review meetings, extraordinary meetings and organisational meeting).

Within the framework of the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, the UAE has

nominated the required competent authority as provided by Article 7 of the Convention on Early Notification and Article 4 of the Convention on Assistance and made them known to the IAEA. The INIR team was also informed that the UAE participates in Convention Exercises and the IAEA Unified System for Information Exchange in Incidents and Emergencies (USIE).

It is also noted that the UAE has communicated its laws on nuclear liability as required by Article XIX of the Protocol to Amend the 1963 Vienna Convention on Civil Liability and Article XVIII of the CSC.

Finally, in the context of the Convention of Physical Protection of Nuclear Material and its Amendment, the UAE nominated its Central Authority and Point of Contact as requested under Article 5 of such instruments. However, it has not yet fully reflected some of the provisions of the Amendment to the CPPNM in relevant legislation and has not yet informed the depositary of its laws and regulations giving effect to the CPPNM and the Amendment as requested by Article 14 of the two instruments.

The INIR Team concludes that while the UAE has diligently implemented the obligations arising from the nuclear safety international instruments, efforts remain to be done to fully implement the nuclear security instruments, as described above.

The INIR team also discussed the issue to review and possibly to amend the existing legislation, in particular to address the findings of the IRRS report in which it was suggested to "FANR to review Article 36 (6) of the Law No. 6 Concerning the Peaceful Uses of Nuclear Energy with a view to ensuring that prosecutions are possible for situations where FANR has to take action to restore radiological safety" (Suggestion S14). The INIR team was informed that the Cabinet issued a Resolution in August 2015 concerning Administrative Penalties and Fines on Violating the Conditions of the Licenses issued by FANR. Further, FANR had developed an implementing regulation to further specify the procedure to follow to implement the Resolution.

FANR also identified some discrepancies and overlaps among and between Laws No. 6 and No. 4 and other laws and regulations, but no plan has been developed yet to address these issues at the legislative level.

The INIR team noted the on-going legislative efforts of the UAE Ministry of Cabinet Affairs and the Future, aiming at keeping the UAE legislation up-to-date and gathering from the UAE entities inputs and forecasts on the issuance of new legislative instruments and amendments to existing ones, through various letters sent to all Ministries and Federal Authorities. However, it seems that nuclear related laws are not listed on the annual legislative agenda of the Federal Government for revision and amendment.

Areas for further action	**Significant**	
	Minor	Revision of the legislation

RECOMMENDATIONS

R-5.1.1 The UAE should amend its legislation to fully reflect the provisions of the Amendment to the Convention on Physical Protection of Nuclear Material (CPPNM) . The UAE should also inform the depositary on its laws and regulations to give effect to the CPPNM and its Amendment as required by Article 14 of these instruments.

SUGGESTIONS

S-5.1.1 FANR is encouraged to consider regular updates of the Federal Law by Decree No. 6 and other relevant legislation governing the nuclear power programme to take into account the lessons learned.
GOOD PRACTICES

6. Safeguards **Condition 6.1: An SSAC that is operational for the nuclear power programme**	**Phase 3**
Summary of the condition to be demonstrated	The State System of Accounting and Control (SSAC) is operational to (a) regulate and control all activities associated with the nuclear power programme, (b) provide correct and complete information, on time, to the IAEA, (c) facilitate IAEA verification activities through institutional arrangements and by providing access to IAEA inspectors.
Examples of how the condition may be demonstrated	1. Clear responsibilities for the implementation of safeguards at the State and facilities level are defined; 2. Procedures in place for the provision of required information, access of IAEA inspectors and facilitation of verification; 3. Procedures in place relating to accounting for and control of nuclear material based on a system of reports, records and measurements that permit the tracking of inventory changes and the closing of material balances; 4. Mechanisms to detect unauthorized activities involving nuclear material and other items subject to regulatory control.

Observations

Law No. 6 of 2009 and FANR-REG-10 (Regulation for the System of Accounting for and Control of Nuclear Material and Application of Additional Protocol) establishes the requirements for the SSAC at the licensee level and, together with FANR-RG-015 (Regulatory Guide on Implementation of the Obligations and Requirements of the Additional Protocol to the UAE Comprehensive Safeguards Agreement), provide the framework for meeting the international obligations and commitments under the Safeguards Agreement (SA) and the Additional Protocol (AP). Terminology was clarified in FANR-REG-10 to make it consistent with IAEA terminology and guidance.

FANR-REG-10, published in 2012, is under revision and IAEA SERVICES SERIES No. 21 (Guidance for States Implementing Comprehensive Safeguards Agreements and Additional Protocols) and other IAEA safeguards-related guidance will be taken into consideration during the review.

An ISSAS mission (2014) reviewed the SSAC and capability of FANR to implement a SSAC. The main conclusion of the ISSAS mission was that the UAE has an adequate and independent regulatory authority and an effective SSAC system, which allows the UAE to fully implement its safeguards obligations. FANR and ENEC/Nawah provided information about the status of actions from this ISSAS mission.

In February 2017, nuclear material was introduced to Barakah NPP which had the effect of automatically rendering the Small Quantities Protocol (SQP) 'Non-Operational'. This resulted in the full-scope implementation of all provisions of Part II of the Comprehensive Safeguards Agreement (CSA); FANR Safeguards Department (SGD) submitted the UAE Initial Report to the IAEA in accordance with Article 61 of the Safeguards Agreement. The correctness and completeness of the

Initial Report was confirmed by the IAEA during inspections across the UAE in May 2017.

Inventory Change Reports have been submitted by SGD to the IAEA for each calendar month since March 2017. In March 2018, the first Physical Inventory Listings and Material Balance Reports were also submitted.

FANR, ENEC and the IAEA continue to work closely concerning the implementation of safeguards in the UAE and hold regular Safeguards Technical Meetings to ensure safeguards obligations are met. Following a series of such Safeguards Technical Meetings, the Subsidiary Arrangements (general part) entered into force on 8 June 2017. In addition, draft Subsidiary Arrangements (Facility Attachment) for BNPP Unit 1 were prepared and are awaiting entry into force. All necessary documents were submitted to the UAE Permanent Mission in Vienna. FANR expects that Subsidiary Arrangements (Facility Attachment) for BNPP Unit 1 will soon enter into force.

Responsibilities for safeguards implementation have been defined in the FANR Integrated Management System Manual with nonproliferation-specific items being documented in Core Process 8. A FANR internal audit of the Safeguards Department was performed in April 2018. All procedures were reviewed and no major findings were identified.

SGD cooperation with national competent entities, LOFs and internal FANR departments has strengthened the ability of the UAE to detect unauthorized activities involving nuclear material and other items subject to regulatory control. Cooperation with federal and local customs authorities and a unified permitting system for export control has contributed to the strengthening of regulatory control.

Several mechanisms to detect unauthorized activities involving nuclear material and other items subject to regulatory control were established or strengthened. This includes the addition of radiation detection systems on border entry points, arrangements with other UAE organizations, bilateral agreements and protocols with other states, an outreach programme to increase public awareness of nuclear and radiological materials, and cooperation between different licensing agencies of the seven UAE emirates.

With respect to the nuclear power programme, FANR obtains the necessary information and access from ENEC/Nawah to satisfy the requirements of the SSAC and IAEA verification activities.

The INIR team was informed that a number of additional staff have been recruited and trained to strengthen the SSAC for the nuclear power programme, four of which are in FANR. The ENEC/Nawah Safeguards and Export Control Department currently consists of 5 staff in Safeguards and 6 in Export Control, supported by 2 Safeguards Engineers and an Accounting Specialist within the Operations department. Co-ordination between FANR and other UAE organizations was strengthened by providing additional IAEA and other training courses for the safeguards staff of FANR and ENEC/Nawah.

The INIR team was also informed that the ENEC/Nawah Safeguards Department reports into the Nawah organization and uses the ENEC Management System to implement the safeguards programme. The IAEA Department of Safeguards is informed about the ENEC/Nawah relationship, including roles and responsibilities, and the transitioning of responsibilities has not negatively impacted on the effectiveness or efficiency of safeguards

implementation over the course of several IAEA inspections and complementary access. Once an operating licence is issued (to Nawah), the ENEC/Nawah Safeguards Department will be fully integrated within Nawah.

ENEC/Nawah ensures participation of safeguards staff in multiple national and international trainings/ workshops to maintain qualified staff.

ENEC/Nawah internal audits of the Safeguards Department are performed annually and no major findings have been identified. In addition, 12 FANR inspections have been conducted since 2015. While no major findings were identified, all minor findings have been included in the corrective action programme.

ENEC/Nawah developed procedures to ensure that IAEA inspectors can perform their verification activities. These procedures have been approved by FANR.

ENEC/Nawah Safeguards Department has worked closely with FANR and IAEA from the early stages of the programme regarding the installation of the IAEA Containment and Surveillance (C/S) system at Barakah NPP. The IAEA has successfully installed and operated their C/S system (cameras, seals and server) at Unit 1.

Areas for further action	**Significant**	
	Minor	

RECOMMENDATIONS

SUGGESTIONS

GOOD PRACTICES

GP-6.1.1: Implementation of a number of mechanisms to detect unauthorized activities involving nuclear material and other items subject to regulatory control for an effective implementation of safeguards provisions.

7. Regulatory Framework Condition 7.1: Competent and Independent regulatory body operating effectively	Phase 3
Summary of the condition to be demonstrated	An independent regulatory body is in place with sufficient funding and competent to oversee the peaceful, safe and secure operation of the NPP including review, licensing and inspection activities.
Examples of how the condition may be demonstrated	1. Evidence from reviews carried out during licensing; 2. Evidence from inspections carried out during construction; 3. A comprehensive inspection programme for operations; 4. TSO arrangements in place for support in regulation of commissioning and operation.

Observations

FANR was established in 2009 by Article 4 of the Nuclear Law as a public organisation with an independent balance sheet, independent legal personality, full legal competence and financial and administrative independence. The Authority is not a part of any other organization and has no legal or other relationship with any promotional body.

The Nuclear Law Article 5 states that "the Authority shall determine all matters relating to the control and supervision of the Nuclear Sector in the State, particularly those related to Safety, Nuclear Safety, Nuclear Security, Radiation Protection and Safeguards and implements any obligations under the relevant international treaties, conventions or agreements entered into by the State". Article 6 states, inter alia, that the Authority shall be exclusively responsible for issuing all licences to practice any of the Regulated Activities in the State. Article 25 clearly states the regulated activities.

The INIR team reviewed the 2018 annual inspection plan. The 2018 plan was prepared with the assumption that fuel will be loaded in June 2018. FANR will modify this plan based on the real status of construction and operation readiness.

Unannounced inspections have not occurred to date. However resident inspectors report on their findings through video conference to FANR headquarters on a weekly basis.

FANR has developed inspection instructions. Inspection reports related to construction are submitted to ENEC as the construction licensee and inspection reports related to operational readiness are submitted to Nawah.

As Unit 1 passed cold hydraulic testing (CHT) and hot functional testing (HFT, FANR asked ENEC to submit its equipment and asset preservation programme since there will be a significant start-up delay of Unit 1. FANR will modify its inspection and assessment programme accordingly.

A number of inspection reports are available on the FANR website. During the INIR mission several other inspection reports were uploaded.

The CNS report states that FANR has its budget set by its Board of Management and in the past received funds made available by annual government allocation. FANR has now transitioned to having licensees pay fees and those fees constitute more than 90% of the approved budget, with the balance provided

by government allocation. The FANR Board of Management appoints an independent auditor, registered with the appropriate UAE authorities, to audit annual accounts and prepare reports regarding the results of the audit. The overall budget provided has been adequate to enable FANR to carry out all of its significant regulatory responsibilities over the reporting period.

FANR staffing is approximately 200 people. About 60% of the employees are Emirati citizens. The balance of the staff is comprised of expatriates with nuclear experience recruited from 25 countries around the world. FANR has complemented internal competencies of internal staff through the use of expert TSOs in the assessment and inspection of the nuclear power programme.

FANR will not change its organizational structure for the operational phase, however an internal document, 'New Deliverables for Transition to Operation Project for the period 2016–2020' has been developed. In addition, in-house training is conducted for this transition for all FANR technical staff.

FANR is supported by the International Advisory Group for Nuclear Safety Regulation. Some examples of advice were provided. This Group will also support FANR during the operational phase.

FANR complements its in-house training programmes through collaboration with ENEC, Khalifa University, the IAEA and other partner institutions in a national programme on capacity building, which offers to citizens a range of education, training and development opportunities in the UAE and overseas.

FANR is preparing new contracts with external support (TSOs), as the current contract expired.

There is a vision to develop a local TSO; however, this is a long-term plan.

FANR is supporting R&D e.g. Halden project, Atlas, and has a joint project with the French Institute for Radiological Protection and Nuclear Safety (IRSN) regarding radiation protection.

Areas for further action	**Significant**	
	Minor	Further improvement of inspection programme.

RECOMMENDATIONS

SUGGESTIONS

S-7.1.1 FANR is encouraged to include unannounced inspections in its inspection programme.

GOOD PRACTICES

7. Regulatory Framework **Condition 7.2: Management system in place**	**Phase 3**
Summary of the condition to be demonstrated	The regulatory body has developed and implemented a comprehensive management system including processes for assessment, licensing, issuing and reviewing regulations and

	qualification of suppliers. The management system clearly defines responsibilities, lines of authority and interfaces with external organizations. Processes are also in place to assess the effectiveness of the system.
Examples of how the condition may be demonstrated	1. A suite of documentation defining the organization and its processes; 2. Results of internal or external audits; 3. Defined requirements for review and improvement of the management system.

Observations

FANR has developed an Integrated Management System (IMS according to the requirements of IAEA Safety Standard Series No. GS-R-3. The content and objectives of the IMS are described in the IMS Manual including the FANR vision and mission statements aiming at safety, health, environmental, security, quality and economic elements. A process map is presented in the SER and FANR explained the hierarchy of IMS documents.

Management commitment is expressed in the IMS Manual where responsibilities and lines of authority are outlined and described as well as vision and mission statements and core values.

FANR has developed an internal document entitled New Deliverables for Transition to Operation Project for the period 2016–2020. This is a road map for the operational phase of Barakah NPP, including modifications of some core processes of IMS.

The Deputy Director General (DDG) and Department Directors are also involved in approving the processes as members of the IMS Committee. This committee meets on average three times a month. In these meetings, amongst other matters, the progress of development of processes, procedures and handling of non-conformances are managed. The IMS committee also discusses the effectiveness of the system, proposals for changes and submits agreed proposals to the process owners for resolution.

FANR is planning to revise the IMS based on GSR Part 2 and, in parallel, make modifications according to International Organization for Standardization (ISO) Standards 9001, 2015 and obtain ISO certification. However, a firm schedule is not yet established.

FANR has developed a 5-year strategic plan and a yearly operational plan. The strategic plan was available to the team. Strategic objectives are as follows:

— Ensure the Peaceful, Safe and Secure use of Nuclear Energy and Radiation Sources;
— Develop Sustainability of the UAE Regulatory Infrastructure;
— Ensure the provision of all administrative services in accordance with the quality, efficiency and transparency standards; and
— Enhance innovation culture within the organizational work environment.

Strategic objectives are further elaborated in actions, responsibilities and performance indicators.

The FANR IMS includes a Knowledge Management (KM) process, which consists of 6 elements: knowledge identification, capturing, storing, collaboration, digital saving and maintaining. The process was reviewed twice (in 2012 and 2014) based on internal assessment and IAEA review.

FANR's internal audit department helps the Authority accomplish its objectives by

bringing a systematic disciplined approach to evaluating and improving the effectiveness of risk management, control, and governance processes. The Chief Audit Executive reports directly to the Audit and Risk Committee and the Board of Management and has an administrative reporting line to the Director General.		
Areas for further action	**Significant**	
	Minor	
RECOMMENDATIONS		
SUGGESTIONS		
GOOD PRACTICES		
7. Regulatory Framework **Condition 7.3: Regulations in place**		**Phase 3**
Summary of the condition to be demonstrated	The regulatory body should have in place a comprehensive set of regulations, and have a process for their regular review and re-issue as required.	
Examples of how the condition may be demonstrated	A comprehensive set of regulations covering safety, security and safeguards.	

Observations

Articles 11, 38, and 39 of the Nuclear Law empower the FANR Board of Management to issue administrative, financial, technical and employment regulations which are required for FANR's operation and regulations specifying the requirements which all operators must comply. In addition, FANR shall develop explanatory guidelines on how to comply with regulations. In developing regulations and guidelines FANR shall take into consideration comments from stakeholders, information made available by experts, and internationally recognised standards and recommendations, such as IAEA standards.

FANR has established within its Integrated Management System (IMS) a process for establishing and revising regulations and guides that includes provisions for consultation with stakeholders and the public, as well as review and incorporation of their comments.

FANR continues to develop regulations as needed for developing the UAE nuclear energy programme. The IAEA safety requirements, as well as those of other well-recognized international organisations and regulatory bodies, continue to be key references. Regulations that are currently under development are Regulation 18: Application of Penalties, Regulation 22: Decommissioning Trust Fund (awaiting Cabinet Resolution) and Regulation 27: Disposal of Radioactive Waste.

In addition, explanatory guidelines on how to comply with Regulation 16: Operational Safety including commissioning have not yet been finalized.

FANR regulatory guides describe methods and criteria acceptable to FANR for implementing its requirements. FANR has found it effective to adopt many of the guides issued by the regulatory body in the country of origin of the nuclear technology.

All approved regulations and regulatory guides are available on the FANR web site (with the exception of those marked for restricted use only). The FANR website also makes available a documented plan for new regulations and revision of the existing ones. The FANR procedure for Regulation Development and Maintenance includes steps to identify the need for new, amended or withdrawal of regulations. The procedure requires that every regulation be reviewed at least every 5 years and revised as needed. The INIR team observed that several regulations, impacted by changes of IAEA Safety Requirements, were issued in 2010 and 2011 are being revised but were not issued yet.

The document entitled Status of Issued Regulations and Anticipated Future Development of Regulations provides an overview of future work needed to develop new regulations and to review the existing ones. However, a periodic review of guides is not part of this document.

Areas for further action	**Significant**	
	Minor	Regulations and guides Regulations and guides review process

RECOMMENDATIONS

SUGGESTIONS

S-7.3.1 FANR is encouraged to continue the work to finalize regulations and guides required for the operational phase.

S-7.3.2 FANR is encouraged to strengthen its process for the periodic review and revision of its regulations and guides.

GOOD PRACTICES

7. Regulatory Framework **Condition 7.4: Arrangements in place for co-operation with regulatory bodies in other countries**	**Phase 3**
Summary of the condition to be demonstrated	The regulatory body has reviewed opportunities for co-operation with regulatory bodies in countries operating similar plants and put appropriate arrangements in place.

Examples of how the condition may be demonstrated	Co-operation agreements identifying support mechanisms.

Observations

FANR has taken a very active role in international collaboration, and in doing so contributes actively to, and takes stock of, the development of the global safety regime. International engagement is driven by the ambition to achieve the highest standards of performance in the nuclear sector, including safeguards and non-proliferation, as clearly laid out in the Nuclear Policy.

FANR continues to cooperate with nuclear regulatory bodies in operating countries (United States of America, France, United Kingdom, Canada, Republic of Korea, Australia and Finland). Currently, there are 21 international agreements, and MOUs for cooperation were concluded relevant to nuclear safety, security and safeguards. These agreements facilitate the exchange of technical information and the exchange of personnel for training purposes.

A cooperation mechanism is in place with the Korea Institute of Nuclear Safety (KINS) to exchange information on operational safety aspects of the APR1400. A KINS representative is seconded to FANR with responsibility to provide this information.

FANR participates in a number of international R&D programmes. This includes, participation in the US Nuclear Regulatory Commission's (NRC) Code Applications and Maintenance Program (CAMP)/ Cooperative Severe Accident Research Program (CSARP)/Radiation Protection Computer Code Analysis and Maintenance Program (RAMP), which allow FANR to use several safety analysis codes. FANR is also a member in the OECD-NEA Halden Research Project and OECD-NEA ATLAS project which facilitates FANR's access to safety research outcomes and interaction with the international R&Dcommunity and international regulatory authorities.

FANR maintains an active participation with multiple peer review programmes such as the Multilateral Design Evaluation Programme (MDEP) for interacting with international regulators looking at new reactor designs. In addition to CNS and JC peer reviews within the framework of the IAEA.

Since 2010 FANR concluded 35 cooperation agreements with regulatory organizations in different countries as well as with UAE organizations. FANR regularly reviews the status of these arrangements and their results. Such an evaluation report from June 2018 was available to the INIR team. Over 90% of national and international agreements are active and achieved very good results.

Areas for further action	**Significant**	
	Minor	

RECOMMENDATIONS
SUGGESTIONS

GOOD PRACTICES

8. Radiation Protection **Condition 8.1: Equipment for dose monitoring and control in place**	**Phase 3**
Summary of the condition to be demonstrated	Radiation monitoring equipment and dosimetry requirements are in place. *Note: This covers the protection of workers and public on-site during planned operation. Off-site releases from planned operation are addressed under Issue 13. Environmental Protection and accidental releases and associated radiation protection are addressed mainly under Issue14. Emergency Planning.*
Examples of how the condition may be demonstrated	1. National arrangements for dosimetry measurements and record keeping in place; 2. Provision and maintenance of adequate instrumentation, protective clothing, and facilities.

Observations

Provisions for individual and workplace monitoring are made in the FANR-REG-04 and FANR-REG-11. Responsibilities of the licensees regarding dose record keeping and for their transmission to FANR on a regular basis are also indicated.

A dose register has been established by FANR for regulated material licensees. However, FANR is currently investigating the establishment of a national dose register to include the occupational dose registry from Barakah NPP and other regulated material licensees. A White Paper containing proposals for the National Registry is undergoing review and should be finalized by the end of the year. International examples of national registries have been reviewed and an IAEA expert mission was provided in February 2018. However, challenges remain in implementing the concept; these include linking with individual's health records and the exchange of information with other countries' dose registers.

A Secondary Standards Dosimetry Laboratory (SSDL), owned and operated by FANR, was established at Khalifa University in 2017. It will provide calibration services once it becomes ISO 17025 accredited, which is expected to be by the end of 2018. The SSDL is equipped to provide services to most UAE customers from the medical, industrial and nuclear sectors; FANR will publish its fees for this service in due course.

The SSDL joined the IAEA/World Health Organization (WHO) SSDL Network in February 2018 which allows its standards to be calibrated by the Agency. This Network comprises 80 laboratories in 67 countries. It is responsible to verify that the services provided by the SSDLs follow internationally accepted metrological standards and further carries out international intercomparing exercises.

Nawah's monitoring and dosimetry equipment arrangements include a dosimetry laboratory, accredited to ISO 17025 (testing and calibration). Nawah monitors external radiation exposure using electronic dose meters (for job control) and thermo-luminescent dose meters (TLDs) for assessing the regulatory dose. The laboratory is equipped with a TLD irradiator for calibration purposes**.**

The dosimetry service also has equipment and procedures for internal dose estimation through whole body counting and urine analysis. These are described in procedure RP-PRC-0002, Measurement and Assessment of Internal Exposure Dose. All radionuclides which could be present in potential contamination zones are capable of being measured.

Nawah's dosimetry service has been inspected by FANR and accredited by the Dubai Accreditation Center. Nawah reports its occupational dose records to FANR every six months.

The calibration of some equipment at Barakah NPP is undertaken in the Republic of Korea and in Europe. However, the INIR team noted that this introduces delays and potential for damage to equipment.

The main sources of radiation exposure onsite at this time are industrial sealed radiation sources used in non-destructive testing (NDT). Nawah informed the INIR team that KHNP is providing radiation protection services for this activity because of their experience on similar plants in Korea. However, Nawah's radiation protection department oversees all activities involving radioactive sources and materials onsite.

A number of gaps were identified in the Pre-OSART assessment with respect to radiation protection instrumentation, protective clothing and facilities. The INIR team was informed that all issues had been addressed. In addition, Nawah reported that it had also addressed all issues identified in FANR's and its own review of the '5Ps'.

Areas for further action	**Significant**	
	Minor	Calibration of radiation measuring instruments

RECOMMENDATIONS

SUGGESTIONS

S-8.1.1 Nawah is encouraged to consider calibrating all radiation measuring instrumentation within the UAE.

GOOD PRACTICES

GP-8.1.1 Development of an accredited dosimetry service for both internal and external dose assessment.

8. Radiation Protection **Condition 8.2: Programmes to optimize doses from operation and maintenance in place**	**Phase 3**
Summary of the condition to be demonstrated	The operating organisation has programmes to ensure doses from routine and unplanned operations are optimized and these have been reviewed by the regulatory body. *Note: This covers the protection of workers and public on-site during planned operation. Off-site releases from planned*

	operation are addressed under Issue 13. Environmental Protection and accidental releases and associated radiation protection are addressed mainly under Issue 14. Emergency Planning.
Examples of how the condition may be demonstrated	1. Approved radiation protection programme; 2. Procedures for the planning and control of radiation exposures during planned work and emergencies.

Observations

Nawah's overall radiation protection programme is described in document RP-PGD-0001, the purpose of which is to "protect the workers and public through radiation protection control measures such as dose constraints and hierarchy of prevention", and to "comply with FANR Regulations, and conform with applicable Regulatory Guides/Industry Standards". It provides a comprehensive description of roles and responsibilities, accountabilities and implementation requirements.

The Nawah procedure 'Radiation ALARA Management' (RP-PRC-0009) identifies planning strategies to control dose and minimize exposure at Barakah NPP. Nawah's policy is to set its own administrative dose limits to 80% of statutory limits. FANR has inspected the Nawah Radiation Protection Program (including implementing procedures) and had one finding in respect of allowing the use of emergency dose limits (per FANR-REG-12), under abnormal conditions, without an emergency being declared; this has now been closed.

In response to a Pre-OSART suggestion, the INIR team was informed that Nawah has reviewed its procedures and practices and established behaviours to minimise the spread of contamination and set standards that ensure the accurate measurement of contact dose rates.

The INIR team was informed that Nawah had amended its administrative dose limit for the lens of the eye to 16 millisievert (mSv) per year. This is intended to implement the latest IAEA requirements laid out in the publication Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards Series No. GSR Part 3. The INIR team was also informed that Nawah does have systems in place to cater for the control of exposure to pregnant women and breast-feeding mothers, on the assumption that personnel concerned declare themselves to Nawah; these control mechanisms are described in procedures controlling access to the Radiologically Controlled Area.

The team was informed that a fully integrated system for preparing Radiation Work Permits (RWP) and controlling worker exposure has been included in the Operating Management System (OMS) with pilot testing undertaken; KHNP experience was utilised in developing the system.

Nawah has a Radiation Protection Department of 31 staff. This currently comprises of a manager, three section heads and 18 engineers. However, there is a proposal awaiting approval which would see this becoming one director, two managers, four section heads and 18 engineers; this elevation in the organisational hierarchy is to be welcomed. Engineers are qualified through On the Job Training and Task Performance Evaluation. Section heads and managers require professional qualifications and previous experience in radiation protection. The director's job specification requires an appropriate degree and at least three years of experience.

In August 2017, FANR assessed Nawah's Technical Training Program for Radiation Protection personnel to support Organisational Operational Readiness and determined that it met the requirements for the Systematic Approach to Training process.		
Areas for further action	**Significant**	
	Minor	
RECOMMENDATIONS		
SUGGESTIONS		
GOOD PRACTICES		

9. Electrical Grid Condition 9.1: Interface between operating organization and grid company effective	Phase 3
Summary of the condition to be demonstrated	Arrangements in place for coordination of grid operation with power plant operation.
Examples of how the condition may be demonstrated	1. MOU between grid operators and NPP operators on how grid will be managed to ensure reliable support for the NPP and prevent unnecessary shutdowns/power reductions; 2. Protocol for scheduling shutdowns (and power changes if projected) and managing grid maintenance.

Observations

Abu Dhabi Transmission and Despatch Company (TRANSCO) is mandated to manage the electrical grid development, access and control within Abu Dhabi. TRANSCO is a subsidiary of Abu Dhabi Water and Electricity Authority (ADWEA). On 4 January 2016, ENEC and TRANSCO entered into a 'Connection, Use of System and Interface Agreement' (LGL-CON-16-001) to coordinate and control the grid connection and interfaces required for the Barakah NPP. This agreement specifies the requirements for the NPP grid connection such as responsibilities, access terms, connection point plans, charging rules, the establishment of protection equipment etc. Where necessary this connection agreement will be updated through the addition of annexes to the agreement.

To supplement and give effect to the connection agreement ENEC/Nawah and TRANSCO have developed their own procedures. Nawah has established an Operations Coordination Procedure (OP-PRC-0013) which establishes communication, responsibilities and interface protocols between the NPP and grid operator. TRANSCO has also developed its own procedures specifically for the management of the integration of the NPP. Where necessary these agreements will be shared between the organisations and added as annexes to the connection agreement.

Nawah has scheduled and conducted training for the TRANSCO operators. Similarly, TRANSCO has scheduled and conducted training for the Barakah NPP Unit 1 Operators.

Future upgrades and enhancements to the electrical grid are coordinated between ENEC and TRANSCO through the connection agreement.

TRANSCO produces an 'Electricity Seven Year Planning Statement — Main Report' which is updated annually. This report details all future grid expansion plans as well as their likely impact on the system operation. This allows the relevant Barakah NPP personnel to timely assess all planned grid developments and management changes in terms of their potential impact on the NPP.

Nawah has an established Work Management Program (WM-MAN-0001) which controls the scheduling and management of maintenance activities, planned load reductions and load-threat sensitive work activities. Activities are scheduled and communicated sufficiently ahead of time between Nawah and TRANSCO to allow for the resolution of responsibilities and interfaces.

A license to generate electricity to the grid is required and has been obtained by ENEC/Nawah. This license is issued and managed by the Department of Energy.		
Areas for further action	**Significant**	
	Minor	
RECOMMENDATIONS		
SUGGESTIONS		
GOOD PRACTICES		

9. Electrical Grid **Condition 9.2: Plans for grid enhancement executed**	**Phase 3**
Summary of the condition to be demonstrated	Necessary upgrades and enhancements to the grid and interconnections completed and tested.
Examples of how the condition may be demonstrated	Report on current status of required enhancements.

Observations

The INIR team was informed that all the necessary upgrades, grid enhancements and interconnectors required for the operation of Barakah NPP Units 1 and 2 have been completed. These enhancements include 3 sets of double overhead lines to three different substations. Two of these substations are in the vicinity of other generation stations. The third is interconnected to a separate energy grid operated by the Gulf Countries Council Interconnection Authority (GCCIA).

Several grid upgrades and enhancements have yet to be tested. Planning is currently underway between ENEC, Nawah and TRANSCO to ensure that all necessary performance tests are catered for during the Power Ascension Tests (PAT). Various tests are required. These are prescribed by KEPCO as well as the Electricity Transmission Code. Several additional tests required by TRANSCO have been added to the PAT programme.

ENEC and TRANSCO have completed various initial studies to assess the impact of a full power trip and major grid component failures. Some tests relating to the response of the NPP to large changes in grid frequency will be simulated as testing is impractical.

Areas for further action	**Significant**	

	Minor	
RECOMMENDATIONS		
SUGGESTIONS		
GOOD PRACTICES		
9. Electrical Grid **Condition 9.3: Grid reliability demonstrated**		**Phase 3**
Summary of the condition to be demonstrated	Results of analysis to confirm the reliability of the national grid system provided regularly and contingency arrangements in place for restoration of power in the event of a major loss of grid capability.	
Examples of how the condition may be demonstrated	1. Agreements of provision of regular reporting of grid reliability; 2. Defined arrangements for restoration of power in the event of a major loss of grid capability; 3. Tests planned to address impact of full power trip and major grid component failures.	

Observations

A detailed electrical grid integration study specifically addressing the Barakah NPP Units 1–4 has been compiled by TRANSCO. The INIR team was informed that the results of analysis conducted to date confirmed the reliability of the national grid system as well as the arrangements for restoration of power in the event of a major loss of grid capability.

Historically the electrical grid in Abu Dhabi has demonstrated good reliability. Additional 8.6 MW AC diesel generators, one for every two units, have been installed on-site within a dedicated building. No additional off-site auxiliary electrical supplies are foreseen.

TRANSCO manages a Power System Emergency Management and Response Plan (EMRP) which is updated and issued on an annual basis. This plan establishes the methodology for the co-ordinated restoration of power to all consumers in the Emirate of Abu Dhabi as well as relevant consumers in the northern emirates of the UAE as quickly and safely as possible following an emergency situation, as well as in the case of a total or partial blackout. This response plan defines the relevant duties of all TRANSCO departments and sections as well as duties of the interconnected generation and distribution companies in order to realise the objective of achieving a fast but safe restoration of supply through coordinated teamwork.

Barakah NPP is prioritised in the grid response plan — in order to enhance reliability — by being excluded from any load shedding that may be necessary to maintain the grid frequency. This prioritisation also extends to the dispatch priority of the NPP essentially classifying it as a baseload generation station. In addition to this, the NPP is the first to be provided power following the restoration of the system so as to alleviate extended periods of islanded operations or loss of off-site power. The response plan classifies various emergencies and for each class defines the associated responsibilities of ADWEA Crisis Management Committee and group companies. The emergency classification and related responsibilities are also detailed in the Corporate Crisis Management Plan Manual.

Areas for further action	**Significant**	
	Minor	
RECOMMENDATIONS		
SUGGESTIONS		
GOOD PRACTICES		

10. Human Resource Development **Condition 10.1: On-going human resource development programme in the operating organisation effective**	**Phase 3**
Summary of the condition to be demonstrated	Programs for training and development of staff in the operating organisation are in place and effective to support the continued operation of the current and future units.
Examples of how the condition may be demonstrated	1. Initial and continuing training programmes and mechanisms to review their effectiveness in place; 2. Availability of suitable training facilities including a full scope plant specific simulator, and competent trainers; 3. Recruitment and training programmes that recognize the need for new and replacement staff, depending on the overall programme objectives; 4. A review/accreditation of training against national or international standards (e.g. INPO); 5. Availability of a leadership development programme.

Observations

The Pre-OSART mission report states the following:

— "There are appropriate plant procedures developed in which the structure, levels of authority, functions, roles and responsibilities in training are well described. All training activities are well supported by the senior management of the plant as demonstrated by the resources, both human and financial, available to support training needs. An appropriate set of Key Performance Indicators KPI is available in training and follows the structure of goals and objectives set in the plant Business Plan. These KPIs are reported regularly to the plant management for review.";
— "Training instructors demonstrated very good lecturing and presentation skills (…). Despite close cooperation between training instructors and subject matter experts from the line departments, the team observed the mechanism to systematically sustain the instructor's knowledge, skills and familiarity of work practices can be improved";
— "Appropriate initial training programmes are established, developed and implemented for Operations and most other technical departments. Refresher training is regularly conducted."

The INIR team was informed that the instructor qualification procedure has since been revised to include the requirements for instructors to participate in field activities.

Nawah has a department responsible for recruitment and training of personnel. It also provides training services for ENEC based on a Service Agreement. Since the Korean training model was not fully applicable, Nawah developed its own training and qualification program.

Nawah is currently recruiting and providing induction training for around 48 staff per month. All recruited staff are required to complete the 2½ week induction training.

There is a fully operational Technical Training Centre and all its workshop facilities are fully equipped. A modern simulator training center is available at the plant site which is equipped with two full scope simulators. A series of additional Main Control Room simulators has been developed by the plant.

Ten areas identified in the January 2017 Pre-OSART self-assessment have also been addressed. The implementation of the remaining action is planned for completion and monitored through 'Corrective Action Programme' (eCAP).

All training programs address Nawah's multinational and multicultural structure.

Areas for further action	**Significant**	
	Minor	

RECOMMENDATIONS

SUGGESTIONS

GOOD PRACTICES

10. Human Resource Development **Condition 10.2: Ongoing human resource development programme in the regulatory body effective**	**Phase 3**
Summary of the condition to be demonstrated	Programs for training and development of staff in the regulatory body to oversee the commissioning and operational phase of the NPP are in place and effective.
Examples of how the condition may be demonstrated	1. Plans to develop capability to carry out inspections and reviews for the operational phase; 2. Ongoing training programmes and mechanisms to review their effectiveness in place; 3. Availability of a leadership development programme.

Observations

FANR has developed a full competency framework profiles for each job position in the nuclear, radiation, security and safeguards functions. The competency framework considers the knowledge, skills and attitude requirements for all phases including for the operational phase of the nuclear power plant.

FANR is identifying areas for improvement of its Leadership and Management Development programme that will enable employees to become better leaders and valuable contributors to FANR's broader regulatory and transparency goals. FANR has issued a Request for Proposal (RFP) to develop a customized Leadership Development Programme

which is aimed to focus on generic management and leadership competencies as well as technical regulatory leadership competencies. The design and implementation of this programme is envisaged for end 2018. Moreover, FANR has established an Inspector Qualification Programme which includes a phased training approach to authorize inspectors to perform inspections at Barakah. Every three years an inspector is required to participate in requalification/refresher training to renew their inspector status and to maintain the relevant operating knowledge.

FANR has embarked on a Transition to Operations Training Plan which includes a detailed training plan to ensure all its employees are ready to fulfil their roles for regulating the operational phase.

FANR has recently sent three UAE nationals to complete an intensive Westinghouse Management Senior Reactor Operator Certification Programme. FANR has further developed the technical competencies of its staff members, UAE nationals, through secondment programmes to the US NRC, in the construction inspection areas, for a period of 6 months.

As part of the transition plan, the FANR Emergency Preparedness and Response Organization (FERO) has developed and implemented qualification cards detailing the training requirements for each member of FERO. This includes the Nuclear Assessment Team and the Barakah Radiological Assessment Team. Included in these training sessions is FANR's participation in Nawah Emergency Drills as well as the IAEA organized drills.

The UAE nationals constitute now 60% of FANR workforce; FANR is aiming to increase the quota by 10% each year.

Areas for further action	**Significant**	
	Minor	

RECOMMENDATIONS

SUGGESTIONS

GOOD PRACTICES

10. Human Resource Development **Condition 10.3: National educational programmes and research and development to support capacity building implemented**	**Phase 3**
Summary of the condition to be demonstrated	National educational and research programme required to support the nuclear power programme in place.

Examples of how the condition may be demonstrated	1. Evidence of university courses/research activities in support of the nuclear programme; 2. Support for research programmes; 3. Combined initiatives by government and industry to support educational programmes; 4. Availability of relevant university programmes; 5. Availability of technician training institutes and craftsmen training; 6. Ongoing maintenance of the National Capacity Building Plan.

Observations

ENEC and its subsidiaries (Nawah and Barakah One Company) work with local universities to support recruitment of qualified UAE workforce for the operation of the Barakah NPP. There is also an outreach program to schools to encourage students to study science and advise them of career possibilities with ENEC and its subsidiaries. The Higher Diploma in Nuclear Technology program is a long-term manpower supplier for technician positions within Nawah. The program is a joint venture between Abu Dhabi Poly Technical and Nawah's Capacity Building department.

Nawah Energy Company has been certified as a National Registered Training Provider by the Vocational Education and Training Awards Council (VETAC), the regulator for the National Qualifications Authority (NQA). As a certified training provider Nawah is authorized to issue nationally-endorsed qualification certificates.

ENEC and Nawah partnered with the IAEA, Khalifa University and the Federal Authority for Nuclear Regulation (FANR) to hold an UAE-IAEA Nuclear Energy Management School, which provides a unique international educational experience aimed at building future leadership to manage nuclear energy programs and to nourish a wide range of knowledge on issues related to the peaceful use of nuclear technology.

FANR Research and Development Policy was approved by the Board of Management. The main objective for establishing a government-funded nuclear R&D programme is to provide the necessary conditions for the safe and reliable implementation of peaceful nuclear activities in the UAE, and to develop know-how, expertise and institutional capabilities in the country to allow for excellence and innovation, as well as meaningful participation in international research and development. This R&D programme will help build the long-term capacity to support the UAE nuclear energy programme through creating partnerships with other national and international research organisations.

A draft 'White Paper' was prepared by ENEC on R&D that was focused on ENEC needs. FANR joined this initiative and there was a meeting of all stakeholders to develop an integrated programme. The resulting proposal has not been yet approved and it is not clear what are the next steps.

Areas for further action	**Significant**	National R&D programme
	Minor	

RECOMMENDATIONS

R-10.3.1 The UAE should develop a national programme on research and development (R&D) to support the ongoing nuclear power programme and implement it.
SUGGESTIONS
GOOD PRACTICES

11. Stakeholder Involvement Condition 11.1: Transparent and open communications continue		Phase 3
Summary of the condition to be demonstrated	Government, Operator and regulatory body have a programme of stakeholder involvement that maintains a proactive, transparent and open approach, including statutory requirements.	
Examples of how the condition may be demonstrated	1. Operational public information centres; 2. Evidence of communications with the media and public; 3. Continued communication, led by the government explaining the rationale for nuclear power; 4. Qualified and experienced staff in place; 5. Public opinion surveys; 6. Mechanisms set up by operating organization for local stakeholder involvement; 7. Well defined and implemented stakeholder involvement plan for the operating organization; 8. Open information policy and practice in the regulatory body; 9. Examples of regulatory stakeholder communications; 10. All organizations continue to share with one another their stakeholder management plans.	

Observations

Many outreach activities have been conducted at a governmental, operator and regulatory body levels. These activities are implemented through interfaces with local communities, schools, governmental entities and media. The activities have been supported using multiple media channels including social media, public relations and organised events.

There is a visible Government's support for stakeholder involvement and public communication. This includes a commitment to transparency, availability of resources and the enabling of communication staff in the development and implementation of communications strategies and plans.

ENEC has developed a five-year communications strategy and its communication department is mandated to ensure the continuity of effective communication activities and alignment with the Government's strategy and initiatives. ENEC has established communications with the media and the public through specific procedures that are part of ENEC's integrated management system. ENEC has an annual stakeholder involvement plan for addressing each stakeholder group.

The INIR Team was informed that ENEC is establishing three information centres. The main centre will be built in the ENEC headquarters in Abu Dhabi, the second will be housed at the Barakah NPP site and the third one will be a mobile information centre. These centres are intended to raise awareness about the UAE peaceful nuclear energy programme.

To date ENEC has conducted six public opinion surveys and two stakeholder opinion polls. Public opinion and stakeholder satisfaction are measured through annual opinion polls. The results of these polls are analyzed and relevant issues addressed via changes to the communication strategy and plans. Public support for nuclear power reached 82% according to the results of the latest survey. However, 66% of people believe that nuclear power plants release high levels of radiation and 59% believe it is dangerous for workers. ENEC will focus on addressing these results by making changes to their

ongoing stakeholder involvement programme.

Nawah, as the operating company, has developed an annual stakeholder involvement plan for the areas directly related to the operation of the Barakah NPP. Nawah closely collaborates with ENEC to achieve a common framework and approach to coordinate stakeholder involvement related activities.

Both ENEC and Nawah are active in communication through the 'Majalis'. 'Majalis' can be translated as 'place of sitting' and is equivalent to a 'council' representing different interest groups. The UAE Federal Government is responsible for this communication approach.

FANR has a 5-year communication strategy which includes a set of strategic objectives and priorities. This strategy covers multiple stakeholders including staff, media, public and neighbouring countries. A procedure on how to communicate with media and public has been developed and approved. This procedure aims at ensuring effective management and implementation of the day to day communications. Official spokespersons are identified and prepared through a comprehensive training programme.

FANR's communication objectives are focused on establishing and maintaining public trust for its nuclear regulatory role. FANR's communication plan and performance are monitored and measured by the Prime Minister's office to ensure its effectiveness and sustainability.

The INIR team was informed that FANR promotes openness by encouraging the public to ask questions. FANR also actively seeks stakeholder and public input when drafting nuclear regulations. All established regulations are made publicly available on FANR's official website. FANR hosts regular awareness sessions for licensees, governmental agencies and the public. These awareness sessions provide information about FANR's responsibilities and assist to develop transparent relations with the public and key stakeholders including 'Majalis'. FANR also makes use of social media to solicit comments on draft regulations. This mechanism proved to be very effective.

FANR recently launched its student outreach programme and 'Majalis' sessions to engage students and members of the public on the regulatory activities being carried out by FANR. Government entities are also important stakeholders for FANR. They have frequent engagement with other government entities, such as the Federal Customs Authority (FCA), where the role of FANR and the status of the nuclear power programme is discussed.

FANR has established a corporate communication function tasked with ensuring that communication is effective and consistent. Communication should reflect FANR mission and roles for the UAE nuclear energy programme by promoting independence, collaboration, excellence and transparency.

FANR is planning to conduct its first public opinion survey in 2018 to measure the level of public awareness and confidence. FANR has however already conducted multiple surveys with specific segments and stakeholders following outreach or awareness sessions.

ENEC, Nawah and FANR hold periodic ad-hoc coordination meetings to ensure that a coordinated approach is maintained during communications with stakeholders. This coordinated approach makes careful provision to maintain the separation of roles and responsibilities as per the mandates of the different organizations.

Areas for further action	**Significant**	
	Minor	

RECOMMENDATIONS
SUGGESTIONS
GOOD PRACTICES

12. Site and Supporting Facilities Condition 12.1: Confirm/update site characterisation parameters and continue site monitoring	Phase 3
Summary of the condition to be demonstrated	The operating organisation has confirmed the site characteristics, taking into account information obtained during the construction phase. The operating organisation has a plan for on-going monitoring to ensure the site continues to meet the design intent.
Examples of how the condition may be demonstrated	1. A report confirming the site characteristics, taking into account monitoring data and information obtained from construction; 2. Arrangements to monitor the characteristics of appropriate natural and human induced hazards as well as the demographic, meteorological and hydrological conditions of relevance.

Observations

The Barakah site was selected in 2009 as a result of the site selection process.

In April 2013 FANR issued the regulation REG-02 (Siting of Nuclear Facilities) which specifies the requirements to be used within the UAE when evaluating potential sites for NPPs. The regulation requires that the owner/operator establishes "measures to monitor and verify [that] all site characteristics remain within the assumptions used in the design and the final safety analysis report throughout the life of the nuclear facility".

Detailed site characterisation studies have been conducted to meet the requirements of the regulation. Results of these studies have been documented and included in Chapter 2 of the PSARs and FSARs. This chapter has been periodically updated by ENEC/Nawah and submitted to FANR for review as a component of the PSAR for Units 1 and 2, PSAR for Units 3 and 4 and FSAR for Units 1 and 2. These updates include any new information on site characteristics found from routine monitoring. During each review, FANR raised Requests for Additional Information (RAIs) all of which were closed and compiled in the Safety Evaluation Report (SER)

An IAEA Site and External Events Design (SEED) Review Mission was conducted from 21 to 24 November 2011. This SEED mission focussed on FANR's SER of the PSAR for Units 1 and 2. A number of recommendations were made during this mission and the INIR team was informed that all of these have been addressed.

Based on the Chapter 2 information submitted in PSARs, FANR has issued two construction licenses for the four Units on the site.

Lessons learned from the Fukushima Daiichi accident were evaluated by ENEC/Nawah and changes implemented where necessary. This evaluation followed an approach modelled on the 'stress test' approach of the European Nuclear Safety Regulators Group (ENSREG).

The INIR team was informed that all information obtained during the construction phase by ENEC and Nawah has confirmed the original site characterisation assessment. In addition to this Nawah has a plan for on-going monitoring to ensure the site continues to meet the design intent as required by the regulation. This plan has been accepted by FANR.

Requirements for a 10-yearly review of the site related aspects pertaining to nuclear safety have been established by FANR in the regulation REG-16 for Operational Safety including Commissioning

(FANR-REG-16, Article 14). However, it was noted that the first review of this kind will take place after 5 years of operation.		
Areas for further action	**Significant**	None
	Minor	None
RECOMMENDATIONS		
SUGGESTIONS		
GOOD PRACTICES		

13. Environmental Protection Condition 13.1: Environmental limits and conditions defined	Phase 3
Summary of the condition to be demonstrated	The licence conditions include any environmental conditions and limits. *Note: This covers off-site releases from planned operation and all other environmental issues. The protection of workers and public on-site during planned operation. are addressed under Issue 8. Radiation Protection and accidental releases and associated radiation protection are addressed mainly under Issue 14. Emergency Planning.*
Examples of how the condition may be demonstrated	Availability of environmental conditions and limits and processes to ensure they are met.

Observations

Radiological limits are documented in Article 4 of the FANR regulation FANR-REG-04 (Radiation Dose Limits and Optimisation of Radiation Protection for Nuclear Facilities). Requirements for the discharge conditions and the establishment of a monitoring and reporting system for radiation releases are documented in Articles 23 and 24 of the FANR regulation FANR-REG-11 (Regulation for Radiation Protection and Predisposal Radioactive Waste Management in Nuclear Facilities).

The FANR regulations require licensees to take all reasonable precautions to control the release of radioactive material or hazardous substances within the site of the licensed activity and into the environment.

In order to address these regulatory requirements, ENEC/Nawah has issued the Offsite Dose Calculation Manual (ODCM) ENV-MAN-0002 Rev 2. The ODCM describes the methodology and parameters proposed by the licensee to be used in the calculation of offsite doses due to radioactive liquid and gaseous effluent discharges. The manual also establishes the pre-operational Radiological Environmental Monitoring Program (REMP) and the alarm and/or trip set points to ensure that the established limits and constraints are not exceeded.

Methodologies and calculations adopted in the ODCM have been derived from appropriate guidance from the US Nuclear Regulatory Commission, the Korea Nuclear Safety and Security Commission and the International Commission on Radiological Protection. The ODCM has been assessed by FANR in terms of meeting the UAE regulations and all associated RAIs are reported to be closed.

The Environment Agency – Abu Dhabi (EAD) is mandated to issue and manage environmental permits within the Emirate of Abu Dhabi. Requirements for environmental monitoring and protection are established by the Federal Law No. 24 of 1999 (as amended in 2006) concerning the protection and development of the environment.

ENEC/Nawah compiled a Non-Nuclear Environmental Impact Assessment (NN-EIA) and a Nuclear Environmental Impact Assessment (N-EIA) for the Barakah NPP Units 1–4. These assessments were submitted to EAD in 2010 in support of the environmental permit application. EAD reviewed this

application and granted a 'No Objection Certificate' for the construction activities of the Barakah NPP. The associated environmental permit needs to be renewed on an annual basis.

Limits and conditions for environmental impacts during operations have been established via the environmental permit as well as in an Operation Environmental Management Plan (OEMP). This plan details the non-radiological environmental parameters that will be monitored in order to demonstrate operational activities are compliant with applicable legislation and standards.

Areas for further action	**Significant**	
	Minor	

RECOMMENDATIONS

SUGGESTIONS

GOOD PRACTICES

13. Environmental Protection **Condition 13.2: Environmental monitoring programmes in place**	**Phase 3**
Summary of the condition to be demonstrated	An environmental monitoring programme is in place that allows the impact of operation to be assessed through comparison with the baseline study.
Examples of how the condition may be demonstrated	1. An operational environmental monitoring system in place as agreed in the EIA; 2. The Radiation Protection module of OSART (Module 4.7), particularly the sub-section on radioactive waste management and discharges, includes a review of some environmental monitoring arrangements.

Observations

In 2015, ENEC initiated the preparation of a pre-operational Semi-Annual Radiological Environmental Operating Report (SAREOR) in accordance with the approved pre-operational Radiological Environmental Monitoring Program (REMP. This report has been updated and submitted to FANR on a six-monthly basis in accordance with the applicable regulations.

The Barakah NPP's operational REMP will be based on the results of the pre-operational REMP although minor modifications are expected to be made to some minor surveillance methodologies and/or frequencies. The responsibility to update and submit the SAREOR will be transferred to Nawah once the operating license for Unit 1 has been granted.

In 2015, FANR initiated the compilation of a baseline report characterising the radiation levels and radioactive materials in the environment of the UAE. This report is currently under review and is

expected to be published on FANR's website once approved. The report is expected to be updated on an annual basis.

FANR has established an environmental laboratory and is continuing to develop its capabilities to analyse environmental samples of radionuclides discharged from nuclear facilities. This laboratory will be used to verify environmental monitoring results submitted by licensees. FANR has also established a network of gamma monitoring stations throughout the country and near to Barakah. These will provide gross gamma measurements and assist in the monitoring of radiological environmental impacts.

The Operation Environmental Management Plan (OEMP established by ENEC/Nawah, as required by the environmental permit, will be used to monitor the non-radiological environmental parameters in order to demonstrate that operational activities are compliant with applicable legislation and standards. The OEMP has been approved by EAD and reports are required to be submitted on six-monthly basis.

The original NN-EIA prepared in 2009 provides the non-radiological baseline against which future possible impacts will be monitored and measured. This baseline has been updated during the construction phase resulting in a new revision in 2016.

Areas for further action	**Significant**	
	Minor	
RECOMMENDATIONS		
SUGGESTIONS		
GOOD PRACTICES		

14. Emergency Planning Condition 14.1: Owner/operator emergency arrangements in place and tested		Phase 3
Summary of the condition to be demonstrated	The operating organisation has prepared and tested its emergency preparedness programme and it has been verified by the regulatory body.	
Examples of how the condition may be demonstrated	Documentation describing the operating organisation's emergency arrangements; facilities and equipment in place to support the plan; regular test of the arrangements.	

Observations

In February 2016, the UAE conducted its first full scale exercise of the emergency plan for a nuclear accident at the Barakah NPP, with demonstration of both onsite and offsite emergency response capabilities.

The Pre-OSART report stated that Nawah had not yet demonstrated the deployment and capability of the mobile accident management equipment and noted several inadequate or missing arrangements. Currently all planned mobile equipment is onsite and demonstration of its use is expected in the 4th quarter 2018; the final deployment to permanent Accident Management Program Warehouse will be accomplished during the 2nd quarter of 2019. The INIR team was informed that all the missing arrangements identified in the Pre-OSART have been addressed.

In early October 2017, a FANR team conducted an inspection to review the status of the Nawah Emergency Preparedness Programme in preparation for the 24 October 2017 exercise. FANR raised ten issues of concern in its inspection report. The majority of the issues of concern are now closed, with the remainder anticipated to be closed by the 4th quarter of 2018.

Nawah conducted an emergency response exercise on 24 October 2017. This exercise was performed to fulfill Nawah's obligation to conduct a full-scale emergency exercise before Unit 1 fuel load. Nawah evaluators identified a number of issues that have been closed, except one. FANR's finding from the exercise evaluation was that Nawah's critique and exercise evaluation report did not identify and document performance gaps that were observed by FANR assessors. This issue is scheduled to be resolved by 4th quarter of 2018.

It is planned that another full scope exercise will be conducted in 4th quarter of 2019.

Nawah's self-assessment before the Pre-OSART mission recognized several gaps regarding its emergency preparedness and response capability.

The INIR team was informed that all gaps are now resolved with the exception of the Assembly and Accountability drill. This drill is planned for 2019, after the Physical Protection System is completed.

In March 2015, ENEC submitted, on behalf of Nawah, an Operating License Application (OLA) which included the On-Site Emergency Plans. FANR has completed the review of this and concluded that it meets requirements of the FANR regulation FANR-REG-12.

Areas for further action	**Significant**	

	Minor	
RECOMMENDATIONS		
SUGGESTIONS		
GOOD PRACTICES		
14. Emergency Planning **Condition 14.2: Government and Regulatory body arrangements in place and tested**		**Phase 3**
Summary of the condition to be demonstrated	The government (through defined EPR entities) and regulatory body have prepared a national plan, together with arrangements to implement their responsibilities, and ensure clear decision making process at all stages of the emergency. Arrangements have been demonstrated through a national emergency exercise involving all relevant organizations. Regulations for emergency worker dose protection are in place.	
Examples of how the condition may be demonstrated	1. Regulatory requirements for EPR defined including: operator notifications, emergency dose protection; 2. Procedures to implement the regulatory and government roles; 3. Availability of facilities and equipment to support the plan; 4. Arrangements for international notifications; 5. Plans for medical treatment of exposed persons.	

Observations

The Law No. 6 of 2009 on the Peaceful Uses of Nuclear Energy specifies the responsibilities of the licensee, the competent government authorities and FANR regarding emergency preparedness and response, including the development, review, approval and oversight of the Licensee's onsite and the off-site emergency plans.

The Law No. 2 of 2011 establishes the National Emergency, Crisis and Disasters Management Authority (NCEMA) as the national competent authority for developing national emergency response plans, coordinating response and conducting exercises. This law outlines the main functions and responsibilities assigned to NCEMA to implement the UAE policy regarding necessary procedures to be used for managing and coordinating emergencies, crises and disasters. NCEMA reports to the Supreme Council of National Security.

FANR and NCEMA entered into a Memorandum of Understanding (MOU) on 15 July 2012 relating to the Cooperation in the Field of Nuclear and Radiological Emergency Preparedness and Response. Under this MOU, FANR will provide support in the event of radiological or nuclear emergencies.

The INIR team was informed that the legal framework is being revised to take into account the additional NCEMA functions.

In February 2016, the Ministry of Interior (MOI), in cooperation with relevant entities, developed and issued the third version of the Off-site Nuclear and Radiological Emergency Response Plan for the Barakah NPP (hereafter referred to as the Off-site Plan) which describes the roles and responsibilities of each national and local response entity, and the various support organizations.

NCEMA, FANR, ENEC and other relevant entities conducted five table-top drills, eight Integrated Facility Drills, and two drills with offsite participation to enhance the coordination between the on-site and off-site activities for the Barakah NPP before the Fuel Receipt Exercise. ENEC and other relevant entities, in coordination with FANR and NCEMA, successfully conducted a Full-Scale Fuel Receipt Exercise on 23 February 2016.

The EPREV report states that the authorities for preparedness and response are clearly defined in the National Emergency Framework and in the regulations. All key organizations are addressed.

The regulation FANR-REG-12, Regulation for Emergency Preparedness for Nuclear Facilities, establishes emergency exposure limits for emergency workers.

Medical support and treatment for conventional and radiological injuries can be provided by the Al Ruwais Hospital which has the capability for treating exposed or contaminated personnel.

The off-site facilities required to be operable during a nuclear emergency in accordance with the Off-site Emergency Plan includes the incident commander emergency operation centre, reception centres, shelter(s), medical response facilities and a public information centre. All facilities except for the permanent reception center are operable. Currently the reception centres are mobile which are to be deployed in either the west or east of the Barakah NPP, depending on the wind direction.

Construction of the permanent reception centre for the east side of the Barakah NPP has been approved and the budget allocated. Construction will start in 2019. This center will serve also as a Chemistry, Biological, Radiological and Nuclear (CBRN) center and also for the Abu Dhabi National Oil Company (ADNOC).

FANR has established its Emergency Response Organization (FERO) which comprises a number of teams that may respond to an emergency situation at the Barakah NPP.

FERO members perform their tasks from an Emergency Operations Centre located at FANR headquarters. This centre has dedicated equipment, tools, communication systems and documentation, and it is fully operational. FERO staff qualification system is ongoing.

The coordination with the neighboring states in the region through the Regional Plan is well established and considered as a good practice by the EPREV mission.

FANR requirements for the Emergency Planning are described in two regulations: Regulation for Emergency Preparedness for Nuclear Facilities (FANR-REG-12) and Requirements for Off-site Emergency Plans for Nuclear Facilities (FANR-REG-15).

The revision of the regulation REG-12 started last year and included the revision of the Regulatory Guide 24. The internal review is done, and the stakeholder review is continuing. Publication is expected

in 2019. The IAEA publication entitled Preparedness and Response for a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GSR Part 7, is to be taken into consideration.

The UAE Action Plan addressing the actions related to the onsite emergency plan and offsite emergency plan based on the EPREV mission recommendations and suggestions have been prepared and monitored by ENEC, NCEMA and FANR. The INIR team was informed that all recommendations and suggestions are addressed.

Areas for further action	**Significant**	No
	Minor	No

RECOMMENDATIONS

SUGGESTIONS

GOOD PRACTICES

14. Emergency Planning **Condition 14.3: Arrangements for regular training, drills and exercises in place**	**Phase 3**
Summary of the condition to be demonstrated	A programme of training, drills and exercises to confirm the ongoing acceptability of their emergency response arrangements has been defined for each organization and for integrated exercises.
Examples of how the condition may be demonstrated	1. Plans for each national organization to test their arrangements in isolation; 2. Plans for integrated exercises to demonstrate the overall national plan.

Observations

FANR Regulation No. 15, Article 7, requires that a full-scale exercise should be conducted at least every two years.

Since September 2015, Nawah participated in numerous table-top exercises and in over 20 drills. Two full scope exercises were conducted in February 2016 and October 2017 and evaluated by FANR/NCEMA.

FANR takes the opportunity of Nawah's drills, exercises and rehearsals to activate its own Emergency Response Organization (FERO) and test its abilities to take the necessary decisions during an emergency at the Barakah NPP, cooperate with relevant entities and meet UAE's obligations at the international level.

Several table-top exercises and awareness sessions were implemented by FANR targeting relevant entities at federal and emirate level.

NCEMA, in cooperation with the main stakeholders, organized the two full-scope exercises and four drills. NCEMA has developed exercise evaluation criteria guidance that is used for the evaluation of the exercises and drills that have been conducted. An action plan for improvement was developed after the October 2017 exercise.

Nawah drills and exercises are scheduled in accordance with an eight-year plan. The Pre-OSART identified that no drills or exercises were planned for:

— Outside working hours (at night, week-ends etc.);
— That are not pre-staged;
— Scenarios combined with external hazards such as oil spills.

The INIR team was informed that the eight-year plan has been modified, taking into account lessons learned from the various exercises and the Pre-OSART evaluation. However, exercises have still not been planned for outside working hours. Nawah noted that procedure revisions will be in-place by July 2018 that will ensure all the above objectives will be adequately demonstrated in a drill or exercise within the current 8-year cycle.

Areas for further action	**Significant**	
	Minor	
RECOMMENDATIONS		
SUGGESTIONS		
GOOD PRACTICES		

15. Nuclear Security Condition 15.1: Physical protection system demonstrated and approved	Phase 3
Summary of the condition to be demonstrated	The physical protection system has been completed, tested and approved by the regulatory body and the procedures, training and testing requirements for the protection of nuclear material are in place.
Examples of how the condition may be demonstrated	1. Evidence of acceptance by, and handover to, the operating organization of the physical protection system; 2. Evidence of review and approval by the regulatory body; 3. Procedures for system maintenance and testing and training of personnel.

Observations

Construction and installation of the Physical Protection System (PPS) is nearly completed on the site. Individual elements of the PPS are subjected to a four-step process to ensure system reliability. The four phases include: (1) site acceptance testing; (2) performance testing; (3) on-going operability testing; and (4) maintenance. System reliability commissioning and testing is being led by the Chief Program Office (CPO) with a 3rd party validations being performed by elements of the ENEC Deputy Chief Executive Officer (CEO) Security Department. The ENEC Security Department will maintain responsibility for ongoing testing and maintenance once CPO has completed system turn over.

ENEC has completed all areas of construction and installation with the exception of the programming of the Security Computers to include the Central Alarm Station and Secondary Alarm Station and the completion of the Bullet Resistant Enclosures and the Defensive Fighting Positions.

ENEC also reported that no elements of the PPS have been officially turned over from CPO to the Security Department but have conducted a 'soft-turnover' for training of security staff on equipment such as the X-ray machines.

The training for personnel consists of three separate phases: Manufacuturer 'train the trainer' training as the PPS is being built; Vendor 'train the trainer' training for the testing and maintenance of the PPS; and, Security Operations Training Personnel for use of the PPS utilizing lesson plans and subject matter experts as well as on-the-job- training.

Procedures for maintenance and testing are currently in development and approximately 95% are completed. Additionally, US NRC NUREG 1959 Revision 1: Intrusion Detection Systems and Subsystems and NUREG 1964: Access Control Systems will be adopted and utilized along with the US NRC Regulatory Guide 5.44: Perimeter Intrusion Alarm Systems. Lastly, vendor manuals may be adopted as well.

An IPPAS mission was conducted within the UAE in November 2016. The mission was completed while each of the 4 Units were under construction phase, and there was no fuel on site. Consequently, the IPPAS mission did not focus on the operational readiness of Unit 1 of the Barakah NPP.

FANR was involved from the early stages of construction. The PPS was reviewed but FANR has not yet inspected the PPS for overall system effectiveness. The Safety Evaluation Report has been drafted

and a readiness exercise will be conducted prior to fuel loading and lessons learned from this exercise will be utilized as part of the inspection programme. All stages of the PPS were reviewed by FANR and RAIs sent to ENEC and Nawah requesting further information. The target sets and vulnerability assessment were reviewed as part of the PPP review. It was noted that ENEC procedures are not part of FANRs review for approval.		
Areas for further action	**Significant**	
	Minor	Completion of PPS
RECOMMENDATIONS		
SUGGESTIONS		
S-15.1.1 ENEC and Nawah are encouraged to ensure that the Physical Protection System (PPS) is completed, tested and approved and the testing and maintenance procedures are in place.		
GOOD PRACTICES		

15. Nuclear Security **Condition 15.2: Contingency plan approved**	**Phase 3**
Summary of the condition to be demonstrated	The regulatory body has approved the contingency plan and an action plan agreed to address any outstanding issues.
Examples of how the condition may be demonstrated	1. Evidence of an approved security plan and contingency plan; 2. An agreed action plan being monitored to completion.

Observations

Article 46 of the Federal Law by Decree No. 6 of 2009, states that the licensees must submit a Physical Protection Plan to FANR for approval together with the application of a license. FANR-REG-08, Version 1, for Physical Protection of Nuclear Material and Nuclear Facilities requires the licensee to develop and implement such plan. ENEC submitted to FANR an application for a licence of operation of Unit 1 and 2 of the Barakah NPP including the Final Safety Analysis Report (FSAR). Chapter 20 of the FSAR is a summary of Physical Protection Plan (PPP), as well as complementary documents such as: Cyber Security Program Manual, Security Qualification and Training, Target Sets Analysis, Contingency Plan and Vulnerability Assessment.

The PPP includes the details of the design of the PPS and the security organization, which will be in place during the operation of the plant. The Contingency Plan, which has to be in conformance with the regulatory guide FANR-RG-26 for Response and Contingency Plans of Nuclear Facilities, defined the set of actions for response to unauthorized acts indicative of attempted unauthorized removal or radiological sabotage, up to and including the Design Basis Threat (DBT).

FANR has not yet approved the contingency plan but will conduct an inspection to ensure the plan is as designed and will observe an exercise to validate its effectiveness prior to approval. In accordance with the Construction Licensing Condition 6, the Construction and Operational Experience Feedback Committee will identify any shortcomings and provide feedback in accordance with the FANR Core Process 7. Based upon the short coming a regulatory position will be determined.

As part of their plan review, FANR has conducted technical reviews for safety and security interface coordination of the contingency plan and emergency plan. As a result of this review, a Request for Additional Information (RAI) regarding facility actions related to a suspension of the contingency plan was forwarded to ENEC. Additionally, ENEC has held meetings and briefings on interface issues such as command and control and ensured all stake holders have signed off on the plans. Additionally, a section of the PPP specifically addresses activities between security and operations to include emergency ingress and egress routes.

The Critical Infrastructure and Coastal Protection Authority (CICPA) is responsible to protect all critical infrastructures in the UAE, including the Barakah NPP. They are providing to Nawah, armed Response Force for responding to nuclear security events, including the DBT.

CICPA was involved in the preparation of the Contingency Plan but is not an approval authority. However, ENEC in cooperation with CICPA has conducted testing and limited scope drills in areas such as timeline and pathway analysis. ENEC has additionally tested security responder weapon engagement distances with CICPA for feasibility of actions. ENEC utilized existing international guidance and actual testing of systems during development of the plan.

Areas for further action	**Significant**	
	Minor	Completion of Contingency Plan (see Condition 15.4.)
RECOMMENDATIONS		
SUGGESTIONS		

GOOD PRACTICES

15. Nuclear Security **Condition 15.3: Leadership and security culture evident (See also 2.2)**	**Phase 3**
Summary of the condition to be demonstrated	The senior management of all organizations provide effective leadership; a nuclear security culture is evident throughout the owner/operator and its activities are verified and challenged by regulatory inspection.
Examples of how the condition may be demonstrated	1. Evidence of leadership behaviours to promote a security culture; 2. Policies and actions with respect to error reporting, questioning attitude; 3. Review of regulatory inspections of processed and behaviours carried out; 4. Planned inspections for operating phase.

Observations

A robust Nuclear Security Culture has been established in ENEC and Nawah within the security organization and site population to ensure security behaviours and consciousness are effectively communicated throughout the various organizations on site.

This is achieved through varied initiatives to include training, information campaigns and employee surveys. General plant access training for ENEC employees provides security specific training to include: (1) tamper indication training to inform plant employees on how to identify and respond to the signs of tampering or sabotage of equipment; and (2) actions personnel should take in the event that their access credential is lost or compromised.

The World Institute for Nuclear Security (WINS) developed a Nuclear Security Culture Survey and Senior Management Leadership Course which were both presented to employees and managers in 2016. The survey is provided biennially and reviewed as part of the training needs assessment.

ENEC has no defined periodicity for a senior management training but rather utilizes the adverse trend analysis to identify any additional training needs.

ENEC, in addition to the training provided upon hiring and biennial refresher training, utilizes external experts such as WINS to conduct workshops. Additionally, a security awareness programme has been established that provides continuous reminders such as posters throughout the facility and internal workshops such as awareness of the PPP.

The Nawah training center provides training for security such as plant access training and induction training for all employees. CICPA conducts this training for their personnel but also conducts joint training with ENEC and Nawah.

There are four levels of training provided depending upon position with ENEC. For temporary and external or self-employed service providers, the example given was for visitors that receive only the

information on the access form on areas and actions to be avoided. Visitors would then be assigned an escort.

In accordance with the Federal Law by Decree No. 6 of 2009, FANR has conducted inspections at the Barakah NPP regarding the safety, the nuclear security and the radiation protection. The inspections ensured that the licensee complies with the applicable law and regulations and any conditions set out in the licence requirements. FANR has completed dedicated security inspections to review the implementation of a global security culture for the applicant/licensee, the implementation of training plan and interviews with ENEC and Nawah staff. FANR is completing on-going security inspections to verify that the PPS has been built as designed; when the plant is ready to operate, FANR will conduct security inspection on its readiness.

The INIR team was informed that FANR reviews the nuclear security culture as part of all their inspection activities.

Areas for further action	**Significant**	
	Minor	

RECOMMENDATIONS

SUGGESTIONS

GOOD PRACTICES

15. Nuclear Security **Condition 15.4: Preparation and approval of the security plan**	**Phase 3**
Summary of the condition to be demonstrated	The regulatory body has approved the security plan and an action plan agreed to address any outstanding issues.
Examples of how the condition may be demonstrated	1. Evidence of an approved security plan and contingency plan; 2. An agreed action plan being monitored to completion.

Observations

Article 46 of the Federal Law by Decree No. 6 of 2009, states that the licensees must submit a Physical Protection Plan to FANR for approval together with the application for a license. The Regulation FANR-REG-08, Version 1, for Physical Protection of Nuclear Material and Nuclear Facilities requires the licensee to develop and implement such plan. ENEC submitted to FANR an application for a licence for operation for Units 1 and 2 of the Barakah NPP including the Final Safety Analysis Report (FSAR. Chapter 20 of the FSAR is a summary of the Physical Protection Plan (PPP, as well as complementary documents such as: Cyber Security Program Manual, Security Qualification and Training, Target Sets Analysis, Contingency Plan and Vulnerability Assessment).

FANR has performed a review of the PPP as well as the complementary documents and has submitted to ENEC and Nawah more than 100 Requests for Additional Information (RAIs). The Security Evaluation Review (SER) draft has been completed and it has been preliminarily concluded that FSAR Chapter 20, along with supplemental application materials, should meet regulatory requirements contained primarily in the regulation FANR-REG-08, Version 1. Confirmation by inspection will also be undertaken by FANR.

FANR has three phases for review and approval: (1) review (ECR); (2) validation through inspection; and (3) exercises. FANR has nearly completed phase 1 of the process and once finalized, will, prior to fuel load, assemble a team of inspectors to inspect aspects of the PPP and conduct exercises prior to approval. Of the 100 RAIs forwarded to ENEC, only one is remaining to be closed.

Periodic inspections will be in accordance with FANR Core Process 3 (CP3). An initial review instruction has been completed and inspection instructions for constructed as designed; ready to operate and others are progressing and will be conducted in accordance with CP3.

ENEC utilized a building block approach based upon the vulnerability analysis to ensure no conflicts between PPP and emergency plan commitments. These are validated through exercises.

Areas for further action	**Significant**	
	Minor	Completion of PPP

RECOMMENDATIONS

SUGGESTIONS

S-15.4.1 ENEC and Nawah are encouraged to complete the Physical Protection Plan (PPP), including the contingency plan, for approval.

GOOD PRACTICES

GP-15.4.1 FANR technical reviews address the safety and security interfaces in the physical protection system, and the contingency and emergency plans.

16. Nuclear Fuel Cycle Condition 16.1: Arrangements for fuel supply in place		Phase 3
Summary of the condition to be demonstrated	The provisions to secure the first few fuel reloads (consistent with the national fuel cycle strategy) have been contractually committed and responsibility for implementing the long-term strategy defined.	
Examples of how the condition may be demonstrated	1. Requirements specified in contract with fuel supplier; 2. Implementation plan for national fuel cycle strategy including any planned national fuel cycle infrastructure with well-defined time schedules.	

Observations

KEPCO Nuclear Fuel (KNF) has been contracted to provide nuclear fuel and fuel management services for the four Units at the Barakah NPP for the initial fuel load as well as the following two reloads. Options exist for the subsequent two loads after that.

Altogether ENEC has entered into contracts with six suppliers for the purchase of uranium concentrate, enrichment and conversion services.

ENEC is looking at the fuel supply market and is reviewing options for alternative supplies. The UAE has also contributed to IAEA's Low Enriched Uranium (LEU) bank in Kazakhstan.

The first fuel load for Unit 1 was delivered in several batches to the site between February and April 2017. FANR observed the unpacking of the fuel with a focus on radiation protection aspects. The fresh fuel is stored in the new fresh fuel store and in dry storage racks in the spent fuel pool.

The INIR team was informed that the storage arrangements conform to KNF's requirements and FANR's requirements set out in the regulation FANR-REG-03.

It was noted that a particular requirement of FANR-REG-16, which required an authorized Senior Reactor Operator (SRO) to be present during fuel handling, was relaxed. FANR however reviewed the arrangement for the activity and was satisfied.

Given the recently announced delay to loading fuel for Unit 1, the new fuel will be in storage for longer than anticipated. Nawah's review of Unit 1's new fuel storage arrangements takes account of adverse environmental conditions and the potential for introducing foreign material into the assemblies and are confident the new fuel will remain within specification.

As noted under Issue 18. Industrial Involvement, the UAE is considering developing its own fuel assembly line capability at some time in the future. ENEC will be responsible for developing this approach in line with its overall fuel procurement strategy. Any arrangements would conform with international non-proliferation requirements.

Areas for further action	**Significant**	
	Minor	

RECOMMENDATIONS

SUGGESTIONS
GOOD PRACTICES

16. Nuclear Fuel Cycle **Condition 16.2: Spent fuel management arrangements in place**	**Phase 3**
Summary of the condition to be demonstrated	Plans to implement the spent fuel management strategy are in place. Adequate on-site storage is available and the schedule and budget for interim spent fuel storage is consistent with the on-site storage capabilities. Any fuel take back arrangements are clear and agreed.
Examples of how the condition may be demonstrated	1. Documented and approved strategy covering interim storage, and addressing timing, funding and responsibilities of future storage facilities; 2. Contractual arrangements for handling spent fuel (fuel take back, reprocessing) in place and consistent with the national storage capacities. Transport requirements and provisions are included.

Observations

Each spent fuel pool has the capacity to store 20 years' worth of spent nuclear fuel. Nawah intends to establish an Interim Spent Fuel Storage Installation (ISFSI) before the pool capacity is reached; this will involve dry cask storage.

The location of the ISFSI and the logistics of getting spent fuel from the spent fuel pool (SFP) to the ISFSI have been studied an onsite centralized facility serving all four Units is envisaged and will be constructed if necessary. This arrangement will be used until the fuel is sent to the Geological Disposal Facility.

Financing for the construction of the ISFSI will come from the operating budget of Nawah, noting that draft FANR-REG-22 specifically disallows this financing to be provided by the DTF.

Any damaged fuel retrieved from the reactor will be placed in special containers and stored in the spent fuel pool.

New fuel leasing and take back arrangements will be the subject of ongoing studies in line with the Nuclear Energy Policy.

As with the Issue 17. Radioactive Waste Management, the Cabinet Resolution for the approval of the Policy on the Long-term Management and Disposal of Spent Nuclear Fuel and Radioactive Waste is awaited (see Recommendation 17.2.1.).

Areas for further action	**Significant**	

	Minor	
RECOMMENDATIONS		
SUGGESTIONS		
GOOD PRACTICES		

17. Radioactive Waste Management Condition 17.1: Plans for decommissioning available		Phase 3
Summary of the condition to be demonstrated	An initial decommissioning plan is developed.	
Examples of how the condition may be demonstrated	Initial decommissioning plan is developed according to the national decommissioning strategy and consistent with regulatory requirements	

Observations

Nawah's Initial Decommissioning Plan (IDP, Rev 0) was submitted in support of the Operation License Application (OLA).

FANR-REG-21, Decommissioning of Facilities, Articles 6 and 7, requires that:

"The initial Decommissioning plan shall be updated by the holder of a License for Operation of a Facility and shall be reviewed by the Authority periodically at least every three years unless otherwise required by the Authority or when specific circumstances warrant or when changes in an operational process require significant changes to the plan".

The revised version of the IDP, Rev 1, issued in March 2017, was made available to the INIR team. It is an updated version of the IDP Rev 0 taking account of the responses from Nawah to address FANR RAIs and other refinements. It is generic across all 4 Units, but individual Unit decommissioning plans will be produced in due course.

The IDP will be improved as time goes on based on operational experience, particularly in relation to waste volumes and cost estimates, and further information from the Korean reactors. The INIR team considers that it would be advantageous to have unit specific IDPs by the time of the startup of each unit and be based on information which is more relevant to the UAE.

A dedicated decommissioning section within the Nawah organisational structure has been established and they are setting up systems to monitor waste arisings and other factors which will feed into improved decommissioning and waste management cost estimates. Also, in the future, more data will be available from the Korean reactors.

FANR has reviewed the IDP Rev 1 and has no reservations with respect to it meeting the requirements of the regulations FANR-REG-21 (Decommissioning of Facilities) and draft FANR-REG-22 (Decommissioning Trust Fund) at this stage.

Areas for further action	**Significant**	
	Minor	

RECOMMENDATIONS

SUGGESTIONS

GOOD PRACTICES

17. Radioactive Waste Management **Condition 17.2: Arrangements for low and intermediate level waste in place**	**Phase 3**
Summary of the condition to be demonstrated	Existing, enhanced or new facilities for the storage of LILW are prepared to receive waste arising from operation of the nuclear power plant. Plans for the disposal of LILW are in place and the responsible organization for managing radioactive waste has been established.
Examples of how the condition may be demonstrated	1. Facilities either operational or on schedule to receive waste as required from NPP; 2. Ownership and management responsibilities for radioactive waste and waste management facilities clear.

Observations

ENEC has conducted an internal assessment for different waste storage and disposal strategy options. Nawah will manage operational waste arisings using 'state of the art technologies' to meet the requirements for disposal.

Each unit of the Barakah NPP has 10 years' storage capacity (which can be extended) for Low and Intermediate Level Waste, after which it is assumed LLW will be disposed of in a near-surface facility. Short-lived ILW will be decay-stored until it reaches a level which will allow it to be classified as LLW; long-lived ILW will go to a GDF along with spent fuel.

The INIR team was informed that the Policy on the Long-term Management and Disposal of Spent Nuclear Fuel and Radioactive Waste and identifying the entity that will be charged with implementing such policy is awaiting Cabinet approval. This, together with the approval of the Decommissioning Trust Fund (DTF) resolution, will allow the development of plans for the disposal of LLW by the proposed new Radioactive Waste Management Organisation (RWMO).

Although the RWMO has yet to be formally established, ENEC has set up an interim group, which they anticipate will form the basis of the RWMO. ENEC has studied the legal form of a number of RWMOs around the world including those which are private entities, government owned and a hybrid, and it is expected the RWMO will be a subsidiary of ENEC and a separate legal entity from Nawah with its activities funded by the DTF.

Some basic work to site a LLW facility has begun from which a plan will be developed. The draft Policy states that the preferred location for this will be near the Barakah site.

Draft FANR-REG-27, Disposal of Radioactive Waste, and supporting regulatory guide FANR-RG-027, Near-Surface Disposal of Radioactive Waste, are undergoing stakeholder review.

Regarding ownership of waste, the Nuclear Law, Article 41, stipulates this will be the State upon its delivery to the RWMO. Nawah will treat and package the waste onsite in accordance with the Waste Acceptance Criteria set by the RWMO for the LLW facility. If packages are deemed to be out of

specification, then Nawah will repackage at their cost. However, this may not become apparent for some time and consideration should be given to where the formal liability rests for the costs of repackaging wastes which fail, perhaps many years into the future.		
Areas for further action	**Significant**	Policy and strategy on the Long-term Management and Disposal of Spent Nuclear Fuel and Radioactive Waste
	Minor	
RECOMMENDATIONS		
R-17.2.1 The UAE should approve the Policy on the Long-term Management and Disposal of Spent Nuclear Fuel and Radioactive Waste and develop a strategy for its implementation.		
SUGGESTIONS		
GOOD PRACTICES		

17. Radioactive Waste Management **Condition 17.3: Work to develop HLW disposal arrangements ongoing**	**Phase 3**
Summary of the condition to be demonstrated	The responsibility for ultimate disposal of HLW is clear. The responsible organization continues to follow international efforts and progress toward ultimate HLW disposal, and plans to revise the national policy as appropriate. Timescales are consistent with interim storage arrangements.
Examples of how the condition may be demonstrated	1. Responsibilities clearly defined for development and implementation of disposal plans; 2. Evidence of international interactions; 3. Current national policy available and adequate to meet future requirements; 4. Evidence of continuing to follow international efforts and research on geological disposal; 5. If fuel take back or reprocessing options are considered, the contractual arrangements address the disposal of high level waste including transport arrangements and financial provisions.
Observations The new RWMO will be responsible for planning for the disposal of High-Level Waste (HLW) in line with the Nuclear Law and the draft Policy. The scenario for HLW disposal has been presented in the IDP and in determination of the DTF fee, which envisages fuel disposal at 90 years from start of operations, this is based on the reference scenario outlined in the regulation FANR-REG-22 (draft).	

Although this is a long way ahead, the draft Policy on the Long-term Management and Disposal of Spent Nuclear Fuel and Radioactive Waste requires the RWMO to investigate direct disposal of spent nuclear fuel in a deep geological repository in the UAE as the reference scenario. Selection of possible sites for a geological repository will commence in the in the "near future so that planning and research and development can proceed in a timely manner."

The draft Policy states that the UAE will leave other options open: reprocessing in another country; fuel leasing and take-back arrangements; and an international repository as options for consideration in a dual-track approach.

The draft Policy states that FANR will:

"…approve and continuously monitor the strategy for the UAE long-term management and disposal of spent nuclear fuel and radioactive waste, and oversee the timely and effective implementation of this Policy by the NPP Operators and the RWMO."

As mentioned under Issue 17.2, the Policy on the Long-term Management and Disposal of Spent Nuclear Fuel and Radioactive Waste is awaiting Cabinet approval. A recommendation on that is provided under Issue 17.2.

In terms of international engagement, ENEC has visited many WMOs around the world and will be signing MOUs with them. ENEC participates in the meetings of several relevant IAEA groups including TWG on Fuel Cycle Options and, in the near future, DISPONET. Additionally, ENEC/Nawah and FANR participate in the meetings of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. FANR have also participated in the IAEA Technical Meeting on Financing Schemes for Radioactive Waste Disposal Programmes and shared important aspects from it with ENEC/Nawah.

Areas for further action	**Significant**	
	Minor	

RECOMMENDATIONS

SUGGESTIONS

GOOD PRACTICES

18. Industrial Involvement Condition 18.1: Support for Industrial development established		Phase 3
Summary of the condition to be demonstrated	The promotion of industrial development for national participation in the nuclear programme continues as appropriate, depending on the national strategy.	
Examples of how the condition may be demonstrated	1. Support for development of appropriate industries e.g. research and development, long-term financing to upgrade capacity of national/local industries; 2. Supply chain for industrial involvement for NPP is established; 3. The plan for gradually increasing localization of suppliers of goods and services for the operations phase, as well as subsequent units after the first NPP is implemented; 4. National nuclear industries association is established for sharing knowledge/experience and mutual cooperation.	

Observations

The construction contract for the Barakah NPP was let as one single turnkey contract for all four units with no requirements for local content. The prevailing procurement policy in the Emirate of Abu Dhabi and ENEC is one of competitive tendering.

The UAE Industrial Development Strategy focuses on a phased approach, both in terms of identifying the localization activities and the phasing of the project.

ENEC has an Industrial Development Team (IDT) reporting to the Chief Operations Officer (COO) of ENEC, whose role is to identify areas for national involvement and to support national companies in developing the required capabilities. This team has significant experience in business development and quality standards in the conventional power manufacturing and construction industry. In the first instance the Industrial Development Team focused on the construction activities and more recently have been targeting the operations and maintenance phase. Potential areas for local involvement are identified through discussions with Nawah regarding the procurement requirements.

In the future IDT will look for other areas related to ENEC's broad remit for developing the nuclear power programme in the UAE. As an example, the IDT referred to discussions that had been held with the UK's Nuclear Advanced Manufacturing Research Centre. Other areas being considered are waste management, fuel supply and research and development. Regarding fuel supply, the UAE policy clearly states that it will not develop enrichment or reprocessing capability but consideration is being given to the economic viability of developing other steps of the fuel production process.

The Industrial Development Strategy also recognizes that not all products and services within a nuclear power plant are unique to the nuclear industry. Many items fall into an 'industrial grade' category. This category is used by similar industries such as oil and gas. In addition to this some products and services are commercial grade items which are readily available. The focus for the Industrial Development Team has been those items/services that are critical to the plant operations, high in volume and/or medium/low complexity.

Within each focus area the team evaluates the potential for local content and identifies potential target products and services. Following this the team develops approaches to targeted companies. Once a company has been identified and has expressed commitment the IDT works with them to understand their own procedures and manufacturing/service provision and assists them in writing new Quality Assurance manuals, procedures or reference materials; trains their personnel and/or identifies and fosters experienced international partnerships.

Spare parts will initially be supplied by original equipment manufacturers with a plan to later alternately source locally where possible. This will be subject to the local partners having the requisite qualifications, experience and pricing.

The current focus is on operations and maintenance where UAE will establish a single (or small number) prime maintenance contractor(s) under one or more long-term maintenance agreements (LTMA) through which all maintenance services will be provided. The LTMA does not have specific targets for local procurement but will have a provision for incentivizing national procurement by providing an additional 3% to the management fee for the prime contractor where work is subcontracted to national companies.

The INIR team was informed that the IDT has been a significant contributor to building UAE readiness in maintenance services and getting companies such as Doosan Babcock, DryDocks, Adyard and CAE suitably qualified and identifying many more industrial grade suppliers.

Areas for further action	**Significant**	
	Minor	
RECOMMENDATIONS		
SUGGESTIONS		
GOOD PRACTICES		

19. Procurement **Condition 19.1: Procurement capability for operations available**	**Phase 3**
Summary of the condition to be demonstrated	The owner/operator has the competences to procure and store operational and emergency equipment and to procure services.
Examples of how the condition may be demonstrated	1. Description of the processes that will be used to specify, procure and accept services and equipment for the operational NPP; 2. Description of the processes that will be used to ensure that counterfeit, fraudulent or substandard/non-conforming items are not used; 3. Description of the processes and facilities that will be used to store equipment to ensure its suitability for use; 4. Demonstration of the competence of the procurement staff based on training and experience; 5. Demonstration of the ready availability of design basis related information supporting the procurement process (e.g. specifications, bills of materials, spare parts lists, etc.).

Observations

The procurement process in Nawah is divided into three sub-processes: (1) Procurement; (2) Nuclear Procurement Engineering and (3) Warehousing.

Procurement is considered in two categories:

— Strategic Procurement, involving long-term strategic contracts with suppliers to optimize the supply chain. These contracts will be managed by Category Managers. The INIR team was informed that there are 3 staff in place but 13 more have been selected. All have experience in procurement for NPPs. Once a supplier has been registered, procurement engineering will define the audit requirements based on the component classification and the QA department will conduct an appropriate audit. The plan is to carry out repeat audits every 3 years;
— Tactical Procurement, involving procurement of materials and services that are not covered by strategic contracts.

The INIR team was informed that Nawah has a number of measures to identify counterfeit, fraudulent and suspect items (CFSI). All Purchase Orders contain specific terms and conditions explaining Nawah's policy of zero tolerance to CFSI; management regularly reinforce the policy to all procurement staff; training in CFSI is compulsory; procurement staff have access to the operating experience feedback network; no items can be purchased with cash or credit card.

Nuclear Procurement Engineering (NPE) performs an engineering evaluation for the procurement of safety (classes 1 and 2) and quality (class 3) related components and services. This evaluation will identify the technical and quality requirements. Reference documents and other materials are currently controlled by KEPCO. NPE has full access to KEPCO's controlled construction database. NPE has 10 engineers, 5 with nuclear engineering experience and 5 recently recruited Emirati's. Qualification and training requirements have been defined and the overall qualification programme lasts up to 2 years

and includes on-the-job training and mentoring.

All Operational Spare Parts (OSP) were ordered through KEPCO as the Prime Contractor and delivered to the KEPCO Construction Warehouse, where they were stored. The Pre-OSART team noted that such storage of spare parts and emergency equipment was not adequate to guarantee that they remain in a suitable condition for operation.

Nawah's Plant General Warehouse (PGW) is a new facility, divided into three storage areas in accordance with the quality requirements. The INIR team was informed that the environmental control of the warehouse is operational.

Upon completion of the KEPCO inspection, the OSP is transferred to PGW by KEPCO. The items are received and inspected by Nawah warehouse staff and stored as inventory, ready for plant operations. Approximately 40% of the OSP have now been transferred to the PGW and the rest are being transferred at a rate of 3 - 5% per week.

The INIR team was also informed that Nawah staff carries out CFSI inspection upon initial receipt of material and additional quality inspections on Procurement Class 1, 2 and 3 items. The level of rejected equipment is very low partly because all materials had already been inspected on receipt by KEPCO who had rejected a number of items, mainly due to problems with documentation.

The INIR team was also informed that all the Pre-OSART self-assessment findings had been closed out.

Areas for further action	**Significant**	
	Minor	

RECOMMENDATIONS

SUGGESTIONS

GOOD PRACTICES

GP-19.1.1 The development of a number of measures to prevent counterfeit, fraudulent and suspect items, including training, management, reinforcement, access to 'Operating Experience Feedback' network.

APPENDIX 2: LISTS OF THE INIR TEAM AND COUNTERPARTS

INIR MISSION REVIEW TEAM	
Milko KOVACHEV	Team Leader, IAEA
Jose BASTOS	Mission Coordinator, IAEA
Pal VINCZE	IAEA
Abdelmajid CHERF	IAEA
Kenneth BROOKS	IAEA
Stephen MORTIN	International Expert
Miroslav LIPAR	International Expert
Rod SPEEDY	International Expert
John MATHIESON	International Expert

PARTICIPANTS FROM THE UAE			
	INFRASTRUCTURE ISSUE	**REPRESENTATIVE**	**RESPONSIBLE ORGANIZATION(S)**
1	**National Position**	Rashid Al Hammadi Mark Goodson	Federal Authority for Nuclear Regulation (FANR)
		Balaji Krishnamurthy Ehab Zurub	Emirates Nuclear Energy Corporation (ENEC)
2	**Nuclear Safety**	Guenael Le Cann Spencer Brown Slawomir Rokita	FANR
		Hasna Al Blooshi Alvaro Fernandez Ronald De La Cruz	ENEC

PARTICIPANTS FROM THE UAE			
	INFRASTRUCTURE ISSUE	**REPRESENTATIVE**	**RESPONSIBLE ORGANIZATION(S)**
3	**Management**	Spencer Brown Rashid Al Hammadi Mark Goodson	FANR
		Tim Abney Glenn McTaggert	ENEC
4	**Funding and Financing**	Andy Woodruffe Zoryana Vovchok	FANR
		Mohammed Tariq Sharif John Tynan Gary O'Connor	ENEC
5	**Legal Framework**	Zoryana Vovchok	FANR
		Jacques Lavoie Amani Al Shamsi	ENEC
6	**Safeguards**	Stephen Brion	FANR
		Nasir Al Ketbi Christopher Hatt	ENEC
7	**Regulatory Framework**	Rashid Al Hammadi Mark Goodson Salah Al Hashimi	FANR
		Tim Abney	ENEC
8	**Radiation Protection**	Andy Woodruffe	FANR
		Shelley Kowkabany Rick Ely	ENEC
9	**Electrical Grid**	Guenael Le Cann Slawomir Rokita	FANR
		Nenad Kolibas Derek Fanguy	ENEC
10	**Human Resource Development**	Shaima Mansoori	FANR
		Roberta Long Hanane Zejli	ENEC

PARTICIPANTS FROM THE UAE			
	INFRASTRUCTURE ISSUE	**REPRESENTATIVE**	**RESPONSIBLE ORGANIZATION(S)**
11	**Stakeholder Involvement**	Salah Al Hashimi Aysha Al Khadouri	FANR
		Maha Moutawei	ENEC
12	**Site and Supporting Facilities**	Spencer Brown Waddah Alhanai	FANR
		Richard Ely Shelley Kowkabany	ENEC
13	**Environmental Protection**	Andy Woodruffe Ameena Al Abdouli	FANR
		Marwan Al Kindy Aziz Mali	ENEC
14	**Emergency Planning**	Andy Woodruffe Fahed Al Bloushi	FANR
		Shaima Al Mulla Richard Garcia Lindley Perryman	ENEC
		Ahmed Al Shemeili	National Emergency, Crisis and Disasters Management Authority (NCEMA)
15	**Nuclear Security**	Osama Al Shehhi Sara Al Saadi Denis Winter	FANR
		Mariam Al Mazrouei Martin Frato	ENEC
16	**Nuclear Fuel Cycle**	Guenael Le Cann Slawomir Rokita	FANR
		Jamal Al Ahbabi Abdulla Ateeq Al Hameli	ENEC
17	**Radioactive Waste**	Andy Woodruffe	FANR
		Jamal Al Ahbabi Abdulla Ateeq Al Hameli	ENEC

PARTICIPANTS FROM THE UAE			
	INFRASTRUCTURE ISSUE	**REPRESENTATIVE**	**RESPONSIBLE ORGANIZATION(S)**
18	**Industrial Involvement**	Mark Goodson	FANR
		Andrew Champ Ken Wigley	ENEC
19	**Procurement**	Mark Goodson	FANR
		Yagoob Al Shehhi George Kuhn Bernard Swanson	ENEC

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APPENDIX 4: ABBREVIATIONS

ACA	APR-1400 Co-operation Agreement
ADWEA	Abu Dhabi Water & Electricity Authority
ADWEC	Abu Dhabi Water and Electricity Company
AE	KEPCO E&C Engineering Architecture
AP	Additional Protocol
ATLAS	OECD-NEA Advanced Thermal-hydraulic Test Loop for Accident Simulation
BNPP	Barakah Nuclear Power Plant
BOK	Book of Knowledge
CAMP	United States Nuclear Regulatory Commission Code Applications and Maintenance Program
CBRN	Chemistry, Biological, Radiological and Nuclear Center
CHT	Cold Hydraulic Testing
CICPA	Critical Infrastructure and Coastal Protection Authority
CNO	Chief Nuclear Office
CNP	Committee of Nuclear Power
CNS	Convention on Nuclear Safety
COEF	Construction and Operating Experience Feedback Programme
CP3	Core Process 3
CPO	Chief Program Officer
CPPNM	Convention on the Physical Protection of Nuclear Material
CSA	Comprehensive Safeguards Agreement
CSARP	United States Nuclear Regulatory Commission Cooperative Severe Accident Research Program
CSC	Convention on Supplementary Compensation for Nuclear Damage
DBT	Design Basis Threat
DDG	Deputy Director General

DTF	Decommissioning Trust Fund
EAD	Environmental Agency - Abu Dhabi
ECMS	Enterprise Content Management System
EIA	Environmental Impact Assessment
EMRP	Emergency Management and Response Plan
ENEC	Emirates Nuclear Energy Corporation
ENSREG	European Nuclear Safety Regulators Group
EPR	Emergency Preparedness and Response
EPREV	Emergency Preparedness Review
FANR	Federal Authority for Nuclear Regulation
FERO	FANR Emergency Preparedness and Response Organization
FSAR	Final Safety Analysis Report
GCC	Gulf Cooperation Council
GCCIA	Gulf Countries Council Interconnection Authority
HFT	Hot Functional Test
HLW	High-Level Radioactive Waste
HR	Human Resources
IAEA	International Atomic Energy Agency
IDP	Initial Decommissioning Plan
IDR	Independent Design Review
IMS	Integrated Management System
INIR	Integrated Nuclear Infrastructure Review
INPO	Institute of Nuclear Power Operations
IPPAS	International Physical Protection Advisory Service
IRRS	Integrated Regulatory Review Service
IRSN	French Institute for Radiological Protection and Nuclear Safety
ISFSI	Interim Spent Fuel Storage Installation

ISSAS	IAEA SSAC Advisory Service
ISO	International Organization for Standardization
ISV	Independent Safety Verification
JC	Joint Convention
JV	Joint-Venture
KEPCO	Korea Electric Power Corporation
KHNP	Korea Hydro and Nuclear Power
KINS	Korea Institute of Nuclear Safety
KM	Knowledge Management
KNF	KEPCO Nuclear Fuel
KPI	Key Performance Indicators
LEU	Low Enriched Uranium
LTEA	Long-Term Engineering Agreement
MDEP	Multilateral Design Evaluation Programme
MMIS	Man Machine Interface System
MOI	Ministry of Interior
MOU	Memorandum of Understanding
mSv	Milisievert
MW	Megawatt
Nawah	Nawah Energy Company
NCEMA	National Emergency, Crisis and Disasters Management Authority
NDT	Non-Destructive Testing
NEPIO	Nuclear Energy Programme Implementing Organization
NPP	Nuclear Power Plant
NRC	United States Nuclear Regulatory Commission
NSC	Nuclear Safety Culture
NSRB	Nuclear Safety Review Board

NQA	National Qualifications Authority
NQAM	Nawah Quality Assurance Manual
ODCM	Offsite Dose Calculation Manual
OECD-NEA	Organization for Economic Co-operation and Development-Nuclear Energy Agency
OEMP	Operation Environmental Management Plan
OLA	Operating License Application
OMS	Operating Management System
OSART	Operational Safety Review Team
OSSA	Operations Support Services Agreement
PAT	Power Ascension Testing
PPA	Power Purchase Agreement
PPP	Physical Protection Plan
PPS	Physical Protection System
PRA	Probabilistic Risk Assessment
PSA	Plant Services Agreement
PSAR	Preliminary Safety Analysis
PUI	Peaceful Uses Initiative
QA	Quality Assurance
RAI	Request for Additional Information
RAMP	United States Nuclear Regulatory Commission Radiation Protection Computer Code Analysis and Maintenance Program
R&D	Research and Development
REMP	Radiological Environmental Monitoring Program
RFP	Request for Proposal
RSD	Radiation Safety Department
RWMO	Radioactive Waste Management Organization
RWP	Radiation Work Permits

SA	Safeguards Agreement
SAAR	Severe Accident Analysis Report
SAREOR	Semi-Annual Radiological Environmental Operating Report
SSC	Structures, Systems and Components
SD	System Design
SEED	Site and External Events Design
SER	Self-Evaluation Report
SFP	Spent Fuel Pool
SGD	Safeguards Department
SQP	Small Quantities Protocol
SRO	Senior Reactor Operator
SSAC	State System of Accounting for and Control of Nuclear Material
SSCs	Structures, Systems and Components
SSDL	Secondary Standards Dosimetry Laboratory
TLDS	Thermo-Luminescent Dose Meters
TRANSCO	Abu Dhabi Transmission and Despatch Company
TSO	Technical Support Organization
USIE	Unified System for Information Exchange in Incidents and Emergencies
VETAC	Vocational Education and Training Awards Council
WANO	World Association of Nuclear Operators
WHO	World Health Organization
WINS	World Institute for Nuclear Security