



المجلس الاستشاري الدولي  
INTERNATIONAL ADVISORY BOARD

# Thirteenth Semi-Annual Report 2016

# Brief summary on the International Advisory Board for the UAE nuclear program

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The International Advisory Board (IAB) was a concept first developed by the UAE government to augment the transparency of its peaceful nuclear energy program. Indeed, the commitment to form such a body was among the original commitments undertaken by the UAE government in its original white paper describing its intent to evaluate and potentially deploy peaceful nuclear energy within its borders.

More specifically, the IAB represents an unprecedented collection of internationally recognized experts in various disciplines associated with the nuclear energy sector. The board includes world-class expertise in the areas of nuclear safety, security and non-proliferation, as well as regulation, quality assurance, operations, human resource development and waste management associated with the construction, operation and decommissioning of civil nuclear power plants. Led by Dr. Hans Blix, the former Director General of the International Atomic Energy Agency (from 1997-1982), the IAB is charged with conducting semi-annual reviews of the UAE's entire peaceful nuclear energy program and subsequently preparing a semi-annual report summarizing their observations, findings and recommendations. The decision by the UAE government to make these reports available to the public in hard-copy form and over the internet represents yet another example of the latter's commitment to achieving the highest standards of transparency in its peaceful nuclear energy program.

The IAB, while not invested with any legally binding powers, has nevertheless been designed to be an independent advisory body. As stated above, after each of its semi-annual meetings, the Board will issue a report detailing the consensus views of its members with regard to the progress achieved by the program, as well as any areas of concern that merit special attention. The government will not seek to edit these consensus IAB views and will undertake to publish them free of modification, as intended by the IAB members. Notably, however, the government and the IAB membership have agreed to work together to make those modifications necessary to avoid the dissemination of any sensitive security-related information to which the IAB may have access.

While the IAB's semi-annual reports may address additional topics, they will always be required to specifically address the issues of:

1. Nuclear safety
2. Nuclear security
3. Nuclear non-proliferation
4. Program transparency
5. Program sustainability

The UAE government, and those entities involved in the UAE will use the Board's semi-annual reports to improve performance and, where necessary, allocate additional resources in order to ensure the successful implementation of the over-all program. It is hoped that the UAE populace and the international community will use the reports as an objective source of information via which they may become more informed about and follow the progress of the UAE's nuclear sector.

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**Dr. Hans Blix, IAB Chairman**

## CHAIRMAN'S PREFACE

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With great satisfaction, I transmit to you the thirteenth report of the International Advisory Board on the development of the United Arab Emirates' Nuclear Power Program. This report recognizes the continued progress made in the five areas of the IAB's mandate. As always, the members of the Board are also pleased that all nuclear entities reporting to it are showing a strong commitment to transparency and to the goals set by the Board.

This report discusses host of items: the updated status of the Barakah NPP, the status of the Operating License Application, safeguards of handling fresh fuel, emergency preparedness & response readiness, major tests that lie ahead, capacity building, the nuclear security program overview, ENEC's SURE program, outcomes of the Nuclear Security Summit and UAE's key achievements in 2015 with the IAEA.

At its next meeting the Board would appreciate further reports on how to cope with cyber threats, transparency between ENEC and KEPCO, FANR's financing and independence and updates on being on time and on budget in 2017.

I would like to thank all the entities for their contributions to the thirteenth meeting of the Board and supporting this report and for endorsing the Board's recommendations. Thanks are also due to the Board members for their continuous efforts in developing this report.

With respect,  
Dr. Hans Blix

# BOARD MEMBERS

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*Ambassador Thomas Graham*



*Mr. Takuya Hattori*



*Dr. KunMo Chung*



*Lady Barbara Thomas Judge*



*Sir John Rose*



*Mr. Jukka Laaksonen*

# Introduction



The thirteenth semi-annual meeting of the International Advisory Board (IAB) for the United Arab Emirates (UAE) peaceful nuclear power program was held in Abu Dhabi on April 3rd and 4th, 2016.

The first two briefings were carried out by the Federal Authority for Nuclear Regulation (FANR) and the Ministry of Foreign Affairs (MOFA) in the early evening of April 3rd, 2016.

FANR's briefing was led by the Director General assisted by his team. The MOFA briefing was conducted by the UAE Ambassador to the International Atomic Energy Agency (IAEA), Ambassador Hamad Al Kaabi. The second day of meetings, April 4th, 2016, also featured two briefings, the first conducted by the Emirates Nuclear Energy Corporation (ENEC) and the second by the Critical Infrastructure and Coastal Protection Authority (CICPA). In the afternoon following these meetings, the Board held its own private discussion as has been the regular practice.

The Chief Project Officer (CPO) and the Chief Nuclear Officer (CNO), assisted by their teams, led ENEC's briefing.

The CICPA brief was given by Commander of the Barakah Center and his team. Also present at the joint ENEC & CICPA briefing was the

ENEC Executive Security Director; ENEC's Site Physical Security Manager and ENEC's Information and Cybersecurity Director.

The nuclear power program of the UAE is based on upholding the highest standards of the five principles of safety, security, non-proliferation, transparency, and sustainability.

The IAB is tasked with reviewing the UAE program bi-annually and with reporting how the UAE has adhered to these principles. As a result, and in line with previous publications, this report is divided into five sections that review each of these principles based on the presentations of FANR, MOFA, ENEC, and CICPA. While the structure provides a clear and heavy emphasis on safety, which is appropriate, all five principles declared to be observed by the UAE program are also well covered throughout this report.

The thirteenth meeting of the IAB was held shortly after the successful Paris Conference on climate change held in December 2015, where all countries came together in an important agreement to take the first step toward to globally limit and mitigate climate change and its effects. Specifically, the agreement fundamentally aims to limit the increase in global warming to 2 degrees Celsius above pre-industrial levels, which is the

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point at which significant impacts of climate change would begin to occur. Furthermore, it was announced that there would be a special effort—pressed by the island states—to limit this increase to 1.5 degrees Celsius. However, world temperature has already reached a level of 1 degree Celsius above pre-industrial levels and it is believed to be exceedingly difficult to keep the average world temperature increase from exceeding 2 degrees Celsius.

Meanwhile, the UAE nuclear power program continues to move forward setting the right example for the world community. Preparations for nuclear operations are scheduled to commence sometime in the coming year. Although commercial operations at the first unit had been scheduled for May 2017, this date will be extended—because of issues mentioned later in this report—to the end of 2017. It is still planned, however, that all four reactors at the Barakah site will be completed and operating by the planned date for the commencement of operations at Unit 4. This is primarily due to the learning curve and experience gained from building and operating the first unit and leveraged for the remaining three units. By 2020, when Unit 4 is expected to commence operations, a significant portion of the electricity produced within the UAE will be generated from a safe, clean, and reliable source of power—the Barakah NPP.

The FANR briefing was held first. Chairman Blix opened discussions by noting that this IAB meeting closely follows the Nuclear Security Summit that was recently held in Washington DC. The Chairman commented that a positive solution to the threat of climate change depends partly on nuclear power, thus the IAEA will have a very important role to play. Similarly, FANR will have a significant impact on the success of the UAE nuclear power program. Ambassador Graham added that the arrival of the UAE program has been timely for the chances of success against the effects of climate change. As a result, the UAE program is of very great importance to the world community.

Dr. Chung said that there is global interest in the UAE nuclear power program; as it is of

vital importance for the nuclear renaissance. The Korean president at the Washington summit expressed strong support for nuclear power. The UAE nuclear program offers great confidence and support to the future of nuclear energy in mitigating the effects of climate change should the program remain on schedule and budget.

# Safety

## Safety assessment and recommendation

FANR's Director General began by outlining the major developments at FANR since the 12th IAB meeting, held back in October, 2015. FANR is continuing its thorough review of ENEC's operating license application for Barakah Unit's 1 and 2. Furthermore, FANR is also engaged in a separate review for an ENEC application related to the recipient of fresh nuclear fuel at Barakah.

FANR's Director General also mentioned that the first full scope on-site and off-site emergency exercise was successfully conducted at Barakah. FANR is presently preparing for the IAEA Physical Protection Advisory Service (IPPAS) mission. Significant progress has been made on the installation of safeguards and the development of security programs for the nuclear program. In addition, he said that progress was made on the development of a decommissioning trust fund and on the preparation of waste management regulations in view of the upcoming issuance of the Operating License.

Moreover, he reported on the first meeting of the newly reconstituted International Advisory Group (IAG) advising FANR Board of Management on critical technical and policy issues in nuclear safety regulation. He also informed the IAB on ongoing sustainability efforts which are important for the future success of FANR, including leadership training and career path planning as well as recruitment and training of developpee engineers. At FANR today, nine out of twelve Directors are Emirati nationals. Lastly, FANR recently had opened a branch at the Dubai international airport for the purpose of enhancing its services to companies in the industrial and medical sectors primarily. The meeting then focused on the status of FANR's review of the application for the operating license application (OLA). The initial review of the OLA and the Final Safety Analysis Report (FSAR) were completed in September 2015. During this initial review, FANR issued 1,400 Requests for Additional Information (RAI) to ENEC and approximately 70% of these RAIs have now been addressed. Most of the safety evaluation reports are expected to be completed by the third quarter of 2016.

The issuance of the Operating License is dependent on ENEC's operational readiness. The final completion schedule will be set by ENEC's license submittals and ENEC's commission and operational readiness activities. Of the "active" RAIs, 956 are completed, while 427 remain active, and a small number—15—are yet to be submitted by FANR. The major reports that are due to be submitted are: the Descriptions of Processes and Programs for operation stage, which is now expected to be submitted to FANR by ENEC by October 31st, 2016 of this year along with the Safety Evaluation Report (SER) by FANR, which is to be completed by December 31st, 2016. In addition, the submission of the Accident Management Plan, is expected on December 31st, 2016 and the SER complete by April 30th, 2017. For the post-Fukushima related commitments, the submittal is expected by January 31st, 2017 with the SER complete by February 28th, 2017. Once all OLA documents have been submitted by ENEC, FANR will then proceed to perform a complete review of the late submittals and resolve any associated RAIs. Following the review, FANR will then issue license recommendations and supporting documents to the FANR Board of Management.

In FANR's view, at the current pace, they estimate that the earliest date for completing the aforementioned submittals is May 2017. Once the Operating License is issued, the licensed operator of the Barakah nuclear units can then commence preparations for nuclear commercial operations.

As mentioned earlier, FANR is continuing to review ENEC's application for gaining authorization to import fresh nuclear fuel. Factors such as the Fresh fuel storage readiness, the establishment of safeguards applicable to the import of fresh fuel assemblies, and the transport license to bring in fresh fuel, are closely related to nuclear liability insurance. The licenses for the handling and storage of fresh fuel, the transport of fresh fuel, and the import of fresh fuel, will all be included into the construction license. The nuclear liability insurance must be settled before the Operating License can be issued. Once the Operating License has been issued

# Safety assessment and recommendation



for Units 1 and 2, all four of these licenses will then be terminated. For fuel, a long term nuclear material license for the possession and handling of fresh fuel will remain valid. The three fuel licenses, absorbed under the construction license, were requested for April 1st, 2016 in the applications submitted in 2015 but have not yet been issued.

The full off-site and on-site Emergency Plan exercise was conducted on February 23-25, 2016. This was required by a FANR regulation, to be held prior to the arrival of on-site fresh fuel. It was a full scope exercise involving all relevant ENEC units and relevant off-site organizations. The Day 1 scenario posited a sequence of increasing reactor damage and Days 2 and 3 exercised specific support functions. FANR planned and conducted the overall assessment of the on-site and off-site responses. ENEC conducted its own internal evaluation and the IAEA provided observers. An important part of the exercise was testing the interface between the on-site and off-site plans. Some facilities involved were still under construction and had to be simulated—by their nature these have a limited effectiveness and will be fully tested at the next exercise planned by the end of the year, when these facilities are expected to be complete.

The overall off-site response demonstrated a well-organized and managed off-site response capability. Key areas have been identified for improvement.

ENEC presented the on-site response for the Fuel Receipt Exercise which involved the following facilities:

- The Emergency Operations Facility
- The Alternative Technical Support Center
- The Operational Support Center activities were performed at the Emergency Center
- The Nuclear Center
- The Main Control Room Simulation Cell
- The Ruwais Reception Center
- The Ruwais Hospital
- Traffic Control
- Radiation Monitoring
- Public Alerting

On-site performance was a very successful exercise. There was a good demonstration of command and control. The majority of on-site objectives were met despite the unavailability of some emergency response facilities and the lack of a qualified on shift staff. This issue is currently being addressed through ENEC's Human Capacity Development program. The off-site performance was largely successful. The capabilities of the Reception Center and the Ruwais Hospital exceeded the evaluators'

# Safety assessment and recommendation

expectations. Areas of improvement identified by this exercise include: certain processes and procedures that need to be improved; additional equipment is needed to improve communication; and further training and practice is required.

ENEC presented its achievements in its Emergency Preparedness program, including the completion of the Emergency Response Facilities in Ruwais, which are of the highest technologically advanced facilities in the world, and were used successfully in the Fuel Receipt Exercise in February 2016.

The IAEA observers found FANR's Emergency Planning Response (EPR) facilities to be effectively demonstrated. Some of the areas suggested for improvement were: FANR's arrangements to undertake the dual regulator/response role; clarify the FANR off-site role; support national organizations to enhance their understanding of the nuclear hazard; and ensure that the operator has appropriate EPR arrangements in place. ENEC has committed to another similar exercise prior to fuel load and start-up.

Ambassador Graham asked a question about the philosophy being followed as the project nears start-up for Unit 1: do all issues have to be resolved before start-up or can some matters, perhaps of less than central importance, be dealt with on an interim basis to avoid any start-up delays? Lady Barbara said she would like to know more about this matter. The Director General responded that FANR has an issues list, for example critical infrastructure that has to be accomplished before start-up, and may not be left unfinished. There will be a few unresolved issues that will become a policy issue for a higher governmental authority. However, FANR Director General was confident that the central issues related to nuclear operations will be resolved by the issuance of the Operating License and that subsidiary issues will be addressed with temporary measures for a few months while the licensed operator proceeds to start-up.

Chairman Blix asked the FANR Director General about the latest studies on low

dose radiation. The Director General replied that FANR is following these studies but nothing has been incorporated yet into FANR regulations.

Chairman Blix returned to the EPR issue and said the Emergency Plan must effectively integrate security with safety. Mr. Laaksonen added that it is important to plan and prescribe how the security and safety personnel should communicate and cooperate in the event that an emergency is consequence of an unlawful intrusion to the plant site.

Dr. Chung asked when the first fresh fuel shipment is expected. FANR's Director General replied that ENEC says June 2017. FANR has met with ENEC recently and had further questions on the schedule. Two issues were mentioned that relate to this subject: acquiring the necessary equipment for fuel handling and storage from Korea has been slower than expected; and standing operating relations have been challenging. FANR does not accept import of fresh fuel assemblies before the storage on-site is completed and all equipments are tested.

FANR reported that the implementation of safeguards for the arrival of fresh nuclear fuel is well underway. There have been regular safeguards technical meetings among FANR, IAEA, and ENEC. Safeguards obligations and IAEA containment and surveillance measures will be integrated into the Barakah NPP before the first receipt of fresh fuel. IAEA conducted two site visits in 2015 and FANR has begun safeguards operational inspection readiness inspections. The UAE provided the IAEA with the required advance notification of the first introduction of fresh nuclear fuel.

This introduction would signal the start of the full-scope Safeguards Agreement. The UAE is finalizing negotiations with the IAEA on the UAE Subsidiary Arrangements and Barakah NPP Facility Attachment. FANR is fully prepared for implementation of the full-scope Safeguards Agreement and the immediate submission of a UAE Safeguards initial report to the IAEA as well as subsequent reporting. On April 4th, 2016, Mr. David Scott, opened the meeting on behalf of the Executive Affairs

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Authority Chairman and gave an introduction noting that this IAB meeting represented the seventh year of IAB briefings and that the UAE is very grateful for the Board's efforts. He said that he had first discussed nuclear power for the UAE with IAB member Dr. Mujid Kazimi (who passed away in 2015) back in 2007. He also had high praises for IAB member Mr. Jacques Bouchard (who also passed away in 2015).

He announced that the total Barakah NPP project is now 60% complete, with Unit 1 at 85% complete. Key construction progress performed in Barakah included the cold hydrostatic testing (CHT)—to verify the reactor coolant circuit leak tightness and strength against maximum static pressure—which was conducted in February 2016. The next big test before loading fuel to the reactors is the Hot Functional Test. In this test, the temperature of water in the reactor coolant circuit is increased, to ensure all the systems function properly in this environment.

At the programmatic level, there is significant collaboration with the IAEA. The UAE is one of the most active new-build members of the IAEA. In addition, the UAE is chairman of the Weapons of Mass Destruction (WMD) committee of the Arab League; it is much hoped that measures can be developed to permit the negotiation of a WMD free zone. Following the introduction, ENEC's CPO and the CNO led ENEC's formal briefing. It was stated that the estimated plan is for the Operating License to be granted at the end of May 2017 and for the licensed operator to begin the fuel load process of Unit 1 with the target to begin operations by the end of 2017. The lack of various nuclear related materials have caused a few months delay in the project. Deliveries from South Korea and long lead time items led to a slow start, however, such minor delays can be recovered later on and help restore the overall project to its original timeline. The lessons learned from Unit 1 are also being applied for Units 2-4 and deliveries have become more efficient. ENEC is now focused on guaranteeing project delivery, as well as testing and commissioning of Unit 1, with operational readiness being shifted to the operating subsidiary.

The first hot functional test will be in the September 2016 timeframe. This testing is a practice run for the plant. The present status of the four Units is:

- Unit 1 – ENEC has implemented a safety and a quality rescheduling program of Unit 1 to ensure long term sustainability of the first nuclear reactor; the plant will be physically ready close to being on time even with the materials delay. The operational readiness program of Unit 1 has been shifted to ENEC's operating subsidiary, which includes a dedicated operational structure
- Unit 2 – is largely on time
- Unit 3 – a few months early
- Unit 4 – a few months early

The consensus is that the delivery of the four reactors is on schedule and that ENEC will be able to deliver the UAE peaceful nuclear energy program by 2020. ENEC continues to prioritize safety and quality over schedule and is working with local and Federal energy stakeholders to coordinate the delivery of the units to the grid.

There have been issues with the Shin Kori 3 reactor (the reference plant of the APR-1400 reactor) and KHNP, the Korean nuclear licensed operator, has not been sharing sufficient operating data. Lady Barbara asked why there would be a problem sharing information with Barakah as it is the showcase of South Korean exports. ENEC replied that while South Korea is the best in the world at building these reactors, right now sharing information is challenging, as this is the first time KHNP has shared its operating experience outside of South Korea.

Mr. Scott said that, in his opinion, it is really an issue of culture. Both countries are discussing sharing operating experience. South Korea has no history of sharing operating experience outside its borders. There is no ill will here; the sharing is in the interest of both sides.

# Safety assessment and recommendation

ENEC presented an overview of the Barakah licenses currently active:

- The Site Selection License was approved in February 2010
- The Site Preparation License, Units 1-4, was approved in July 2010
- Units 1 & 2 Construction License, was approved in July 2012
- Units 3 & 4 Construction License, was approved in September 2014

The Unit 1 & 2 OLA was submitted on March 2015 in adherence to the original program schedule set in 2009. The OLA seeks a license to operate Units 1 & 2 for 60 years.

The OLA was submitted on schedule but the final Probabilistic Risk Assessment (PRA) and the Physical Protection Plan (PPP) are ongoing. Some 3,000 procedures, that ENEC and its operating subsidiary, are developing for operations are being developed.

The operating procedures that ENEC's operating subsidiary is developing are solid procedures that will ensure that the reactor functions safely at all times.

Operating procedures for the reactors in Barakah are taken from Korean systems that are specific to the nuclear technology being used in the UAE. The procedures adopted can be seen as more rule-based. Korea will also be supplying many highly experienced individuals with more than 30 years' experience.

Nevertheless, all South Korean nuclear experts

working in the UAE will require retraining and a successful completion of FANR's tests in order to be granted permission to operate the Barakah reactors.

As reported by FANR, ENEC continues to work with the Federal regulator to respond to all RAIs with the target to obtain approval by May 2017.

As previously stated, three major license applications related to fuel receipt have been submitted by ENEC to FANR:

- Handling and Storage of New Nuclear Fuel, submitted in October 2015
- Transportation of New Nuclear Fuel, submitted in December 2015
- Import of New Nuclear Fuel, submitted in January 2016
- Import of Nuclear Materials (not nuclear fuel), submitted in March 2016

Unit 3 & 4 OLAs are planned for submittal in 2017. The Unit 3 & 4 OLAs will be similar to the Unit 1 & 2 application and will incorporate the lessons learned from Fukushima.

ENEC CPO presented a construction update. Manpower at Barakah, as of the week of the IAB meeting, was over 20,000.

As per April 2016, there is a .07% accident rate, per million man hours, and no fatalities at Barakah. Many nationalities are involved in the delivery of Barakah: nearly 2,000 of the total are Koreans and the other nationalities include large numbers of Filipinos, Bangladeshis,



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Indians, Nepalis, Pakistanis, Thais, and Vietnamese.

ENEC pays special attention to the work-life balance of staff at site and announced that a series of on-site facilities that cater to the diverse cultures has been completed to improve the lifestyle offered at Barakah. Construction progress continues at Unit 1 with the reactor pressure vessel, the reactor containment vessel, the monitoring systems, the reactor vessel internal structures, and many auxiliary buildings and other structures about 90% complete.

In addition, the turbine generator building is almost complete and the water treatment building for Units 1 & 2 is 99% complete. Barakah NPP Unit 2, is 67.3% complete as of March 2016 and is also progressing steadily. The reactor containment building and auxiliary building for Unit 2 is largely complete. The Unit 2 turbine building is also progressing well. Unit 3 and Unit 4 are also both proceeding well, according to ENEC's CPO. The reactor containment building and the auxiliary building are well advanced and the Unit 3 turbine building is making significant progress. These two units are benefiting efficiencies and lessons learned from the simultaneous construction of four APR-1400 reactors at site. They are both ahead of schedule.

As per the Prime Contract, ENEC has tasked KEPCO to execute the commissioning (the initial test program) of the Barakah plants through to 100% power performance. KEPCO has subcontracted this work to its nuclear operating company, KHNP. Of the 255 KHNP staff present at site, over 50% have at least ten years of safe nuclear power plant operations. All the personnel involved in this part of the project are co-located in the same building. It is estimated that teams of 400 to 500 individuals will perform the tests. They are fully focused on commissioning and testing and are highly experienced in this task. About 20% of the overall commissioning process is complete. There are two types of system turnovers being executed in Unit 1:

1. Construction to commissioning. Unit 1 passed the Cold Hydrostatic testing first time

2. Commissioning to plant operations

Turnovers from commissioning to construction have not started yet.

The major tests completed are:

- Initial Energization
- Cold and Secondary Hydrostatic tests

The major tests that lie ahead are:

- The Structural Integrity Test (SIT)/ Integrated Leak Rate Test (ILRT) (2nd quarter, 2016) to verify the structural integrity of the containment building and the leak rate test of any extended containment
- Hot Functional Test (3rd quarter, 2016) to verify the operability of the reactor and related auxiliary systems and equipment under hot conditions before fuel loading
- Unit 2 - Initial Energization (3rd quarter, 2016)
- Unit 1 - Fuel Load, pending regulatory approval, (1st quarter, 2017) to verify the serial number and position of the initial fuel, then load fuel in the predetermined order
- Power Ascension Tests (2nd quarter, 2017) to verify that systems and components are ready to be operated at 100% of the full power of the plant

Frequent safeguards technical meetings between FANR, IAEA, and ENEC are ongoing in order to integrate safeguards obligations and IAEA containment and surveillance measures into Barakah NPP before the receipt of fresh fuel. Two site visits were carried out by IAEA in 2015 in support of this objective. FANR has begun safeguard operational readiness inspections to ensure full license and Facility Attachment compliance before the arrival of nuclear material on-site. The UAE is finalizing the negotiations on the Subsidiary Arrangements and the Facility Attachment and FANR is prepared for full scope safeguards implementation and to submit the UAE initial

# Safety assessment and recommendation

safeguards report to the IAEA. FANR then presented answers to several questions the Board submitted at the end of the 12th IAB meeting.

With respect to operations, can Unit 1 be operated as a stand-alone when it shares a number of facilities with Unit 2? FANR responded by saying that, prior to granting an OL for Barakah Unit 1, FANR will verify that all systems and components, important to safety, have been constructed in accordance with requirements and that the plant has reached a level of readiness to give assurance of its safe operation.

Consistent with the above, FANR will verify that all systems common to both Units 1 & 2, and that are required for the safe operation of Unit 1, have been adequately tested and put into service accordingly.

ENEC will be required to demonstrate that all necessary controls are in place to prevent ongoing construction activities affecting the safe operation of Unit 1.

For commissioning activities of Unit 2 that may compromise operation of Unit 1, the governing rule will be that the interfacing elements (e.g., valves, breakers etc.) will remain under the control of the operating unit. Before authorizing operation of Unit 1, FANR will verify that ENEC's Emergency Response Plan is effective to protect the labor force on-site during construction.

The Board asked, given that Shin Kori plant is going to be delayed, there will be minimal time to conduct tests that ENEC was planning to rely upon prior to Unit 1 beginning operations. Now that ENEC is not likely to have its previously expected testing phase, it is critical to understand what steps or tests are being planned to compensate for this? FANR's responded that ENEC's submission for an OL relies upon tests being performed at Shin Kori in order to justify the effectiveness of Barakah's First of a Kind Tests (FOAK). While FANR is aware of delays in the execution of some tests at Shin Kori, FANR is not aware that any tests have been cancelled. Should some of these FOAK tests be delayed

significantly, FANR will require ENEC to review its original plan which may include in some cases performing the FOAK test on Barakah Unit 1, as appropriate.

The Board expressed concerns when FANR indicated in its briefing that it has moved under the Prime Minister's jurisdiction as to what effect will this have on regulatory independence? The Board also expressed that is also important for FANR to develop its contacts with other government agencies. FANR's responded that an agency of the UAE Federal Government, FANR is integrating itself within the UAE Federal Government system. As a result, FANR will apply federal government policies and management standards as far as possible.

For instance, FANR is providing its strategic plan and performance indicators to the Prime Minister's office along with all other federal agencies.

However, FANR's mandate according to the Nuclear Law has not changed, and FANR will continue to make its regulatory decisions for safety, security, and non-proliferation independently and according to the obligations in the Nuclear Law.

FANR is working with the Prime Minister's office to integrate the strategic plan. There is no issue about FANR's complete regulatory independence: FANR writes its own regulations and does its own inspections without interference. FANR has set up a committee to work with other agencies. And FANR management will submit to its Board a paper on what FANR independence means.

# Security

## Security Assessment and Recommendation



Dr. Chung initiated the security briefing by asking when the fresh fuel would arrive in the UAE. The briefer responded that it will be in the country during the fourth quarter of 2016, pending upon regulatory approval. With respect to fresh fuel storage and the security of the implementation of storage plans, in December 2015 ENEC submitted to FANR its Transport Security Plan and its review has been completed. In February of 2016, ENEC submitted its Physical Protection Plan (PPP), Construction Phase II, which includes the Fresh Fuel Storage Plan and the Limited Access Area. FANR is currently reviewing this submission.

Regarding the physical protection for operations, ENEC submitted the PPP for Operations (PPP-O) as part of the OLA for Units 1 and 2 back in March 2015. ENEC's cybersecurity plan was also included in its modification of the PPP-O in the second quarter of 2015 to FANR along with three other related PPP-O plans in 2015. The Contingency Plan and Vulnerability Assessment are also scheduled to be submitted.

The IPPAS workshop and preparatory meeting took place in Abu Dhabi in November 2015 and it was agreed that the IPPAS mission itself, scheduled for the fourth quarter of 2016, will include a national review, a facility review, and a review of the security of sources. The IAB Chairman then inquired about cybersecurity. FANR replied that this was

being carefully studied and that prior to the OL getting approved, there must be a robust cybersecurity strategy in place. The Chairman asked about the Belgian incident concerning the reactor there. FANR replied, that while it is outside their jurisdiction, FANR is working closely with the national security services and is following the matter.

ENEC presented an overview of its nuclear security program. This program is being developed by ENEC in partnership with the CICPA. In accordance with FANR regulations, security measures detailed in the various physical protection plans are required to be implemented 30 days prior to fuel receipt at Barakah NPP. CICPA and ENEC are working together to provide guard force training. The training for Barakah's specialized unarmed guard force will be completed and the force will be mobilized by the end of 2016. PPP-O, Revision 1 addressing nuclear security readiness was developed jointly by ENEC and CICPA and submitted to FANR on March 31, 2016. It included:

- A presentation of the division of roles and responsibilities for security activities between CICPA and ENEC
- A Target Set Analysis summary
- A Contingency Plan detailing actions that are aligned with the Emergency Response Plan
- A Vulnerability Assessment summary

# Security Assessment and Recommendation

- A description of the testing, maintenance, and evaluation program
- A Physical Protection system overview
- A proposed cybersecurity plan is included in the submission

CICPA also presented a report on their progress. The officers presenting the report described their work with ENEC on the Barakah nuclear security program. The continuation of the nuclear security training, site-specific nuclear security training, the program at Khalifa University and workshops held by Sandia National Laboratories were all covered. ENEC is implementing a fitness for duty and a behavioral observation program pursuant to regulatory requirements.

ENEC's CNO mentioned FANR's interest in cybersecurity. In his opinion, the Barakah cyber planning was very sophisticated, and more advanced than in the U.S.

During the CICPA briefing, there were comments and questions on cybersecurity from the Board. ENEC underscored that nuclear cybersecurity is an ongoing global concern. A special task force was organized after the attacks in Belgium. Over the last year, the UAE cybersecurity plan was being established and it is based on the U.S. NRC and Nuclear Energy Institute (NEI) programs, also aligning to IAEA standards.

Regulation and implementation will be carried out by the National Electronic Security Agency (NESA) and FANR working together.

Lady Barbara noted that the oil and gas industry has the same problems. The IAB Chairman mentioned the events in Belgium, Stuxnet, and the attack in Saudi Arabia. CICPA replied that the Authority had addressed lessons learned from Stuxnet and added that a Saudi-type attack is unlikely in the UAE given the controls now in place.

The Chairman asked how the behavioral security plan operates. Look at what happened at Lufthansa. What can you do? The trouble in Germany was that the medical services were supposed to report effectively but did not do it. How does CICPA do it? The reply was that they thoroughly check people and there exists a special unit tasked with searching out problem creators. The risks are considerable but it is necessary to balance employee interests.

Mr. Hattori noted that Japan and Korea have opened centers of nuclear security that the UAE can benchmark against. CICPA showed an interest and mentioned that they are aware of the center of excellence in China and plans on benchmarking against this facility in the near future.



# Non-Proliferation

## Non-Proliferation Assessment and Recommendations including Waste Management

Ambassador Al Kaabi delivered a comprehensive report on the 2016 Nuclear Security Summit (NSS) in Washington, along with a report on the progress realized by all four of the Nuclear Security Summits in the last seven years and the UAE's role in the Summits.

The goals of the NSS process were:

1. To reduce the stockpiles of hazardous nuclear material
2. Improve the security of nuclear material
3. Intensify international cooperation in key areas of nuclear security

At the Washington Summit in 2010, for the first time countries and organizations came together in the NSS process to agree on global arrangements to improve the security of nuclear material and a work plan was agreed to by the members.

Following on the Washington Summit, in 2012 at the Seoul NSS, members discussed the progress made by each country.

At The Hague NSS in 2014, the final communique focused on strengthening the global security architecture, elevating the importance of cooperation between governments and nuclear industry and maintaining the high level of achievement on Summit commitments.

Most recently at the Washington NSS in 2016, which was also the final Summit, members highlighted the continued progress as well as the threat of nuclear and radiological terrorism as one of the greatest challenges to international security. Additional action plans were adopted involving the IAEA, Interpol, the United Nations, the Global Initiative to Combat Nuclear Terrorism, and the Global Partnership Against the Spread of Weapons and Materials of Mass Destruction.

International progress resulting from the NSS process includes the following:

- All of the countries that committed to secure all Category 1 radiological sources in their territories by 2016 have registered their support for the IAEA Code of Conduct
- Many countries have hosted events and meetings on issues such as maritime security, security culture, nuclear forensics, and cybersecurity, as well as taking an array of national, bi-lateral, and multi-lateral actions to counter nuclear smuggling
- Twelve countries have become Highly Enriched Uranium (HEU) free since the NSS process began
- Information sharing has expanded
- There have been increased reviews of national laws related to nuclear security
- Several countries have submitted updates to their UN Security Council 1540 reports since the last Summit

The UAE has been actively engaged in this progress. The UAE is party to all relevant international instruments relating to nuclear security, the UAE submitted its national report to the UN 1540 committee, and the UAE nuclear regulations and regulatory guides are based on the IAEA Nuclear Series documents. The UAE has undertaken a considerable effort to counter nuclear smuggling. In 2014, FANR issued an updated regulation on the export and import of nuclear material. The government is an active participant in the international information sharing effort on nuclear smuggling and is an active promoter and participant in the IAEA network for nuclear security training.

The UAE works closely with the IAEA on nuclear security through participation in workshops, Nuclear Security Guidance Committee meetings, and by providing experts for various meetings. Recent IAEA review missions in the UAE include an Integrated Regulatory Review Service (IRRS) follow up mission in early 2016 and an Emergency Preparedness Review (EPREV) mission in 2015. There is also considerable partnering with external stakeholders. The Inter-Arab

## Non-Proliferation Assessment and Recommendations including Waste Management

Nuclear Detection and Response Exercise recently concluded a three-day exercise in Abu Dhabi. The UAE, in cooperation with various U.S. entities, established the Gulf Nuclear Energy Infrastructure Institute (GNEII) in Abu Dhabi, an educational institution that provides classroom instruction and hands-on experience in nuclear energy safety, security, safeguards, and non-proliferation. GNEII is associated with Khalifa University of Science, Technology, and Research. The UAE has concluded a number of international cooperation agreements to strengthen its nuclear power program and FANR has signed a number of Memoranda of Understanding with foreign entities.

The UAE has continued its highly commendable program of cooperation with the IAEA on many subjects related to its nuclear power program. Key achievements in 2015 include:

- The UAE completed ratification of all Conventions and Treaties outlined in UAE nuclear policy
- The UAE submitted and presented its second National Report to the Fifth Review Meeting of the Contracting parties to the Joint Convention on Spent Fuel Management and on the Safety of Radioactive Waste Management
- Seven national TC projects with the IAEA were implemented, five of these were

completed in 2015

- Three major IAEA Peer Review missions to the UAE were concluded
- There were 827 UAE participants in IAEA activities during the year
- The hosting of high-level meetings in coordination with the IAEA on nuclear non-proliferation and nuclear education training was conducted in Abu Dhabi

In February of 2016, IAEA Director General Amano visited the UAE and Barakah. Mr. Amano stated that "as a newcomer to nuclear power, the UAE is setting a positive example in timely and comprehensive planning and implementation of their nuclear power program, and with their strong emphasis on safety." During his two-day visit he thanked His Highness Sheikh Abdullah bin Zayed Al Nahyan, UAE Minister of Foreign Affairs for hosting the IAEA's International Ministerial Conference on Nuclear Power in the 21st Century, scheduled for October 2017 in Abu Dhabi.

During the CICPA briefing, Sir John Rose expressed that he hoped CICPA and the UAE are being regularly updated on the proliferation threat. CICPA replied that the need for access and updating is regularly discussed. CICPA is part of the U.S. Department of Homeland Security information sharing program and has access to open sources, but not classified information. The CICPA representative said



## Non-Proliferation Assessment and Recommendations including Waste Management



that they were working on the matter.

There was also a question by the IAB from the last Board meeting on non-proliferation, specifically on waste storage.

The presentation on waste disposal was excellent, however questions remain. What is the rationale for interim storage? Is 20 years at the site long enough?"

FANR responded that spent nuclear fuel needs to be cooled for a long period of time to permit radioactivity and heat generation to diminish to safe operation levels before final disposal. ENEC's OLA indicates that the spent fuel pools at each reactor have sufficient capacity for storage of spent fuel arising from 20 years' operation.

ENEC has also indicated in its application that it intends to establish an independent spent fuel storage installation to provide on-site additional dry storage capacity for spent fuel before final disposal.

On-site dry storage of spent fuel is an international-established proven technology. The detailed strategy for spent fuel and radioactive waste management is under development in the UAE. More information will be provided to the IAB as available.

# Transparency

## Transparency Assessment and Recommendations



In the opinion of the IAB, transparency of information in connection with Nuclear Power Projects is very important from the points of view of public acceptance and safety governance. Prompt release of important accurate and valid information is absolutely desirable in order to remove any intentional or unintentional distortion of facts.

On the other hand, in order to assess the accuracy and validity of information, we need thorough review and objective judgment by authorized experts and responsible agents. This might require time and effort which could be beyond expectations by outsiders and non-experts. There could be innocent misunderstandings about transparency. The IAB considers that there might be the need for patient fact-findings and considerations before complaining about the lack of transparency.

Therefore, the IAB calls for prompt and earnest efforts in providing the required information, and patience and considerate understanding of steps required to release information clearly and professionally. Whereas parties involved try their best to be transparent, there could have been unjustified accusation about the issue of transparency. In its final analysis, the IAB calls for the highest attention to transparency. At the same time,

the IAB understands the required time and professional efforts required in releasing complicated technical information.

Since the last Board meeting, there were five public forums in five emirates in the UAE attended by over 1,000 people. One student outreach meeting was held at UAE University in November 2015 and was attended by 75 students. A two-day workshop was conducted for UAE Federal Customs Authority staff on radiation safety and safeguards.

ENEC's CEO has been very active in public outreach. According to the latest public opinion poll, nuclear power public approval rate is one of the highest in the world and ENEC's top leadership remain very involved in public outreach and awareness.

Two "Meet Your Regulator" workshops were held in both Dubai and Abu Dhabi to introduce FANR's e-licensing system to licensees. The workshop was attended by more than 500 licensees from different sectors.

Three public presentations were conducted in different conferences:

- A presentation on lessons learned at the Fukushima Crisis and Emerging Management Conference—held in Abu

# Transparency Assessment and Recommendations

Dhabi March 13th-14th, 2016

- A presentation on FANR capacity building at the Middle East Nuclear Training and Simulation Forum held in Abu Dhabi, March 14th-15th, 2016
- Government Communications delivered a presentation on March 20th, 2016 at the International Government Communication Forum, held in the Emirate of Sharjah

Lady Barbara asked if there was coordination between FANR and ENEC on outreach. FANR replied that regular meetings are held to discuss key messages in order to be consistent. Key messages include the country's security and radiation safety.

According to market research, public concern on nuclear energy is low compared to other countries and there are feelings of national pride about the UAE nuclear power program and its strategic importance to the nation, to power its future growth.

Mr. Hattori commented that in Japan the concern of people living far away from nuclear power plants is a problem. The primary concern in Japan is fear about nuclear safety,

more precisely, fear of radiation exposure. What are the major concerns in the UAE? FANR reiterated that public concerns were low and people seem convinced that for the next 30 to 40 years at least the power plants currently being built will be safe. In public settings, spent nuclear fuel and questions related to nuclear safety are key issues raised by attendees.

Dr. Chung mentioned that the International Risk Management Governance Conference could be helpful. The Chairman emphasized the importance of continuously educating the public and building trust as people forget and there are more people coming into the adult population all the time as generations mature.

# Sustainability

## Sustainability Assessment and Recommendations

FANR commented that its approach to staffing and competence was proceeding on two tracks: staffing of senior expatriate staff to address short to medium term needs and a development program to ensure FANR's long-term sustainability. A strong cadre of experienced professionals in nuclear safety, security, safeguards, and radiation protection is currently present at FANR.

At the end of the first quarter of 2016, FANR had 202 employees plus a strong program of recruitment, education, and mentoring of younger Emiratis. Of FANR's total staff, 61% are males and 39% females, 125 are Emiratis (83 in operations, 35 in administration, and seven in the Director General's office), 77 are expatriates (63 in operations, seven in administration, and seven in the Director General's office).

FANR has in place a robust young professional development program for capacity building. The 12 month program includes elements such as the GNEII program at Khalifa University, department rotation, soft-skills modules, coaching and mentoring, a study tour, and final assessments. Succession planning will help in identifying current and future FANR leaders. The objective is eventually a workforce at FANR that is 99% Emirati.

During the ENEC presentation, Mr. David Scott mentioned that Abu Dhabi is hosting the 24th Women in Nuclear (WIN) Annual Global Conference in November 2016, under the patronage of H.H. Sheikha Fatima Bint Mubarak, the Supreme Chairwoman of the Family Development Foundation, President of the General Women's Union—Chairwoman of the Motherhood and Childhood Supreme Council. There is a very active WIN chapter in Abu Dhabi; the first of its kind in the Middle East, which was established by ENEC in 2014.

The UAE is a leader in nuclear capacity building. This is a long effort on which the UAE has embarked. The UAE needs to develop

enough human capacity for operations and also for sustainability. Recently, the first batch of Emirati reactor operators graduated. ENEC is also making great strides in capacity building. The ENEC Deputy Director for Capacity Building and Training, presented an overview of ENEC's human capacity development. Currently, there are over 100 female employees permanently stationed at the Barakah site.

ENEC is also delivering a considerable set of professional development programs—and there is a significant investment in Emiratis becoming nuclear professionals. Three important programs should be mentioned:

- The IAEA Nuclear Energy Management School in Abu Dhabi, where 42 Emiratis have completed the program
- The Gulf Nuclear Energy Infrastructure Institute, where 24 Emiratis have completed this program and two are currently studying under it (the program is operated by ENEC in partnership with Texas A&M)
- The Westinghouse Senior Reactor Operator Management Certification Program; 38 have completed this program and ENEC will offer its own four-month program starting in 2018

For the first 10 years of operations, ENEC plans to outsource maintenance work to KEPCO while it builds the local nuclear maintenance capability.

After 10 years, ENEC through its operating subsidiary will have the option to decide whether to enact its own maintenance program or continue to outsource. This will influence the Barakah Technical Training Program which was established in 2013 and has since transferred all training sessions from South Korea to the UAE.

# Sustainability Assessment and Recommendations



Regarding manpower, ENEC currently has 1,626 employees representing 39 nationalities. 61.5% are Emiratis and 21% (180) are Emirati women.

During the CICPA briefing, the IAB Chairman asked CICPA officials to give their opinion as to the success of the full emergency exercise that took place at site. CICPA said it was good experience for them and believed the exercise was a success.

During the ENEC presentation, ENEC CNO informed the IAB about the Unit 1 safety and quality reschedule program. The program was launched by ENEC leadership to ensure that the first Unit of the peaceful nuclear energy program commences commercial operations in adherence to the highest standards of safety and quality and to the earliest schedule possible.

ENEC's CEO launched this program to ensure Unit 1 is delivered in line with international professional management principles. The following seven principles would be the foundation of the program with the first two being the most important:

1. Leadership at the ENEC and operating subsidiary level. The two organizations needed to further focus their priorities to ensure they were working efficiently to achieve the

safe and quality delivery, commissioning and operational readiness of Unit 1. The INPO Leadership and Team Effectiveness Model was selected to support this

2. There would be an increase in the number of standing committees on the ENEC Board. This brings the program closer to implementing WANO standards, which have been formed from INPO standards. With respect to ENEC, roles and responsibilities have been further defined following the Excellence in Governance manual, which defines the roles and responsibilities of the Board of Directors, all the committees and draws clear reporting lines up to the CEO of ENEC.
3. Further build the ENEC and KEPCO partnership to ensure long term success of the program
4. Align with external local and Federal stakeholders
5. Concentrate on getting ENEC's work done
6. Work in close collaboration with KEPCO to get its work done in adherence to the requirements of the Prime Contract and the UAE peaceful nuclear energy program
7. Implement excellence.

# Conclusion



Sir John Rose, Lady Barbara, and Ambassador Graham would like to be briefed on the degree to which security forces are updated on proliferating threats. They very much hope that CICPA can find some arrangement that will give them access to classified information. There is a rapidly evolving cyber environment; they need to know what is going on. Of course, the Board understands that there may be limitations on what they can say—things that would reassure the Board. The Board would like to hear about cyber threats from the National Electronic Security Agency (NESA) mentioned by CICPA and FANR.

FANR has an office at the airport, at Barakah, and are moving to new offices in the city. Expansion of the regulator is positive news. The Board supports the independence of FANR—they should interpret for themselves what independence means.

FANR financing is an issue related to independence. FANR should look into how regulatory agencies are financed elsewhere in the world. Independence is extremely important. FANR should study this issue. The Board believes that the trust fund for financing decommissioning costs should be established before operations begin.

The Board would like to congratulate Ambassador Al Kaabi on the important role he has played and continues to play at the IAEA and the Nuclear Security Summits. Hosting International Ministerial Conference on Nuclear Power in Abu Dhabi in October 2017 will be very important.

There is a need for more transparency from Korea and the UAE should communicate and raise their concerns regarding the essential information acquired for the program success. Both sides should work harder and raise more efforts to stay on time and on budget unless rushing will jeopardize safety and security of the program then that is acceptable.

Perhaps the basic contract needs to be refreshed. Problems that exist are: insufficient transparency in Korea; ENEC has experienced significant delays in the delivery of equipment; and there is a challenge on the source for trained and licensed reactor operators projected by the original planned date of 2017. ENEC needs to have an in depth discussion with WANO about average versus top of the line procedures.

The Board is grateful for the considerable effort undertaken by the UAE and the

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supporting entities to provide the IAB with highly competent, informative and valuable presentations.

Again, the Board congratulates the UAE on the continued success of its nuclear power program and finds that the UAE in its program remains fully committed to the principles of safety, security, non-proliferation, transparency and sustainability.

## ACKNOWLEDGEMENT

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The International Advisory Board would like to thank all who were involved in developing this report.