


アラブ首長国連邦UAEの原子力プログラムの進展

2019年1月17日

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(UAE原子力規制庁 勤務 2009年10月1日ー2018年10月31日)

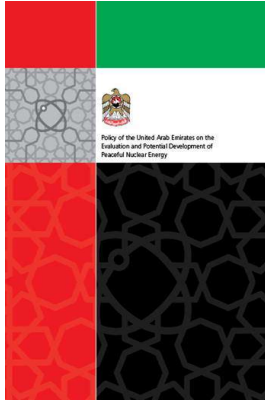
S2-1



1. Introduction of the UAE Nuclear Program

UAE Nuclear Policy

- In 2008 the Government issued the *Policy of the United Arab Emirates on the Evaluation and Potential Development of Peaceful Nuclear Energy*.
- Policy commits UAE to “highest standards of safety and security”.
- The UAE has moved forward on the commitments in its policy through :
 - adherence to the relevant international instruments for nuclear safety, security and non-proliferation,
 - the establishment of a legal, governmental and regulatory framework for safety, and
 - on-going support for the development of the UAE peaceful nuclear energy programme



S3-2

Roadmap for Developing a Successful Nuclear Power Program (Nov. 2009)

Developing UAE National Infrastructure

Roadmap prepared by consultants translated the IAEA **milestones** in developing a successful nuclear power program **into an implementation plan** customized to UAE needs:

- Evaluated current infrastructure and capabilities within UAE
- Assessed different industrial strategies and reported feasibility.
- **Recommendations to improve and develop new elements.**
- Outlined a **schedule** and **responsibilities** and set feasible **milestones**.

S3-3

Overall Planning of UAE Nuclear Power Program


	NPP	C. D.
Unit-1		2017
Unit-2		2018
Unit-3		2019
Unit-4		2020

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Selection of Technology and Prime Contractor

- Following a year-long, intense evaluation of bids from France (EPR), Japan (ABWR), and Korea (APR1400), Prime Contract awarded to the team led by **Korean Electric Power Corporation** on December 27, 2009.
- Decision criteria:
 - Safety
 - Deliverability
 - Contract Compliance
 - Human Resource Development
 - Commercial Competitiveness
- APR 1400
 - Based on Generation 3 technology from the US
 - **“Reference Plant” in Shin Kori 3** under construction
 - South Korea has continually upgraded the reactor design
 - South Korean operating record is among the world’s best
 - National support of South Korea

Advanced Power Reactor 1400




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UAE Nuclear Program Management Structure

- **Federal Authority for Nuclear Regulation, FANR**
 Federal Authority (<http://www.fanr.gov.ae/en/Pages/default.aspx>)
 - Regulations, licensing, inspections, accounting and control of nuclear material
- **Emirates Nuclear Energy Corporation, ENEC**
 (<http://www.enec.gov.ae/>)
 - Promotion and development of required infrastructure for nuclear power program in UAE
- **Nawah Energy Company, Nawah**
 (<http://www.nawah.ae/>)
 - Operation of Barakah nuclear power plants
- **Ministry of Foreign Affairs**
 - Policy coordination and International Cooperation framework arrangements
- **Other entities are assigned with specific responsibilities**
 - **CICPA** : Responsibilities for implementing physical security
 - **Khalifa U**: Human Capacity building
 - **NCEMA**: National emergency and crisis management

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2. UAE Nuclear Legal & Regulatory Infrastructure


2.1 UAE Nuclear Law

Nuclear Law (Decree): October 2009

The main part of the legislative framework is in place.

- In line with the UAE Policy & international treaties, the Federal Law by Decree No (6) of 2009, Concerning The Peaceful Uses of Nuclear Energy (the “**Nuclear Law**”) was issued by the President in September 2009 to:
 - develop & control UAE nuclear sector towards **peaceful purposes**
 - **ensure Nuclear Safety & Security, and Radiation Protection**
 - **prohibit Enrichment & Reprocessing Facilities in UAE**

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2.2 Nuclear Regulations

(Examples are shown below)

FANR-REG-03	Design of Nuclear Power Plants
FANR-REG-05	Application of Probabilistic Risk Assessment (PRA) at Nuclear Facilities
FANR-REG-08	Physical Protection for Nuclear Materials and Nuclear Facilities
FANR-REG-11	Radiation Protection and Predisposal Radioactive Waste Management in Nuclear Facilities
FANR-REG-10	System of Accounting for and Control of Nuclear Material and Application of Additional Protocol
FANR-REG-12	Emergency Preparedness for Nuclear Facilities
FANR-REG-14	Application for a Licence to Operate a Nuclear Facility
FANR-REG-15	Off-site Emergency Plans for Nuclear Facilities
FANR-REG-16	Operational Safety including Commissioning
FANR-REG-17	Certification of Operating Personnel at Nuclear Facilities
FANR-REG-21	Decommissioning of Facilities
FANR-REG-23	Security of Radioactive Sources
FANR-REG-26	Pre-disposal Management of Radioactive Waste

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2.3 Nuclear Regulatory Guides

(Examples are shown below)

- FANR-RG-001 Content of Nuclear Facility Construction and Operating Licence Applications
- FANR-RG-002 Application of Management Systems for Nuclear Facilities
- FANR-RG-003 Probabilistic Risk Assessment: Scope, Quality and Applications
- FANR-RG-004 Evaluation Criteria for Probabilistic Safety Targets and Design Requirements
- FANR-RG-006 Transportation Safety Guide
- FANR-RG-007 Radiation Safety
- FANR-RG-017 Operator Certification Guidance
- FANR-RG-019 Radiation Safety in Industrial Radiography

In addition to the above guides, **US regulatory guides and IAEA safety guides** are specified for use in Review Instruction of each chapter for review of CLA (Construction License Application CLA (PSAR) and Operation License Application OLA (FSAR).

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2.4 Integrated Management System Instructions of FANR

2.4-1 Instructions for Review and Assessment of NPP

- 1). Work Instructions (WIs)
- 2). **SAR Review Instructions (RIs)**

2.4-2 Instructions for Inspection of Nuclear Facilities


- 1). Administration
- 2). Management System
- 3). Construction
- 4). Commissioning
- 5). Operation
- 6). Maintenance
- 7). Radiation Protection
- 8). **Emergency Preparedness**

2.4.-3 Radiation and Nuclear **Emergency** Instructions

2.4.-4 Safeguards Instructions

2.4.-5 **Education and Training Instructions**

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2.5 UAE Regulatory Authority FANR

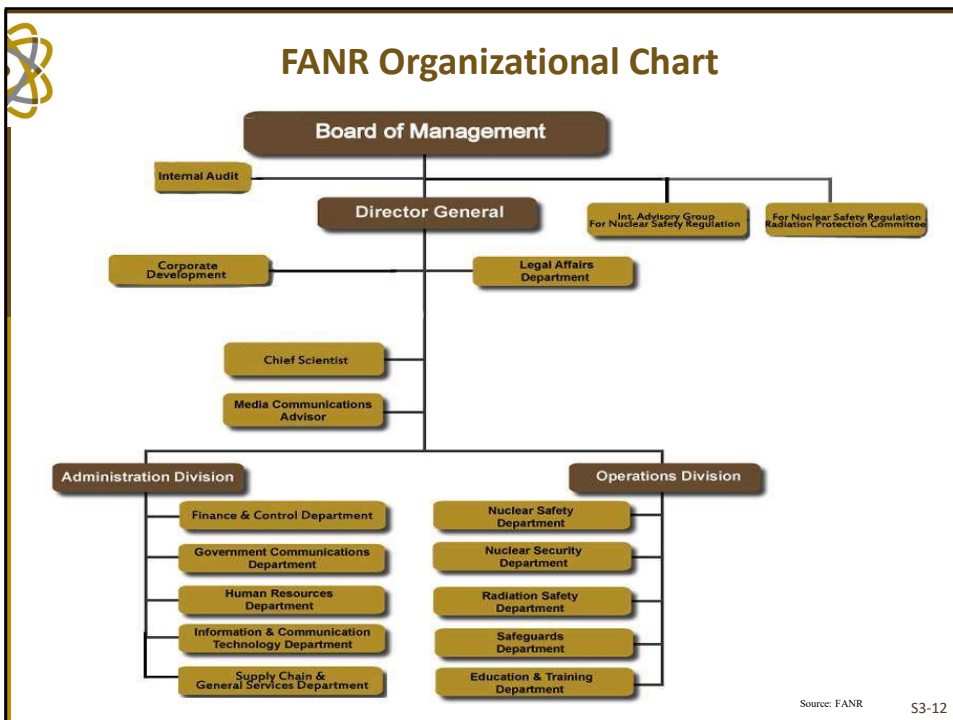
Establishment of a Regulatory Authority for the Nuclear Sector in accordance with White Paper


“...the establishment of an independent, vigilant and effective regulatory authority is a cornerstone for any stable, credible, safe and secure nuclear energy program.” UAE White Paper, April 2008

The Regulatory Authority would be endowed with powers to:

- Establish requirements and regulations
- Issue Licenses
- Inspect and assess facilities
- Monitor and enforce compliance with regulations
- Establish a State System of Accounting and Control (SSAC)

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3. Licensing Activities in the UAE Nuc Program

3.1 NPP Activities that Require Licenses (Article 25 of UAE Law)

- **Selection of a site** for the Construction of a Nuclear Facility
- **Preparation of a site** for the Construction of a Nuclear Facility
- **Construction** of a Nuclear Facility
- **Commissioning** of a Nuclear Facility
- **Operation** of a Nuclear Facility
- **Closure or a change** in the **Closure date** of any Nuclear Facility
- **Decommissioning** of a Nuclear Facility
- **Modifications** having significance on Safety to the Management System and organizational arrangements of the structure, systems and equipment of or contained in any Nuclear Facility
- **Possession, use, manufacture or handling** of any Regulated Material in the State

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Status of NPP Licensing

Licenses issued:

- Site Selection Licence
- Site Preparation Licence
- Limited Construction Licence
- Construction Licence for Units 1 & 2 (July 2012)
- Construction Licence for Units 3 & 4 (Sept 2014)
- Import of Nuclear Fuel
- Nuclear Fuel Handling and Storage
- Nuclear Fuel Transportation

ENEC submitted application for an Operating Licence for Units 1&2 in March 2015


- Authorization of fuel load, start up, nuclear commissioning, commercial operation, and possession of regulated material

followed by application for an Operating Licence for Units 3&4 in September 2016

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3.2 Construction License

Construction License Application for Barakah 1 & 2 (Received on 27 Dec 2010)



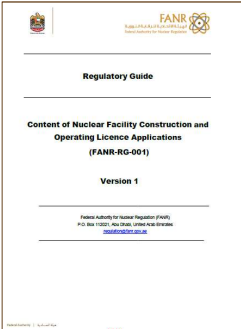
- Application Letter
- Preliminary Safety Analysis Report
- 9000 pages
- 21 Chapters covering Safety, Safeguards and Physical Protection and 2 Supplements

Separate Submittals

- Physical Protection Plan for construction
- Preliminary Safeguards Plan
- **Preliminary Probabilistic Safety Assessment Report summary**
- **Severe Accident Analysis Report**

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Submitted PSAR Followsurface Article (8) of FANR RG-001: SAR Content



1. *Introduction and General Description of Plant*
2. *Site Characteristics*
3. *Design of Systems, Structures, Components, and Equipment*
4. *Reactor*
5. *Reactor Coolant and Connecting Systems*
6. *Engineered Safety Features*
7. *Instrumentation and Controls*
8. *Electric Power*
9. *Auxiliary Systems*
10. *Steam and Power Conversion System*
11. *Radioactive Waste Management including Storage prior to Disposal*
12. *Radiation Protection*
13. *Conduct of Operations*
14. *Inspection, Test, Analyses and Verification Programmes*
15. *Transient and Accident Analyses*
16. *Technical Specifications*
17. *Management of Safety, Security and Safeguards*
18. *Human Factors Engineering*
19. *Probabilistic Risk Assessment and Severe Accident Analysis*
20. *Physical Protection*
21. *Safeguards*
22. *Decommissioning and End-of-Life Aspects*
- S1. *Reference Nuclear Facility, Modification and Independent SV*
- S2. *Safety issues and use of OPEX*


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FANR Effectively Uses Safety Information from RBCoO

Category 1 → Full review and assessment
Category 2 → Capitalize on the RBCoO review and assessment

Category 1 Review is assigned to any item of the SAR that does not meet all criteria for a Category 2 Review or

- new technology ,
- new findings,
- large risk contributors,
- site specific conditions/designs.




Category 2 Review is assigned to any item of the SAR that meets the following criteria:

- The documentation submitted by the applicant is **adequate** to the extent that the reviewer has sufficient information to assess topics below.
- The submission demonstrates that the RBCoO's regulatory requirements associated with this item are consistent with and meet those of FANR.
- The technical basis used by the RBCoO to perform their review and assessment is clearly described and explained.
- With respect to the reference plant there is **no design change** with significant impact on nuclear safety.
- With respect to the reference plant there is **no change in operational activities with significant impact on nuclear safety.**

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Examples of Factors Causing Design Changes from Reference Plant

- High Sea Water and Air Temperature
 - Systems evaluation (all effected systems)
 - Equipment evaluation
 - Layout impact evaluation
 - Operational impact evaluation
- Sand Storm
- Oil Spill in Sea
- **Effect of Geology** →  Source: FANR presentation
- Electrical Grid Frequency (Design change from 60 Hz design to 50 Hz design)
 - Software / Hardware (Electrical Equipment, Mechanical Equipment; Equipment qualification)
- New Requirement: Effect of Air Craft Crash Measures

See next slide

Source: Licensing Report, FANR/ ENEC

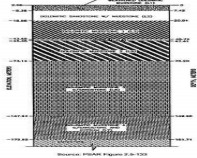
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Seismic Design Verification Inspection for CEDM and ESW Pump House of Barakah NPPs (Excerpts from T. Saito Presentation at Inspection Technique Training Workshop, Nov. 5, 2012)

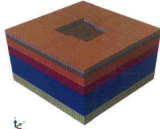
1. How the inspection be performed based on 3 requirements from a selected Inspection Instruction

Background

- Reference plants (SKN 3&4) is built directly on hard rock but BNPP NPPs will be built on soil
- BNPP containment is much heavier due to air-craft crash measure
- Electrical frequency of the SKN 3&4 is 60Hz while that of BNPP is 50 Hz (resulted in in different pump designs – ESW pump)
- Soil-structure analysis needed
- Preliminary analysis shows reference design floor response does not envelope at lower frequencies
- ITS (important-To-Safety) equipment in containment and auxiliary building selected for design verification



Source: Licensing Report, FANR/ENEC



Source: Licensing Report, FANR/ENEC

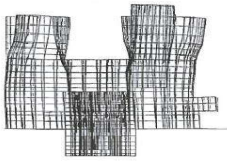


Figure D.2-1. Major X-mode in XZ-plane View

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FANR Review Using Technical Support Organizations (Effective Use of World Experience)

- FANR engaged three TSOs in the US and Europe to support review and assessment of CLA / OLA to augment in-house resources
- FANR provided alignment and direction to TSOs ensuring consistency across the CLA and OLA review.
- FANR retains responsibility for regulatory decisions, through its in-house team of seasoned staff.

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Review Process: Request for Additional Information (RAI)

Example RAI 4.2-1002

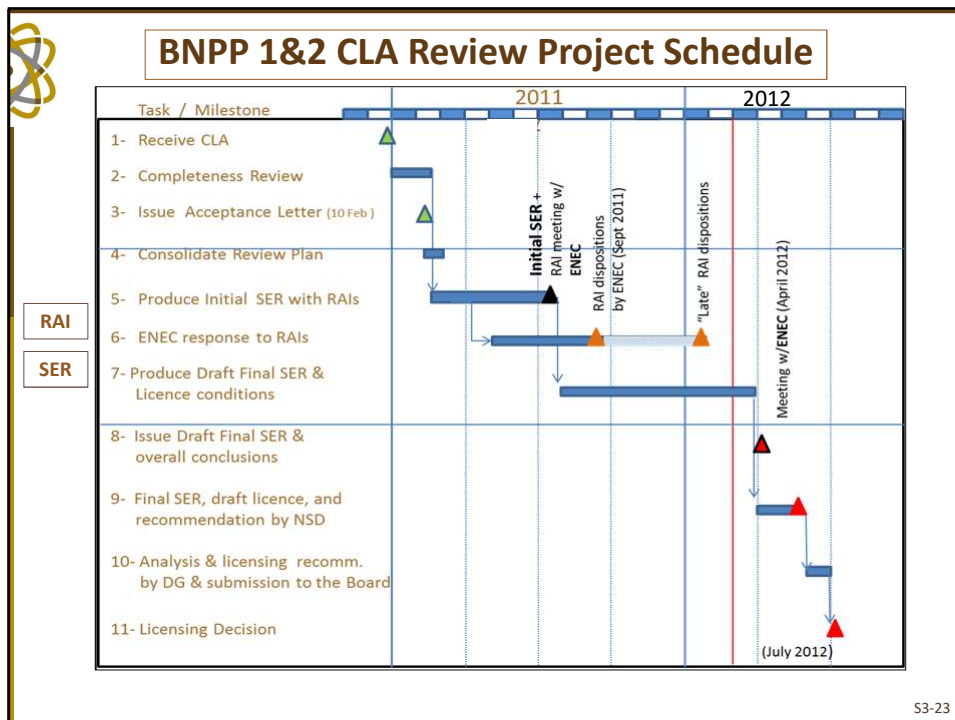
Barakah Units 1 and 2 Final Safety Analysis Report Request for Additional Information [RAI]						
RAI Number [Chapter/Section-Sequential Number Assigned by Section Lead]						4.2-1002
Originator Name		Originator Organization	FANR	Date Submitted	10-Jun-2015	
Work Package	E	FSAR Chapter/Section	4.2	Page No	1	SERs and Interfaces Ch. 6 & 15
FANR Letter Number		FANR-NSD-ENEC-COR-00984-2015		Date Submitted	14-Jun-2015	
Applicable FANR Regulations			FANR-REG-03, Article (44), item 2; Article (45) Items 2; Article (47), Item 1, Article (48), Items 1 & 3			
RAI Topic			Fuel thermal conductivity degradation & fuel enthalpy limits			
SUMMARY OF THE INFORMATION PROVIDED BY THE APPLICANT						
SPECIFIC ADDITIONAL INFORMATION NEEDED TO DEMONSTRATE THAT THE APPLICABLE FANR REGULATION(S) HAVE BEEN MET						

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Safety Evaluation Report (SER) Preparation: Content of SER Section

1. Area of Review
2. FSAR Interfaces
3. Licensing Basis References
 - 3.1 Applicable FANR Regulations
 - 3.2 Review Guidance and Industry Standards to Meet FANR Regulations
4. Regulatory and Safety Review
 - 4.1 Review Methodology
 - 4.2 Applicability of Previously Approved Review Performed under the Barakah Units 1 and 2 Construction License
 - 4.3 Review of Changes and/or Additions to the Preliminary Design Approved under the Barakah Units 1 and 2 Construction License
 - 4.4 Generic Issues and Operating Experience
 - 4.5 FSAR Interface Evaluation
5. Open Items and Commitments
6. Post Operating Licence Commitments
7. Conclusions

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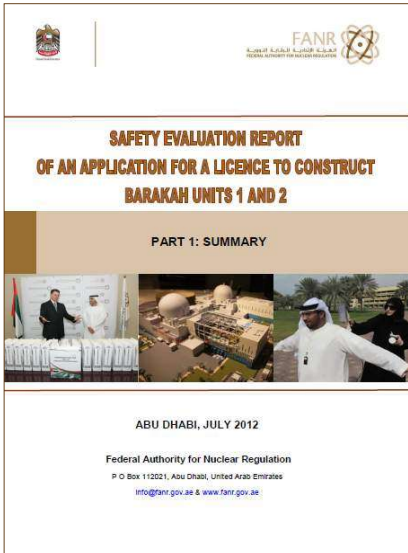
PSAR Review (Summary)

- IAEA IRRS Mission Evaluation on PSAR Review of FANR
"FANR has regulations and a review process for effectively conducting the review of the application."
"Review and assessment in FANR with the support of TSOs is organizationally a well arranged and managed process."
- Request for Additional Information (RAIs) Sent to ENEC
 - 1599
- Safety Evaluation Report (SER) Sections
 - 223
- Safety Evaluation Report
 - Part 1: Summary (70 pages)
 - Part 2: Detailed SER (2500 pages)

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**Safety Evaluation Report (SER) for
BNPP 1&2 Construction Licence Application**

Web Final SER for Barakah Units 1 2 CLA



Part 2: Detailed SER (2500 pages)

PART 2 – FANR FINAL SAFETY
EVALUATION REPORT FOR BARAKAH
UNITS 1 AND 2
CONSTRUCTION LICENCE
APPLICATION

ABU DHABI, JULY 2012

Federal Authority for Nuclear Regulation
P O Box 112021, Abu Dhabi, United Arab Emirates
info@fanr.gov.ae & www.fanr.gov.ae

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Contents of Safety Evaluation Report Part-2

PART 2: SUPPORTING MATERIAL

- 1- DETAILED SAFETY EVALUATION REPORT
- 2- REVIEW OF ENEC's FUKUSHIMA LESSONS LEARNED REPORT
- Appendix 1: ACRONYMS AND ABBREVIATIONS
- Appendix 2: LICENSING CORRESPONDENCE
- Appendix 3: LIST OF DEFERRED COMMITMENTS
- Appendix 4: REFERENCES
- Appendix 5: PRINCIPAL TECHNICAL REVIEWERS
- Appendix 6: RAI History Record

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FANR Assessment on Construction Licence Application and Follow-up Actions

Conclusion and Grant of CL for Barakah Units 1 & 2

- The staff found that the information submitted by ENEC is sufficient to demonstrate that the proposed facility complies with FANR regulations, and satisfies the relevant principles, objectives and criteria for safety, radiation protection, nuclear security and non-proliferation as required by Law .
- FFANR granted Construction License for Barakha Units 1 & 2

Follow-up Actions (Licensing Conditions)

- During its evaluation FANR identified requirements for a number of follow-up submittals from ENEC “Conditional Acceptance”
 - Update PSAR
 - Additional submissions to confirm technical solutions meet FANR requirements
 - Fukushima follow up actions
 - FSAR commitments

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3.3 Operating License

Application for Barakah 1 & 2 Received on 26 March 2015

- Final Safety Analysis Report**
 - 15,000 pages
 - 22 chapters and 2 supplements covering Safety, Security and Safeguards
 - Technical Specifications
 - Independent Safety Verification and Independent Design Review
- Separate Submittals**
 - 1) Quality Assurance Manual
 - 2) **Updated Safety Assessment Report on Lessons Learned from Fukushima Accident** (229 pages)
 - 3) **Severe Accident Analysis Report (SAAR)** (936 pages)
 - 4) Physical Protection Plan (PPP)
 - 5) Safeguards Plan (SP)
 - 6) **Emergency Plan (EP)** (735 pages)
 - 7) Probabilistic Risk Assessment (PRA) Summary Report
 - 8) Decommissioning Overview
- Parts of OLA provide updates on previously approved submissions:**
 - site characteristics
 - NSSS design

Safety Assessment Report for Barakah Nuclear Power Plants (Lessons Learned from Fukushima Accident)

Barakah NPPs Severe Accident Analysis Report Using Best Estimate Methodology

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Supporting Submittals

1. Radiation Protection Program
2. Fire Protection Program and procedures
3. Fire Hazards Analysis
4. Structural/seismic analysis for new and spent fuel racks
5. New fuel emergency response plan
6. Chemistry Program
7. Physical Protection Plan

RP-PGD-0001

Radiation Protection Program

Revision 00

Safety Classification: Non-Safety Related Information Use

Prepared: Jon Song, Lee
 Reviewed: [Redacted]
 Approved: [Redacted] Approved by the Adjutant for Jon Song, Lee
 Date: [Redacted]

SNPP Non-Use Related

FP-PGD-0001

Nawah Fire Protection Program Description

Revision 00

Safety Classification: Non-Safety Related Information Use

Prepared: [Redacted]
 Reviewed: [Redacted]
 Approved: [Redacted] Approved by [Redacted]
 Date: [Redacted]

SNPP Non-Use Related


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Review of Operating License Application for Barakah 1 & 2

Current Barakah 1 & 2 OLA Review Milestones

Task Name	Owner	Finish
Receive Operating License Application (OLA)	Applicant	26/03/2015
Complete Initial Review of OLA	FANR	31/05/2015
Complete Detailed Review of OLA	FANR	31/08/2015
Issue First Round of RAIs - Majority	FANR	31/10/2015
Complete Draft SERs with Open Items - Majority	FANR	29/12/2016
Receive late OLA submittals including all OLA Rai responses and Operational Ruddiness Report	Applicant	2018
Complete review of late submittals	FANR	2019
Approve all SERs and supporting documents	FANR	May/ 2010
Issue Operating License	FANR	May/ 2010

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 List of Nawah Operation Management Programs to Be Reviewed and Documented (Total of 42 Programs)			
Nawah Program Description Doc. No.	Title	SER No. Review documented	FANR-REG-16 Article(s) for review
ENV-PGD-001	Nawah Meteorological Monitoring Program Description	2.0	REG-04
ENG-PGD-AOV-001	Air Operated Valves (AOVs) Program Description	3.9.6	Maintenance, Testing, Surveillance and Inspection Programmes
OP-PGD-0001-RO	Nawah Primary Coolant Outside of Containment Program Description		
ENG-PGD-AG-001	Equipment Qualification Program Description	3.11	Equipment Qualification
ENG-PGD-CTM-001	Cyclic and Transient Monitoring Program Description		Maintenance, Testing, Surveillance and Inspection Programmes
ENG-PGD-EQ-RO	Ageing Management Program Description		Ageing Management
ENG-PGD-FAC-001	Erosion and Corrosion Monitoring Program Description	4.2	Ageing Management, item (3)
RE-PGD-002-RO	Nawah Fuel Integrity Control Program Description		Core Management and Nuclear Fuel Handling
ENG-PGD-RVS-001	Reactor Coolant Pressure Boundary Material Surveillance Program Description	5.2.3	Maintenance, Testing, Surveillance and Inspection Programmes & (16) Ageing Management

DCM-PGD-001	Nawah Document Control and Records Program Description Management	17.0	Accident Management Programme
OP-PGD-0003	Equipment Clearance Safety Program Description	17.0	Accident Management Programme
NRM-PGD-AM-0001	Nawah Accident Management Program Description	19.2	Accident Management Programme
NRM-PGD-PRA 0001	Nawah Probabilistic Risk Assessment Program Description	19.1	
SEC-PGD-0001	Nawah Site Security Program Description	20.0	Management System REG-08
SFG-PGD-0001	Nawah Safeguards Program Description	21.0	Management System, REG-10
EXP-PGD-001	Export Control Program Description	21.0	FANR-REG-09

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3.4 Other NPP-Related Licenses

- Limited Construction Licence
- Construction Licence for Units 1 & 2 (July 2012)
- Construction Licence for Units 3 & 4 (Sept 2014)

ENEC submitted application for an Operating Licence for Units 1&2 on 26 March 2015

- Authorization of fuel load, start up, nuclear commissioning, commercial operation, and possession of regulated material
- Licence will be granted by February 2018

ENEC has made further applications for authorization

- Fuel Handling and Storage
- Transportation
- Import

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4. Other Activities in the UAE Nuclear Program

4.1 Activities Related to Construction and Operation of NPPs

4.1.1 Inspection and control

FANR Inspection: Scope

- ENEC and Prime Contractor
- Vendor
- Site Construction
- Commencing testing (pre-operational tests)
- Operational Readiness



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4.1.2 Emergency Preparedness

IAEA Emergency Management: Drills and Exercises


- FANR completed IAEA Convex 2b exercise – reporting to IAEA via USIE, transmitting data and requesting assistance (August 2015)
- NCEMA conducted first tabletop joint and coordination exercise in addition to assessment of the emergency procedures for each government entity (September 2015)
- NCEMA conducting exercise of the offsite emergency plan to demonstrate the notification process, reception centers operation, activation of the EOC/EOF, implementation of protective actions, capability for radiological monitoring and measurements (October 2015)
- Barakah NPP full scale exercise – onsite and offsite plans - February 2016



Source: ENEC/Construction Week Online, ITP Digital Media Inc.




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IAEA EPREV Mission 2015 (21 – 31 March 2015)

- To review emergency preparedness and response (EPR) arrangements and capabilities associated with the Barakah Nuclear Power Plant (NPP):
 - The on-site emergency preparedness and response plan;
 - National and local off-site EPR arrangements;
 - The interface between the NPP and the off-site EPR authorities; and
 - Arrangements for international notification as per IAEA safety standards
- **Evaluation: Recommendations:**
 - Need to develop a formalized process for determining protective actions, based upon all available information, including plant status and field surveys and including use of OILs
 - Review requirements for the emergency planning zones (UPZ, PAZ, EPD and ICPD) consistent with IAEA safety standards
 - Detailed evacuation plans for the construction population, and procedures for reception center operations to be established
 - All stakeholders should expedite the completion of relevant emergency plans and procedures, test them and fully implement them prior to the exercise scheduled before fuel receipt (February 2016)

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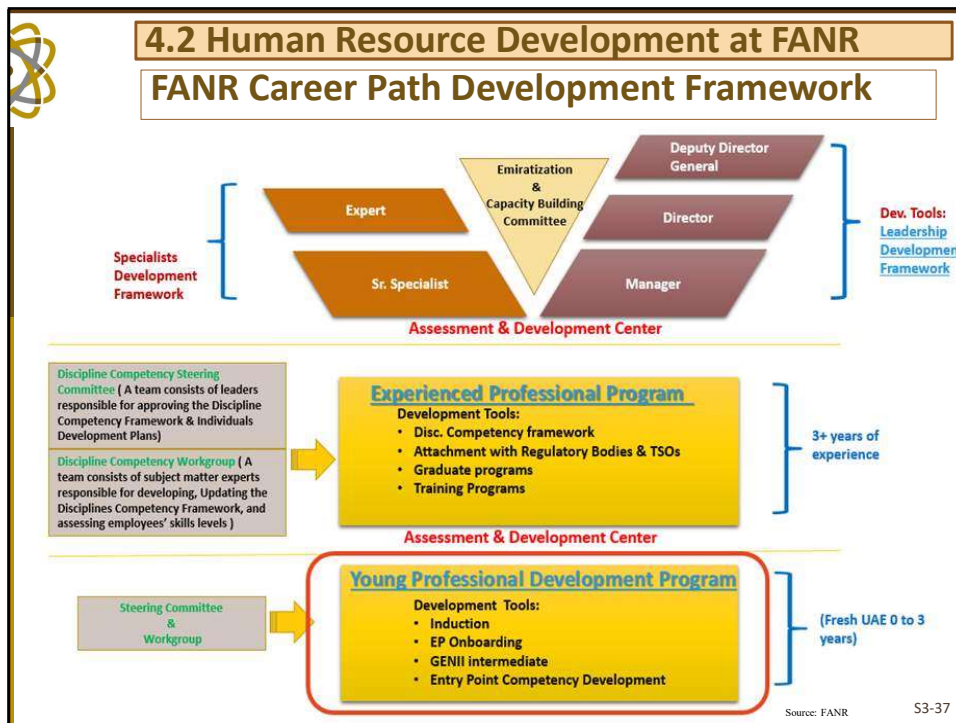


IAEA Workshop on “Capability in the Review/Assessment of Preventive & Mitigative SEOPs and SAMGs, Feb. 2016

ENEC Presentation on UAE Symptom Based **Emergency Operating procedures (SEOPs) and Severe Accident Management Guidelines (SAMGs)**”,



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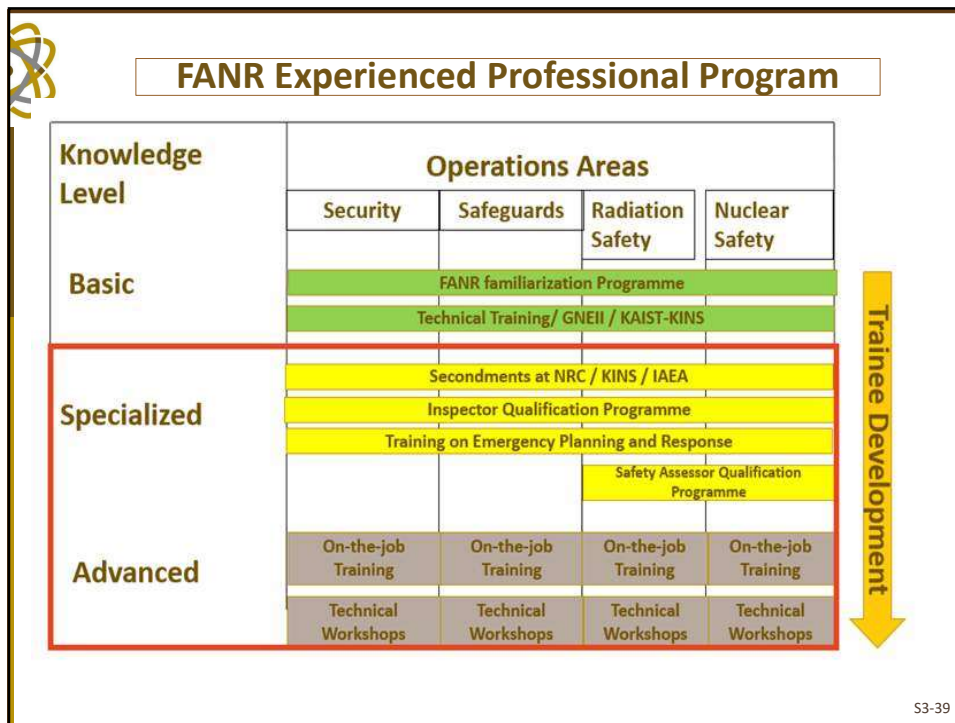
Young Professional Development Program

FANR Newsletter Issue 11 February 2016

Emirati Engineers join Nuclear Training Program

FANR welcomed nine fresh graduate Emirati engineers to embark on a year-long nuclear regulatory development program that will provide them with the fundamental knowledge they need in order to understand technical concepts applicable to nuclear engineering and regulation.

Source: FANR S3-38



4.3 International Cooperation – IAEA Missions and Workshops in UAE

UAE Policy emphasizes working directly with IAEA and responsible nations


The UAE has added to its existing international agreements by:

- Signing an additional protocol to the safeguards agreement with the IAEA;
- Becoming a party to:
 - Convention on the Physical Protection of Nuclear Material;
 - Convention on Nuclear Safety;
 - Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management



Source: FANR presentation


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IAEA Integrated Nuclear Infrastructure Review – **INIR** (Visited UAE in Jan. 2011)

- The UAE, ENEC, FANR and MoFA, the parties most directly involved in the INIR program, found the process to be a valuable, comprehensive and methodical way to ensure that the country was fulfilling its commitments and requirements as outlined in the IAEA's Milestones approach to implementing a nuclear power program
- The value derived is due in no small part to the fact that the UAE relied extensively upon the Milestones Approach as it developed its Roadmap for Success, the extensive document that laid out the path the UAE would take to implement peaceful, civil nuclear power.
- The mission team recognized that the UAE infrastructure is progressing rapidly and is well advanced. The Team also made some recommendations supporting the on-going development of the program.

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IAEA Integrated Regulatory Review Service **IRRS** (Visited UAE in Dec. 2011)

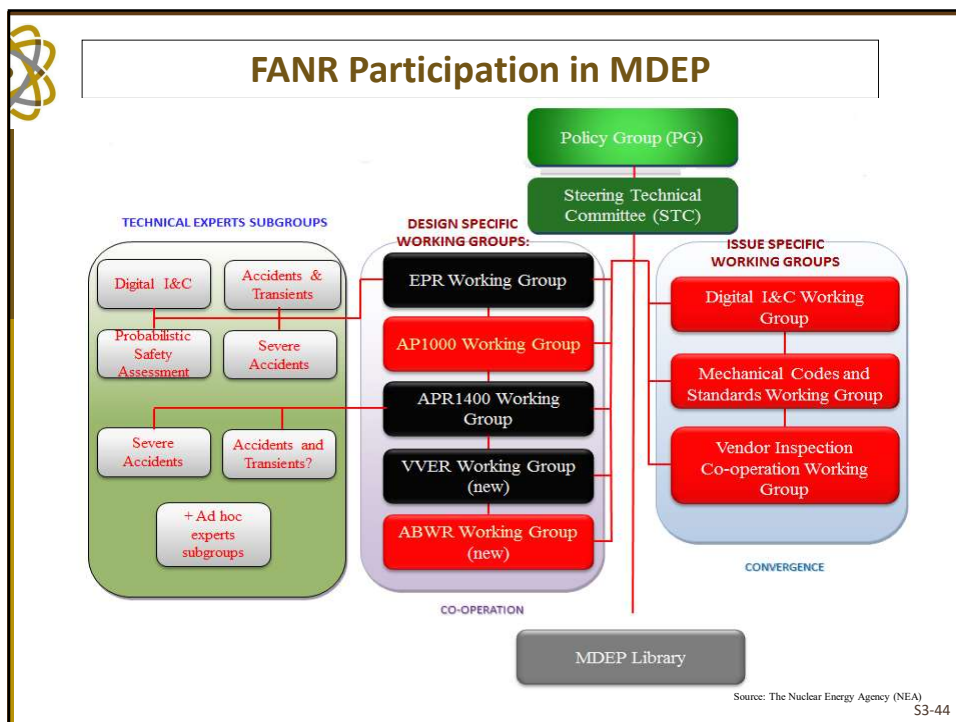
- The UAE opted for a full scope mission, which covers all the 10 core modules
- In addition, the UAE decided to have three additional Modules covering
 - Medical exposure control
 - Occupational exposure control, and
 - Safety and Security of Radioactive Sources
- Plus three policy discussions
 - Response to the Fukushima accident
 - Capacity building and sustainability
 - Regulatory body in the country of origin

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Other IAEA Review Service Missions UAE Received (In addition to INIR, IRRS & EPREV)

- **SEED** Mission (Nov. 2011)
Site and External Event Design Review Service Mission
- **INSSP** Mission (Sep. 2012)
International Nuclear Security Support Plan
- **ISSAS** Mission (May 2014)
IAEA Safeguards Advisory Service
- **ORPAS** Mission (Nov. 2015)
Occupational Radiation Protection Appraisal Service
- **IPPAS** Mission (Nov. 2015)
International Physical Protection Advisory Service
- **EduTA** Mission (Feb. 2017)
IAEA mission to appraise the education and training provisions and infrastructure in radiation protection and the safety of radiation sources in the UAE

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5. Summary of Progress in the UAE Nuclear Program

Nuclear Power Type and Construction Start Day

☒	Type☒	MWe gross☒	Construction start☒
Barakah-1☒	APR-1400☒	1400☒	July-2012☒
Barakah-2☒	APR-1400☒	1400☒	May-2013☒
Barakah-3☒	APR-1400☒	1400☒	Sept-2014☒
Barakah-4☒	APR-1400☒	1400☒	Sept-2015☒
Total:		5600-MWe	

1345-MWe each-net

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Construction Status of Barakah Units 1 to 4 (as of May 2018)

Unit 4:

- Successful installation of the Reactor Vessel and Steam Generators

Next milestone:

- Reactor Containment Building Dome
- Energizing Switchyard
- Completion of welding of major components

Unit 3:

- Successful completion of Reactor Containment Building Dome

Next milestone:

- Energizing Switchyard
- Cold Hydrostatic Test

Unit 2:

- Successfully completed Cold Hydrostatic Test

Next milestone:

- Hot Functional Test

Unit 1:

- Successful completion of construction

Next milestone:

- Fuel Load

Source: ENEC (Emirates Nuclear energy Corporation), the entity responsible for the deployment, ownership and operation of nuclear energy plants in the UAE

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Remaining Critical Areas for Unit 1 Fuel Load and Updated Unit 1 Schedule

Critical Areas	Details of Critical Areas
1 Resolution of Tech Issues Found at Pre-Operational Test	Resolving Outstanding Technical Issues such as Pilot Operated Safety Relieve Valve Issue, Battery Issue, Safety-related Pump Margins, etc.
2 English Proficiency of Operator	Training to attain required level, effective communication and safe operations , etc.
3 Maintenance	Conclusion (Sign) of Long-Term Maintenance Agreement and Contracts, and Delivery of All Maintenance & Engineering programs, Processes and Procedures
4 Operational Focus	Resolving Operational Issues Identified on: Operator Work Management & Clearance Process, Operation Programs & Procedures, Surveillance & Periodic testing, Plant Configuration Control, etc.
5 Security	Delivery of Physical Protection System, Set-up and Operation of Security/Operations Interface, and Implementation of Cyber Security Measures
6 Operating Licence Approval	Completion of FANR Inspection Activities, Demonstration of Integrated Operational Readiness, and FANR Issue (Approval) of Operating Licence

Update Milestone Dates	
Fuel Load	Commercial Operation
May 2020	September 2021

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Overall Summary

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
White Paper Released	Apr 20															
Nuclear Law Issued		Oct 5														
FANR Established		Sep 24														
ENEC Established		Dec 23														
1st Regulation Issued			Oct 28													
1st Reg. Guide Released			Aug 31													
Licence for Site Survey Issued			Mar 7													
Barakah 1																
Prime Contractor Selected		Dec 27														
CLA Submitted			Dec 27													
CL Granted				Jul 17												
First Safety Concrete Poured				Jul 18												
OLA Submitted							Mar 25									
OL Granted													(May)			
Fuel Loading													(May)			
Commercial Operation														(Sep)		
Barakah 2																
CLA Submitted			Dec 27													
CL Granted				Jul 17												
OL & Fuel Load													(Dec)			
C. O.														(in 2021)		
Barakah 3																
CLA Submitted					Feb 28											
CL Granted						Sep 15										
OL & Fuel Load														(in 2021)		
C. O.															(in 2022)	
Barakah 4																
CLA Submitted					Feb 28											
CL Granted						Sep 15										
OL & Fuel Load														(in 2022)		
C. O.															(in 2023)	

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