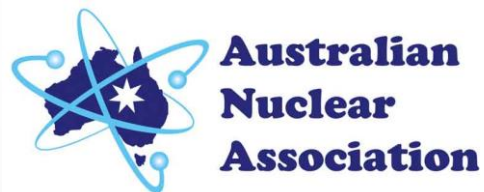




Ian Grant Consulting

Licensing the first NPP in the United Arab Emirates



Australian Nuclear Association Webinar
1 October 2020

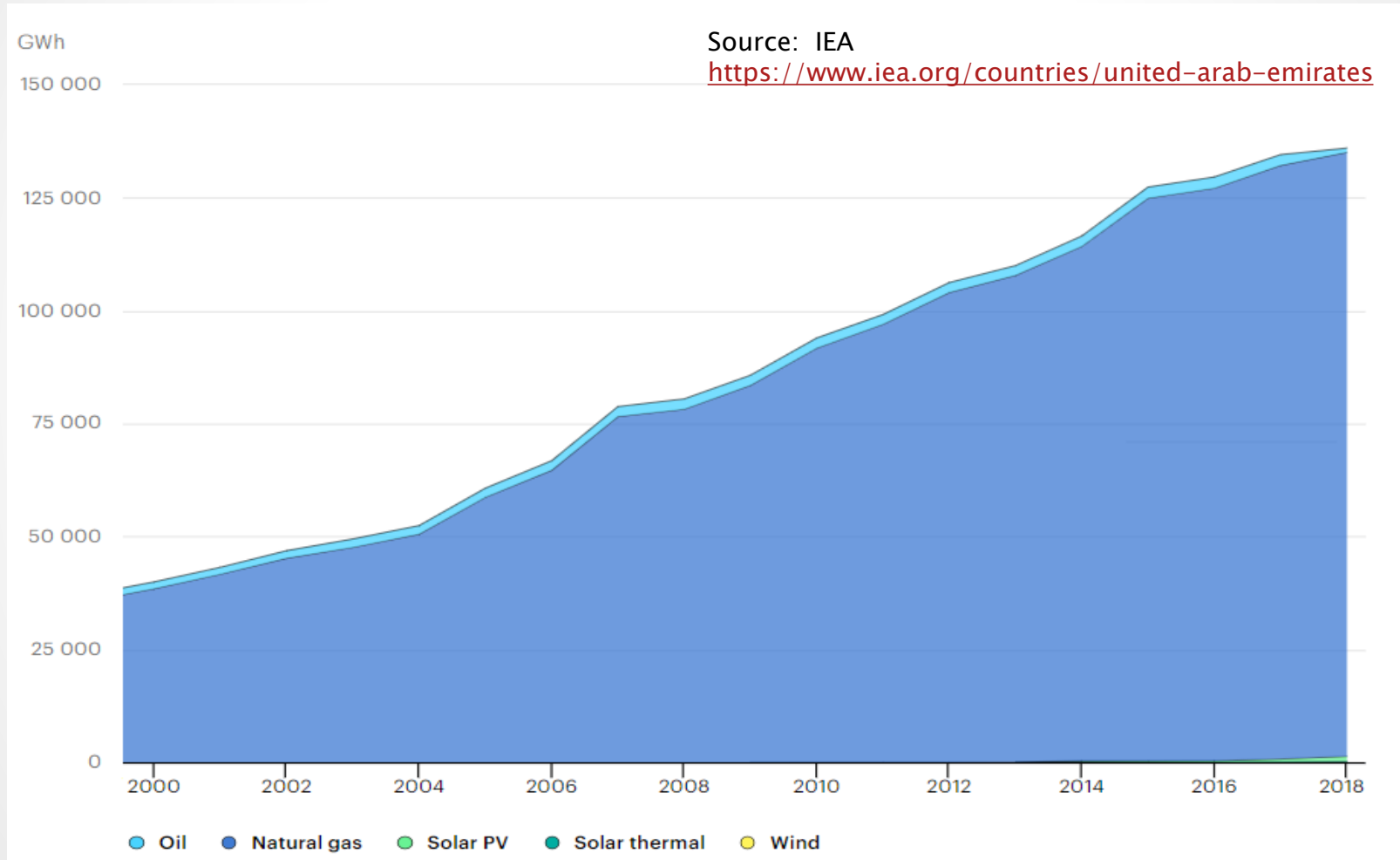
Content

- UAE nuclear programme
- Establishing the legal infrastructure
- Development of the regulatory body and regulatory framework
- NPP licensing approach
- Considerations for licensing SMRs

Pre Launch Considerations

- Population and economic growth in the UAE creating growing electricity demand
- 95% of electricity generation from imported natural gas
- Government desire to increase supply capacity and diversify sources
- Considered options :
 - Nuclear
 - Renewables
 - Oil
 - Coal

UAE Electricity generation 2000–2018



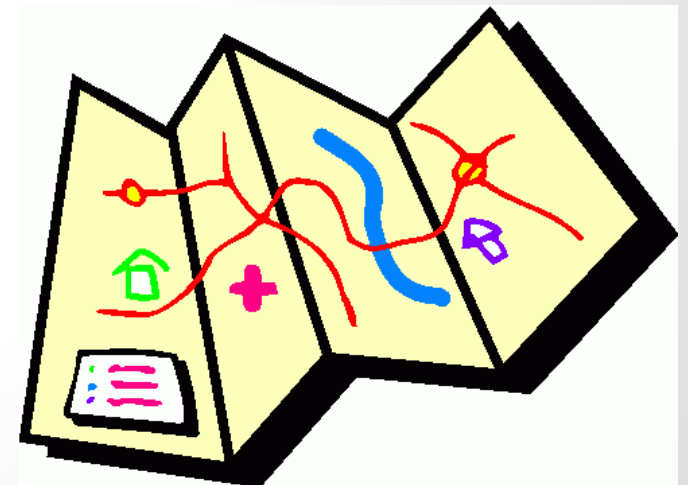
UAE Policy on Nuclear Energy

- Government published policy in 2008
- Sets out goals for a peaceful nuclear energy programme:
 - Complete operational transparency
 - Highest standards of non-proliferation
 - Highest standards of safety and security
 - Close cooperation with the IAEA
 - Partnership with governments and firms of responsible nations
 - Long-term sustainability



Programme launch

- Abu Dhabi Executive Affairs Authority acted as Nuclear Energy Programme Implementation Organisation (NEPIO)
- Developed “Roadmap for Success”
 - comprehensive programme implementation plan based on IAEA Milestones
- Fostered early stages of regulatory body and operator
- Supported by consultants



Technology and vendor selection

- In December 2009, after a competitive tendering process, Emirates Nuclear Energy Corporation (ENEC) announced the selection of a consortium led by Korea Electric Power Corporation for the UAE program
- KEPCO to design, build and help operate four APR1400 nuclear power plants
- KEPCO is one of the world's largest nuclear energy businesses
 - Operates 24 NPP which supply about 25% of the country's electricity with four more units under construction



The APR-1400 NPP

- ▶ Based on proven technology from the USA
 - System 80+ design certified by USNRC
- ▶ South Korea has continually upgraded the reactor design
- ▶ Operating record is among the world's best
- ▶ Reference plant at Shin Kori in Korea



Selected site: Barakah



The Owner and Operator



- Emirates Nuclear Energy Corporation
 - Abu Dhabi government corporation created by statute
 - Charged with implementing the UAE's nuclear power plant programme
 - Owner of the Barakah Nuclear Energy Plant
 - Construction licence holder



- Nawah
 - Joint venture between ENEC and KEPCO
 - Operating company of the Barakah Nuclear Energy Plant
 - Holder of the operating license from FANR

Progress at Barakah



2009

2019



Current status

- Unit 1 first operation August 2020
- Unit 2 completed and in preparation for operation
- Unit 3 and 4 in final stages of construction
- <https://www.world-nuclear-news.org/Articles/An-historic-moment-for-the-UAE>



Establishing the legal and institutional framework



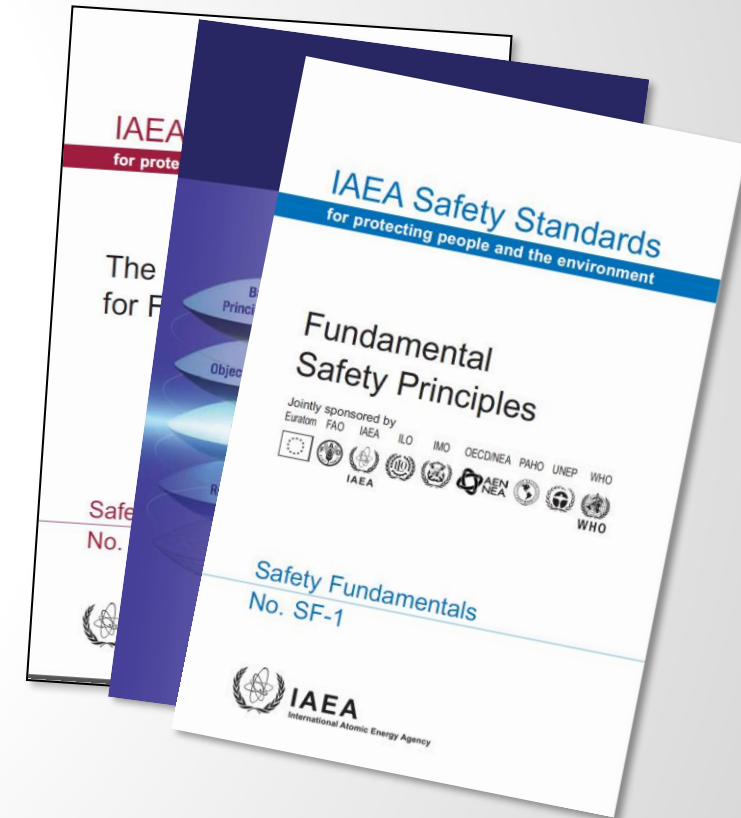
UAE Legal Framework for Nuclear

- The legal framework for the nuclear sector of the UAE consists of:
 - International instruments to which the UAE is a party
 - Bilateral nuclear cooperation agreements with other States
 - Laws made in the UAE



UAE international commitments

- Adherence to all relevant international instruments for safety, security and safeguards
- Cooperation with IAEA
 - Use of IAEA standards
 - Technical cooperation programme
 - Peer review and expert missions: INIR, IRRS, EPREV, IPASS, ISSAS...



Bilateral Agreements

- The UAE concluded agreements with several other nations to advance cooperation in the peaceful uses of nuclear energy, including
 - France, 2008
 - Republic of Korea, 2009
 - United States, 2009
 - United Kingdom, 2010
 - Australia, August, 2012
 - Canada, September, 2012
- Subsidiary agreements with national regulatory bodies pursuant to the intergovernmental agreements



UAE Nuclear Law

- Federal Law by Decree No. 6 of 2009 Concerning the Peaceful Uses of Nuclear Energy enacted in September 2009
- Creates the legal framework for conduct of nuclear activities in the state to ensure safety, security and exclusively peaceful uses
- Establishes the Federal Authority for Nuclear Regulation (FANR) as the independent regulatory body for safety, security and safeguards with defined powers and responsibilities
- Sets out the responsibilities of licensees
- Defines civil penalties

Nuclear Liability

- Federal Law by Decree No 4 of 2012, Concerning Civil Liability for Nuclear Damage
- Determines the provisions for civil liability and compensation for Nuclear Damage as a result of a nuclear accident in line with the 1997 Vienna Convention on Civil Liability for Nuclear Damage
- Other existing statutes in the UAE legal framework are relevant also to the nuclear programme, for example environmental protection, civil defence, urban planning and land use etc.



Developing the regulatory body



The Federal Authority for Nuclear Regulation

- Article (5) of the Nuclear Law empowers FANR to determine all matters relating to the regulation of the nuclear sector in regard to nuclear safety, nuclear security, radiation protection and safeguards and to implement obligations under international instruments entered into by the UAE
- FANR absorbed the regulatory infrastructure for radiation protection that previously existed in the UAE

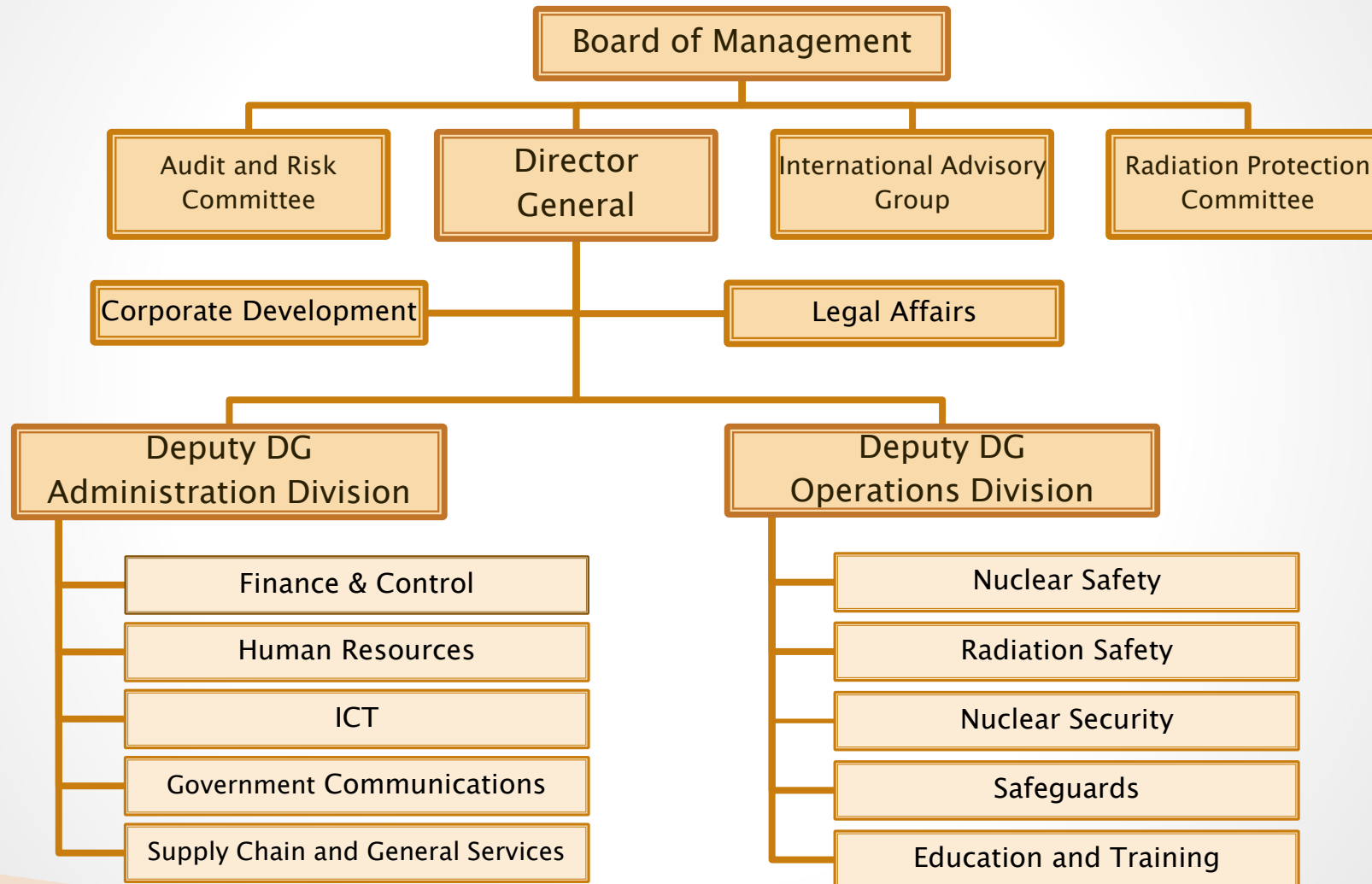


FANR Functions and responsibilities

- The nuclear law empowers FANR to implement the four key elements of a regulatory framework covering Safety, Security and Safeguards (“3S”):
 - standard-setting through regulations
 - authorization of activities through licensing
 - inspection and monitoring of compliance
 - enforcement
- Supporting regulatory functions include
 - Cooperate with and advise other competent authorities in the state
 - Maintain national registers of radiation sources and radiation doses
 - Research and development related to mandate
 - Contact point with IAEA and other entities



FANR organisation



Human resources planning

- ▶ Initial staffing based on FANR leaders experience
- ▶ Benchmarked against international references
 - UK ONR generic design assessment
 - Finland Olkiluoto-3 licence review
- ▶ Resources for first construction licence for NPP
 - FANR in-house staff: approx. 30 Full-Time Equivalents
 - Contract TSO contributed additional 30 FTE
- ▶ Learning curve resulted in significantly less resources for subsequent licence applications

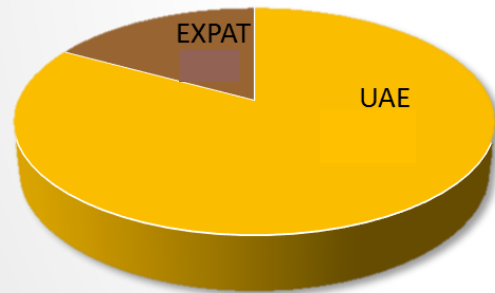


Recruitment Strategy

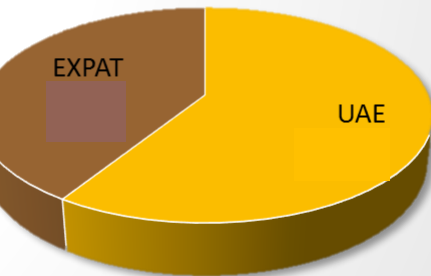
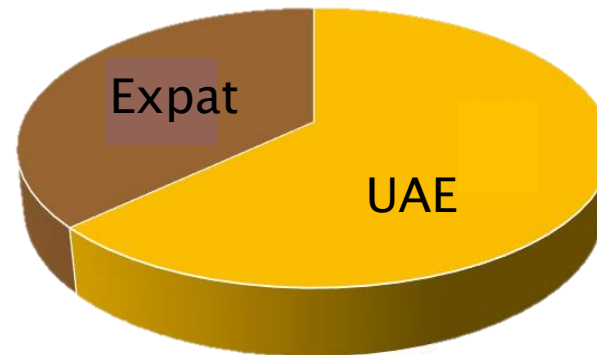
- ▶ FANR implemented a “two-track” HR strategy:
 - Initial staffing by senior expatriate staff to support quick launch of programme
 - Recruitment and development of local personnel to ensure long-term sustainability
- ▶ Currently a strong cadre of experienced professionals in nuclear and radiation safety disciplines
- ▶ Focus on recruitment and development of younger Emiratis

FANR Staff (2019)

- ▶ Total employees: 244*
- ▶ Number of Emiratis: 67%*



Administration Division



Operations Division

*Source: FANR 2019 Annual Report



NPP Licensing



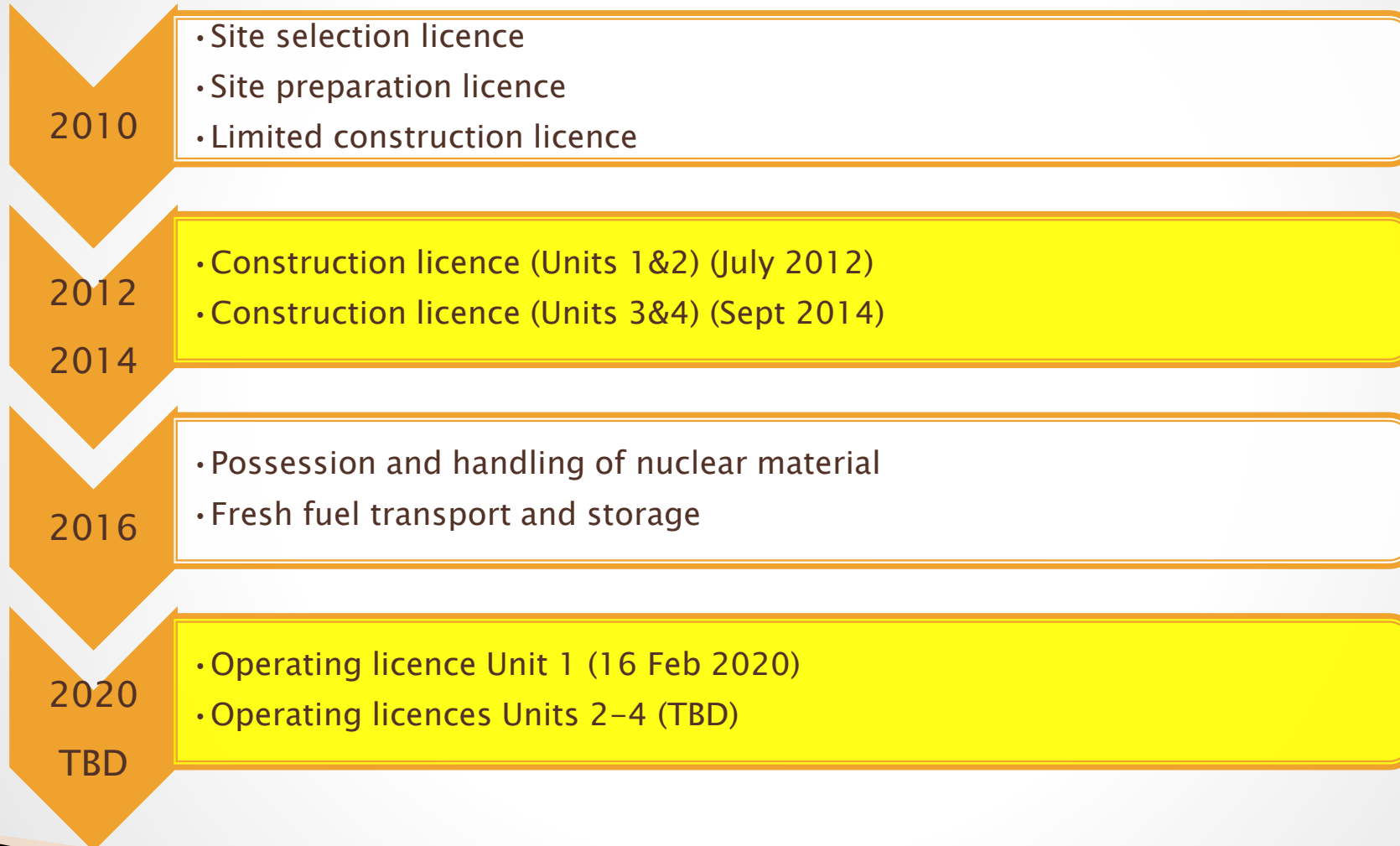
Legal requirement for licence

➤ UAE Nuclear Law

- Aligned with IAEA recommendations
- Prohibits any person from conducting a Regulated Activity in the state unless licensed to do so by FANR
- Requires the applicant for a licence to submit detailed evidence of safety of the activity to FANR
- Requires FANR to review the application in accordance with established procedures and to issue a licence, issue a licence with conditions, or refuse the licence, and record the basis for its decision

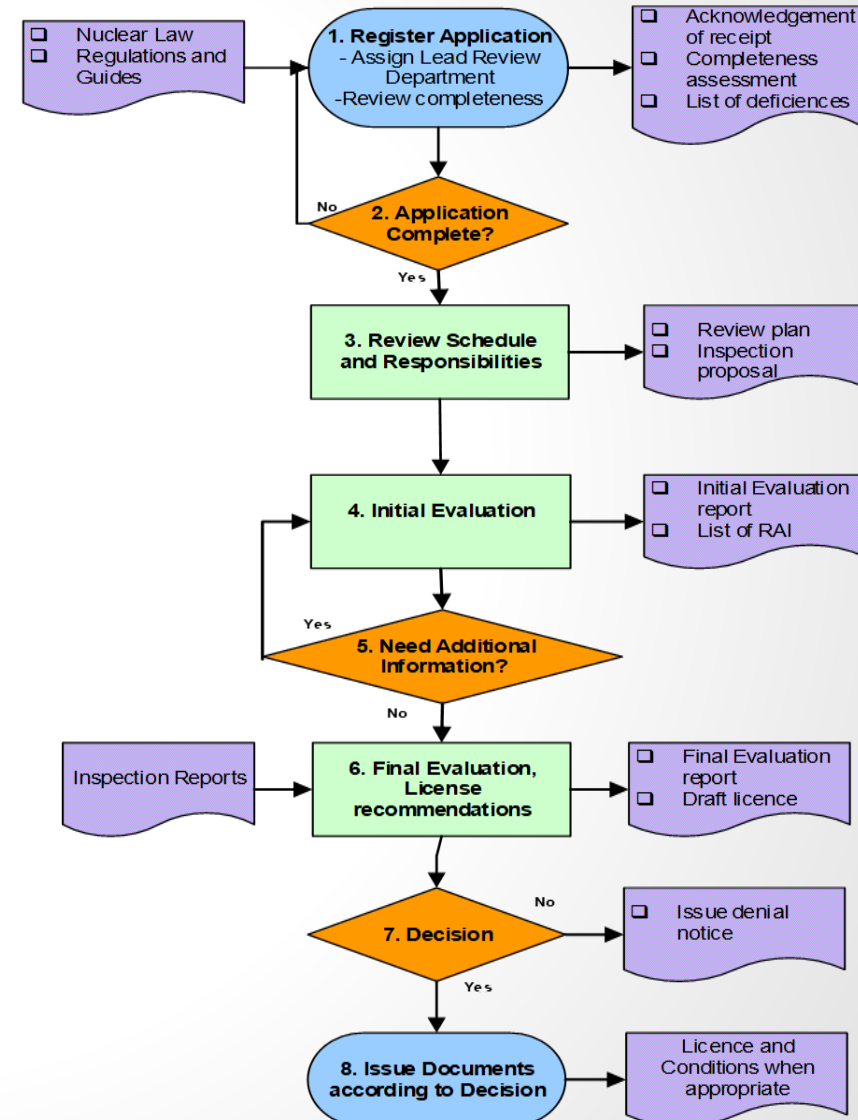


FANR licenses issued for Barakah NPP



FANR licensing process for nuclear facilities

- ▶ Part of FANR Integrated Management System
- ▶ Governs process
 - Receive application
 - Check for completeness
 - Determine review plan and schedule
 - Carry out review and assessment
 - Prepare Safety Evaluation Reports
 - Licensing decision
- ▶ Procedures and work instructions describe details



Construction licence application

- ▶ In accordance with FANR–REG–06 and RG–001
- ▶ Cover letter
- ▶ Preliminary Safety Analysis Report (PSAR)
- ▶ Supporting documents
- ▶ 9000 pages



PSAR contents

1. Introduction and General Description of Plant
 2. Site Envelope Characteristics
 3. Design of Structures, Systems, Components, and Equipment
 4. Reactor
 5. Reactor Coolant and Connecting Systems
 6. Engineered Safety Features
 7. Instrumentation and Control
 8. Electric Power
 9. Auxiliary Systems
 10. Steam and Power Conversion System
 11. Radioactive Waste Management
 12. Radiation Protection
 13. Conduct of Operations
 14. Initial Test Program
 15. Accident Analyses
 16. Technical Specifications
 17. Management of Safety and Quality Assurance
 18. Human Factors Engineering
 19. Probabilistic Risk Assessment, Severe Accident, and Aircraft Impact Assessment
 20. Physical Protection
 21. Safeguards
- Supplement 1 – Reference Nuclear Facility Departures and Independent Safety Verification
 - Supplement 2 – Safety Issues and Use of Operating Experience

Construction licences

- ▶ Authorised construction of the Barakah nuclear facility and activities reasonably associated with the foregoing
 - Manufacture, transport, import, storage, assembly, installation, inspection and testing of equipment and carrying out of civil works
- ▶ Excluded possession of nuclear material, loading of nuclear fuel into any reactor



FANR construction inspection programme

- Inspection plays an important part in the regulatory oversight process
- Opportunity to witness reality in the field
- Licensee procurement and QA
- Prime contractor
- Major equipment vendors and supply chain
- Site construction
- Preoperational inspections



Operating Licence Application for Units 1 & 2

- ▶ Submitted March 2015 by ENEC on behalf of Nawah
- ▶ In accordance with REG-14
 - Cover letter
 - Final Safety Analysis Report
 - Supporting documents
 - 15,000 pages



Focus topics in operating licence review

- Updates on previously approved submissions for construction:
 - Site characteristics
 - As-built NSSS and BOP design
 - Results of preoperational testing
- New information, including:
 - Operating organisation and human resources
 - Management system
 - Commissioning and operating procedures
 - Accident management procedure
 - Emergency plans on-site and off-site
 - Physical protection plan
 - Safeguards arrangements
 - Preliminary decommissioning plan



Objective of review and assessment

- The objective of FANR's review was to determine whether the proposed facility complies with the relevant regulatory safety objectives, principles, and criteria
- In doing so, FANR acquired a deep understanding of the design of the facility, the safety concepts on which the design is based, and the proposed operating principles



Technical Support Organisations

- FANR contracted with experienced TSOs in the USA and Europe to support review and assessment of NPP licence applications
- Each TSO worked exclusively on one or more work packages
 - Provided specialist technical expertise
 - Augmented in-house resources
- FANR set up a secure virtual work environment using MS SharePoint
- Enabled FANR staff and TSOs to collaborate on accessing and creating documents
- Periodic project update meetings for key personnel in Abu Dhabi
- FANR provided direction to TSOs and retained responsibility for its regulatory decisions through work package leads



Cooperation with regulatory body in vendor country

- FANR and counterpart authorities in Korea formed strong relationships based on intergovernmental agreement & MoUs
 - Information on Korean regulatory framework & licensing process
 - Access to translated safety evaluation reports for reference plant
 - Workshops on Korean safety assessments
 - Process for ongoing information requests
 - Support for vendor inspection
 - Training and development of UAE staff



Using Safety Information from Vendor Country

- FANR used the Korean regulatory body safety evaluations to support its licensing review
 - Enhanced safety by building on the work of experts
 - Improved efficiency of review
- FANR conducted its own independent review where:
 - The proposed site, design or operation differed from that approved in Korea
 - New operating experience occurred since the other regulatory body's approval
 - Areas deemed risk-significant, e.g. digital I&C, severe accident analysis
- Review plan identified the category for each topic
- Application of “graded approach”



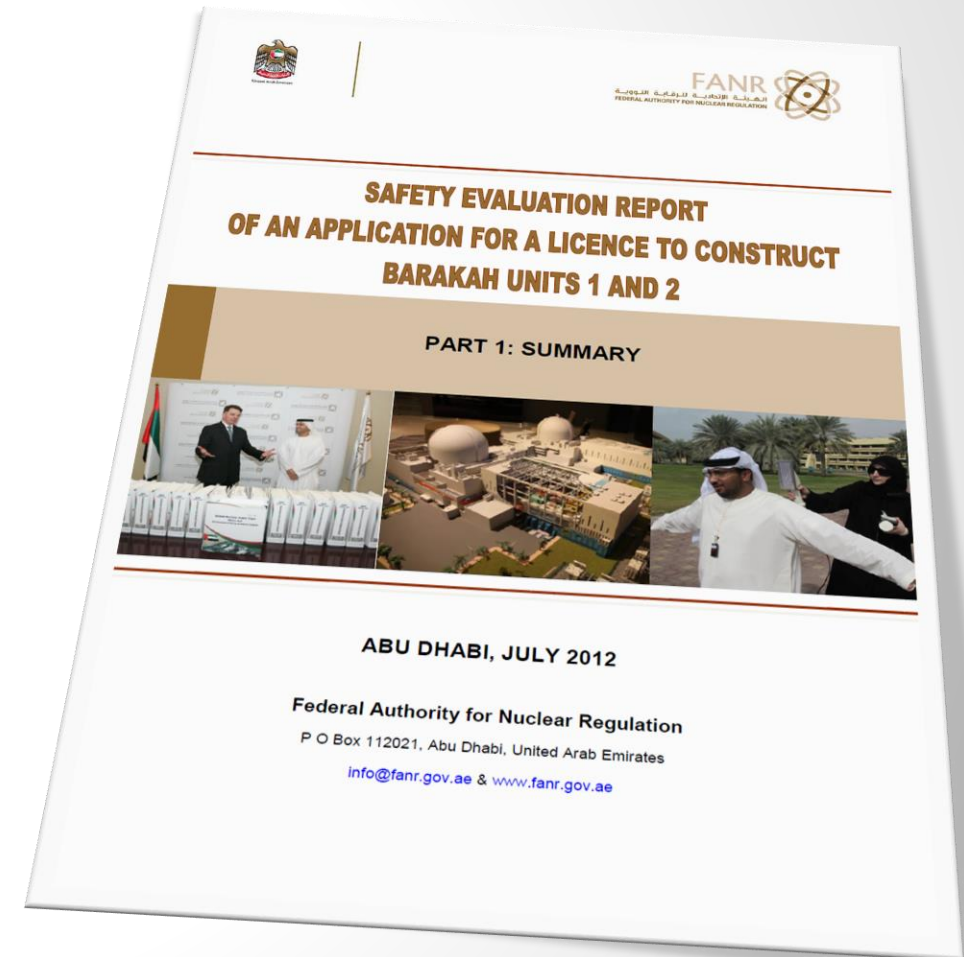
Preparation of Safety Evaluation Report by FANR

- FANR reviewers and TSO drafted SER sections using SharePoint work environment
- SERs written following standard format to help ensure consistency of content and presentation among the various sections of the Safety Evaluation Report developed by individual technical reviewers
- 223 SERs prepared for construction licence application
- 228 SERs for the operating licence application plus summary of inspection findings



Safety Evaluation Report Summary

- SER executive summary available on FANR web site
- <https://fanr.gov.ae/en/rules-regulations/licenses-regulatory-approval>



Unit 1 operating licence

- Body:
 - Authority
 - Title & reference no.
 - Licensee name
 - Facility name
 - Period of validity
- Schedule 1:
 - Activities authorised
- Schedule 2:
 - Licence conditions
- Schedule 3:
 - Application document references
- Schedule 4:
 - Interpretation



<https://fanr.gov.ae/en/rules-regulations/licenses-regulatory-approval>



Considerations for SMR deployment

- Government policy leadership
- Selection of standardized design previously licensed in vendor country
- Strong relationship between host and vendor country regulatory bodies
- Common regulatory standards and processes
- Experienced staff and contractors
- Some technology areas more transferable than others:
 - Design and safety assessment
 - Operating organisation and procedures
 - Environmental assessment and siting
- Host country regulator is ultimately accountable for its decisions



THANK YOU!



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