Nuclear Energy Development in the Middle East: Risks and Advantages

Professor Youssef Shatilla, D.Sc.
Dean for Academic Programs
Masdar Institute of Science and Technology
Abu Dhabi, UAE

Definition of Middle East

Outline

- Why do we care
  - MENA is the most rapidly emerging market for nuclear construction, $30 bn for the next 10 years
- Risks/Concerns
  - Proliferation and safety concerns
  - Workforce development
    - United Arab Emirates, UAE
    - Saudi Arabia
    - Egypt
- Advantages
  - Nexus of energy and water
  - Nuclear Desalination

United Arab Emirates, UAE

United Arab Emirates, UAE

- In 2008 the UAE published a comprehensive national policy on nuclear energy in order to meet a more than doubling in energy demand by 2020
- It clearly states that UAE will forgo both enrichment and reprocessing
- They are planning to produce as much as one-third of their energy consumption by 2030
- on December 27, 2010 a consortium led by KEPCO beat rival French and US teams in a bid to supply the UAE with four APR 1400 nuclear reactors first of which will be come online in 2017
- Excavation already started in Baraka site with first concrete pouring scheduled in 2012

United Arab Emirates, UAE

- International Advisory Board (IAB) headed by Hans Blix will oversee progress of the nation's nuclear energy plan and issue reports on potential improvements to the scheme
- Nuclear Safety Review Board chaired by Dale Klein to review the safety and effectiveness of the construction, startup and operations of the nuclear program, with a core emphasis on nuclear safety
- Emirates Nuclear Energy Corporation (ENEC) is responsible for construction and operation of all plants
- Federal Authority for Nuclear Regulation (FANR) headed by William Travers
- Department of Nuclear Engineering at Khalifa University of Science and Technology and Research (KUSTAR)
- Lots of students sent to US universities to get their BSc, MSc and PhD degrees to jump start the development process

Saudi Arabia

Saudi Arabia

- In April 2010 a royal decree said: "The development of atomic energy is essential to meet the Kingdom's growing requirements for energy to generate electricity, produce desalinated water and reduce reliance on depleting hydrocarbon resources.“
- 16 power plants are scheduled to be built till 2020 the first of which will become online in ten years
- King Abdullah City for Atomic and Renewable Energy (KA-CARE) has been established and tasked with the research and application of nuclear technology and oversee all aspects of a nuclear power industry
- Department of Nuclear Engineering at King Abdulaziz University
- King Abdulaziz City for Science and Technology – National science agency and a national lab

Egypt


EGYPT
MEDITERRANEAN SEA
ISRAEL & THE PALESTINIAN TERRITORIES
LIBYA
JORDAN
SAUDI ARABIA
RED SEA
Marsa Matruh
Alexandria
Port Said
Sidi Abdel Rahman
Giza
Cairo
Suez
Medinat al-Fayoum
Al-Fayoum Oasis
Siwa
Beni Suef
Bawiti
Dahab
Minya
Mallawi
Qasr al-Farafra
Nile River
Hurghada (Al-Ghardaka)
Sohag
0 150 km
0 90 miles
Dakhla Oasis
Mut
Kharga
Luxor
Marsa Alam
Aswan
Berenice
Tropic of Cancer
Lake Nasser
Administrative Boundary
SUDAN
Political Boundary

Egypt

- Most advanced when it comes to human resources
- Department of Nuclear Engineering at Alexandria University - 1963
- Atomic Energy Authority
- Nuclear Power Plants Authority
- Nuclear Safety Authority
- Nuclear Materials Authority
- Has one old Russian 2MW research reactor and a newer 22 MW Argentinean research reactor
- Dabaa has been selected as the site for the next power plant – 80's
- Renewed interest after the "January 25th Revolution"
- In preparation for its planned introduction of nuclear energy, Egypt has made a formal request to South Korea to train its nuclear engineers as part of the Korea International Cooperation Agency's support pro gram for developing countries

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Nuclear Desalination

Nexus of Energy and Water

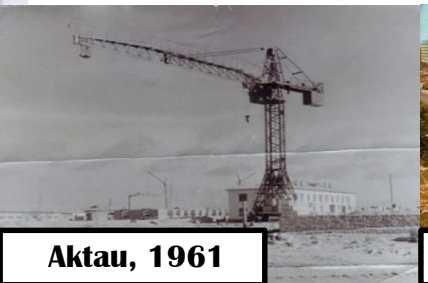
Water

- Abstraction
- Purification
- Distribution
- Utilization
- Disposal

Energy

- Fuel extraction and refining
- Electricity generation

Development


Aktau, 1961


Aktau, 1975

Synergies in Nuclear desalination are a catalyst for sustainable development

Experience on Nuclear Desalination

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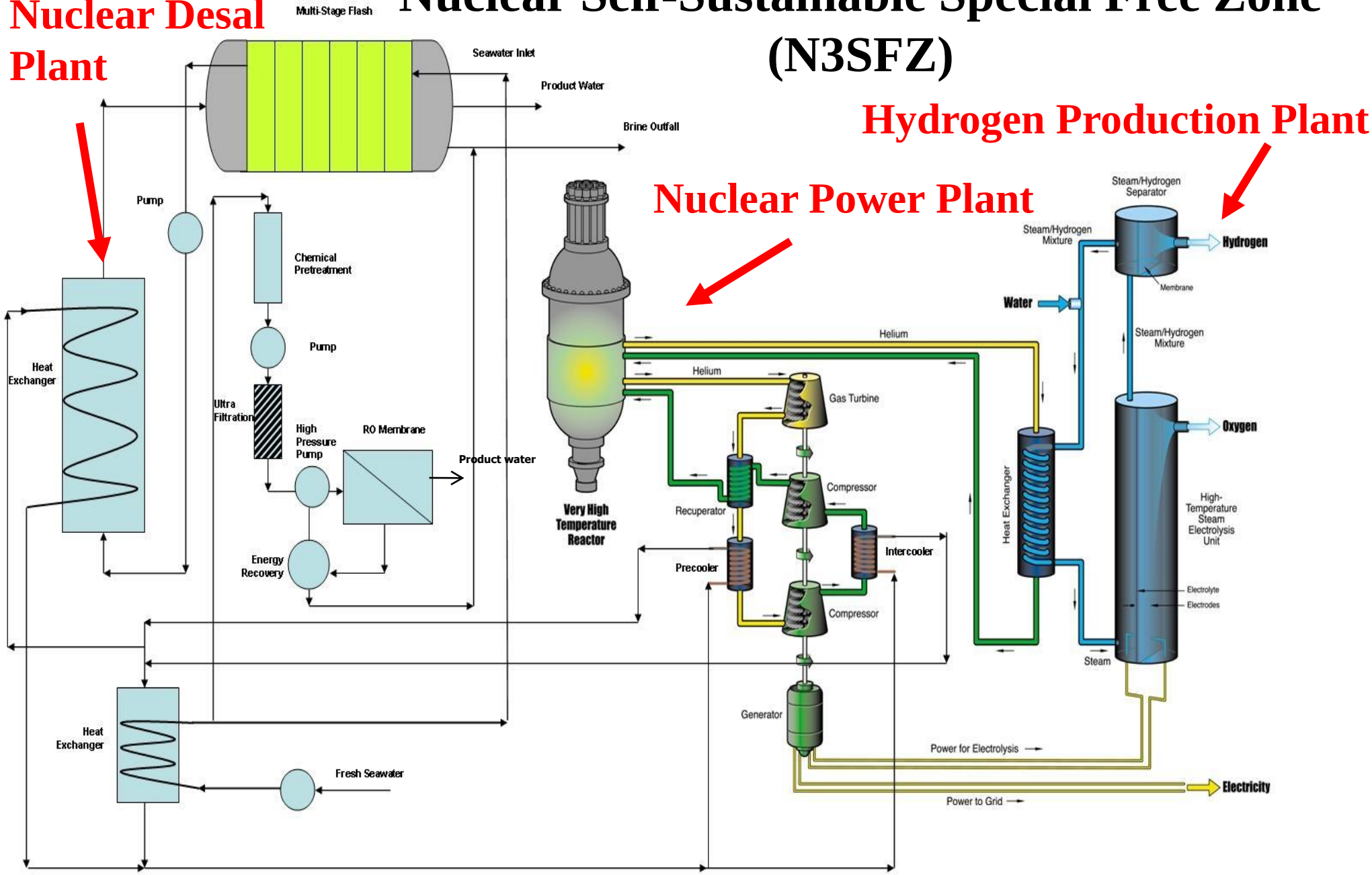
Plant name	Location	Gross power [MW(e)]	Water capacity [m^3/d]	Reactor type/ Desal. process
Shevchenko	Aktau, Kazakhstan	150	80000 – 145000	FBR/MSF&MED
Ikata-1,2	Ehime, Japan	566	2000	LWR/MSF
Ikata-3	Ehime, Japan	890	2000	LWR/RO
Ohi-1,2	Fukui, Japan	2 x 1175	3900	LWR/MSF
Ohi-3,4	Fukui, Japan	1 x 1180	2600	LWR/RO
Genkai-4	Fukuoka, Japan	1180	1000	LWR/RO
Genkai-3,4	Fukuoka, Japan	2 x 1180	1000	LWR/MED
Takahama-3,4	Fukui, Japan	2 x 870	1000	LWR/RO
Diablo Canyon	San Luis Obispo, USA	2 x 1100	2180	LWR/RO
NDDP	Kalpakkam, India	2 x 170	1800	HWR/RO
Karachi	Karachi, Pakistan	175		MED

Commissioned in 2010

"I have a dream"…!!! *MLK*

- **Build a Nuclear Self-Sustainable Special Free Zone (N3SFZ) at Masdar City powered by a nuclear reactor that:**
  - **Generates electricity for MI and surroundings**
  - **Produces potent water through Gulf water desalination**
  - **Generates hydrogen to fuel Abu Dhabi future hydrogen cars**
  - **And it will do all that with 3Z's - Zero emission, Zero waste, and Zero proliferation**

Nuclear Self-Sustainable Special Free Zone (N3SFZ)



N3SFZ Components

- **Reactor:**
  - **Produces net electric power of 100 MW_e for the grid**
  - **Advanced design; long refueling cycle which means no access to nuclear fuel (i.e. proliferation-resistant)**
- **Hydrogen Production Plant (HPP)**
  - **Uses ~146 MW_e from reactor to produce hydrogen through High Temperature Electrolysis of Steam (HTES) – fuel for 280,000 light vehicles**
- **Desalination Plant (DP)**
  - **Uses ~76 MW_e from reactor to produce potent water through Hybrid Multi Stage Flash and Reverse Osmosis (MSF-RO) – 182,400 m^3/d**

Conclusions

- Proliferation and security concerns
- Have taken steps to build educational infrastructure – BSc, MSc and PhD
- Still missing technician pipeline
- Need help when it comes to workforce development
  - Nuclear Education Consortium (NEC)
  - Education, Training and Workforce Development Division (ETWDD)
  - Accreditation Policy and Procedures Committee (APPC)
  - Facilitated by bilateral agreements such as 123
- Nexus of energy and water presents unique set of advantages that lends itself to nuclear desalination

THANK YOU

Q & A