SMRs Deployment for Seawater Desalination in Jordan

Dr. Khaled Toukan
Chairman, Jordan Atomic Energy Commission (JAEC)
Jordan’s Water Situation

- Jordan’s population is expected to grow from 11 million in 2021 to 16.8 million by 2040.
Current Water Supplies

- Severe over-pumping of ground water
- 13 dams provide 280 MCM of the available surface water
- 31 wastewater treatment plants
  - 90% of the reclaimed water is used for irrigation

The most important and vital supply of renewable water will be secured through seawater desalination.
National Desalination and Conveyance (NDC) Project

- 300 MCM/year will be desalinated from the Red Sea in Aqaba and then pumped 450 km to Amman with elevation difference of over 1100 m.
- The average power demand of the project is around 310 MWe.
Electricity cost is the most dominant factor for freshwater cost pumped to Amman (52% of the total cost).

The desalination and the conveyance components of the project should operate non-stop.
- Intermittent energy sources will not work.

Reliable, base-load, and cheap energy source is important for the success of the project and fulfilling future water demands.
Advantages of Nuclear Desalination

1. Providing base-load electricity generation
   - A prerequisite for the success of the NDC Project

2. Clean and relatively cheap source of electricity
   - Enhances economic feasibility of the NDC Project
   - Sustainable development and de-carbonization

3. Long operational lifetime of 60+ years
   - Stable electricity prices
Jordan’s Requirements for NPPs

• Low capital cost and initial investment
• Low cooling water requirements
• Compatible with the small electricity grid
• Deployable post 2030:
  – Increase power demand from water desalination and conveyance
  – Decommissioning of several conventional and renewable power stations
  – Expiration of natural gas import agreements
• Scalable to match the gradual increase in electricity demand
• Transportable to inland sites
  – Heaviest component weight limitation due to seaport capacity and existing road infrastructure
Special Features of SMRs

1. Incremental Development (Scalability)
   • Small size and modularity
   • Continuously matches the expected increase in power demand
   • Ease of managing capital investments

2. Lower Requirements for Cooling Water (~ 5 MCM/year)
   • Flexibility for siting and distributed siting
   • Possibility of using non-conventional water sources (treated water)

3. Increased simplicity and economies of production
   • Lower capital cost and shorter construction time
Integration of SMRs with NDC Project

- **Country Wide Survey** has been performed.

- **Site selection** studies have been completed for Amra Site.

- **Water cooling** studies have been performed.
Potential Configurations of the Project

<table>
<thead>
<tr>
<th>SMR location</th>
<th>Desalination plant location</th>
<th>Desalination technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aqaba North Site</td>
<td>Red Sea</td>
<td>Reverse Osmosis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Thermal</td>
</tr>
<tr>
<td>Amra Site</td>
<td>Amra site (underground aquifers)</td>
<td>Reverse Osmosis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Thermal</td>
</tr>
</tbody>
</table>

- Factors to be considered:
  - Siting limitations such as high seismicity
  - Securing water for reactor cooling
  - Electricity transmission losses
Thank you