UNITED ARAB EMIRATES INTERCONNECTIONS

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Abu Dhabi UAE
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• Beirut, Lebanon

Presentation - outline

• The UAE Power Structure - Overview
• ADWEA System Overview
• Current Power Interconnections
• The key Benefits
• The Key Challenges
• On Going Interconnections
• UAE Recommendations
UAE Systems

All four utilities have Independent Networks

Vulnerable to faults

Individual Capital Investment is High

The United Arab Emirates
ENG Interconnection

ENG Connectivity
### The UAE Backbone Systems

![Map of UAE Backbone Systems]

### UAE Load Demand, Forecast & Installed Capacity

<table>
<thead>
<tr>
<th>Year</th>
<th>SEWA Demand</th>
<th>FEWA Demand</th>
<th>DEWA Demand</th>
<th>ADWEA Demand</th>
<th>UAE Install Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>1680</td>
<td>1587</td>
<td>6406</td>
<td>5473</td>
<td>23448</td>
</tr>
<tr>
<td>2008</td>
<td>1796.0</td>
<td>1682</td>
<td>7129</td>
<td>5926</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>1900.0</td>
<td>1850</td>
<td>7575</td>
<td>6600</td>
<td></td>
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</tbody>
</table>

*Table showing demand and installed capacity for various years.*
Includes planned extensions as of 31/12/2008 along with ADNOC, ENG, GCC & EMAL interconnections.
# Emirates National Grid

**Different and isolated Networks**

- Exposed to risks
- High Capital Investment
- Shortage of Power in some utilities
- Necessity for nationwide grid
- Emergency Support
- Reserve Sharing

## ENG Bodies

- ADWEA, DEWA, SEWA, FEWA
- ENG Higher Committee
- EMC monitoring and coordination centre
- ENG Operation Committee
- ENG Planning Committee
- ENG Technical Committee
Interconnection Rules & Procedures

Each Interconnection has a set of rules developed specifically for that Interconnection.

<table>
<thead>
<tr>
<th>General Interconnection Code</th>
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<tbody>
<tr>
<td>Planning Code</td>
</tr>
<tr>
<td>Operation Code</td>
</tr>
<tr>
<td>Standard Operation Procedures</td>
</tr>
<tr>
<td>Trading Code</td>
</tr>
</tbody>
</table>

Control Responsibilities

Central body for coordination between member authorities for system security and commercial interchanges

- Monitor Frequency, Primary and secondary reserves/response
- Monitor, record and Coordinate voltage and MVAR at cross-border
- Monitor, record and Coordinate scheduled exchange between authorities
- Record and Calculate the deviation of transactions and schedule compensation
- Coordinate outage management / approval and its execution in real time.
Harmonization of Operating/ Control Régimes

To operate the system the following are unified:

- Operating Normal and Emergency Frequency limits
- Operating Normal and Emergency voltage and MVAR at cross-border
- Under Frequency Load Shedding Schemes
- Cross-border Record of Inter System Safety Precaution (RISSP)
- Cross-border outage management / approval and execution

Transco Rules & Procedures

<table>
<thead>
<tr>
<th>License Obligation and Regulatory Requirement</th>
</tr>
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<tbody>
<tr>
<td>POWER/WATER Transmission Codes</td>
</tr>
<tr>
<td>MDEC Code</td>
</tr>
<tr>
<td>TRANSCO Standard Procedures</td>
</tr>
<tr>
<td>TRANSCO Security Standard</td>
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<tr>
<td>PWPA Requirement</td>
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</tbody>
</table>
Transco Responsibilities Within ENG

- Security and reliability including adoption of N-1 criteria
- Keep Sufficient spinning reserve
- Monitor and control power quality (F & V)
- Keep cross-border exchange to its scheduled value
- Utilize AGC for controlling exchange and frequency
- Execute switching operation for interconnectors in predefined steps
- Implement own safety rules within the control authority and (RISSP) on the interconnectors

The key Operational Drivers

Main Operational Responsibilities

- Safety
- Quality
- Security
- Economy
The key Organisational Challenges

- Different organizational regime among member authorities
- Communication difficulties
- Data and information exchange difficulties
- Transformation from the individual operating approach into ENG approach

Operational Benefits

- Reserve Sharing
- Improved Stability and Security of Interconnected Network
- Energy Support
- Voltage Support
- Emergency Support
Real Cases of Mutual Support

- Instantaneous loss of 480 MW Generation (Mar 2009).
- Loss of 7GTs & 3STs (1040 MW) over few mins (June 2009).
- Continuous Export of 1275 MW from AD.
- 510 MW was exchanged on GCC Grid following a drop in frequency from 50.014 Hz to 49.765 Hz (30th Aug 2009).

On-Going Interconnections

- Oil Industry Interconnection
- Aluminium Industry
- Bilateral Connection to Oman
- GCC Interconnection
The Particularity of UAE

• Large Part is Operating in a Privatised Environment.

• Combined Cogen add to complexity: The Water Factor

• Various types of Interconnections: Models, Controls, Environment, etc.

• Wheeling through to Oman

UAE Recommendations

1. Do not hesitate - Connect

2. Vertical Interconnections more beneficial than the Horizontal

3. Simplify The Rules – The engineers to drive, others to support

4. Market is not a pre-requisite

5. Open up the Sector for Wider Participation

6. State Companies must change