



HV/EHV Cable Systems for Abu Dhabi

Vincent Corre
Pierre Argaut



Presentation Overview

- **General information about Abu Dhabi**
- **The Transmission system**
 - Current situation and forecasts
 - Undergrounding policy
- **Main Specifications for underground cable systems**
- **Projects already Commissioned by Silec Cable (132 kV and 220 kV)**
 - Mussafah -> ICAD
 - Yas Island
- **Projects ongoing by Silec Cable (132kV)**
 - Raha Beach
- **Project coming for Silec Cable (132kV)**
 - Sowa, Al Reem, Yas Islands
- **Coming Projects at 400kV**
 - Construction issues
 - Cable and Accessories design and type testing
 - Thermal monitoring
 - Requirements from the operator for a Dynamic Thermal Rating system
- **Conclusions**

Abu Dhabi at a Glance

- **Land**
 - 87% of UAE land
 - Over 200 natural islands
- **Centre of UAE Government and finance**
- **Currency: UAE Dirham**
- **Time Zone: GMT + 4**
- **Population**
 - Population of the UAE 5 million
 - Population of Abu Dhabi 1.6 million, largest in the UAE
- **Economy**
 - Abu Dhabi produces:
 - 90% of the UAE's oil
 - 10% of the worlds oil
 - 5% of the worlds gas
 - Abu Dhabi enjoys the highest income per capita in the world
- **Climate**



Abu Dhabi City & islands



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Spring ICC 2010, Sub C

Nashville, March 23rd , 2010

Table 1. Summary of System Demand Forecast and Generation Capacity for Period 2009-2014.

Description	2009	2010	2011	2012	2013	2014
Total System Peak Demand Forecast (MW)	7,912	9,461	11,287	13,739	15,415	17,048
Identified Generation Capacity (MW)	10,110	12,222	14,252	14,299	13,322	13,372
Required Generation Capacity (MW)	9,781	11,371	13,289	15,869	17,607	19,276

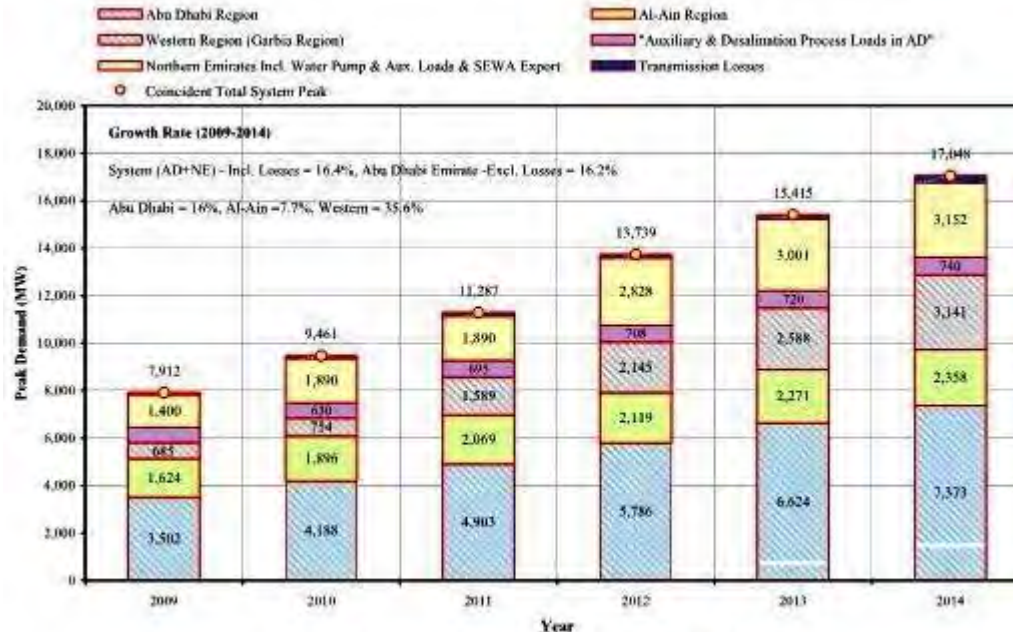


Fig. 1 Summary of Demand Forecast for Yr 2009-2014.

Main Specifications for Underground Systems



132 kV Cable Systems

- Turn Key Contracts for Cable Manufacturers : Complete Civil Works, Cable Laying and Accessories Installation.
- Premolded or Prefabricated Joints
- Dry or Plug-in Terminations
- Cable Direct Buried or in PEHD pipes for Road Crossings
- Excavation by Open Trenches or NDRC/HDD for Roads crossings
- HV Resonant Tests for Commissioning

220 kV Cable Systems

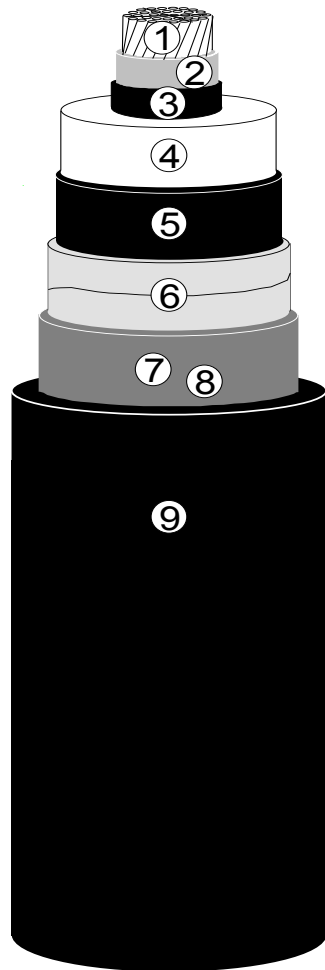
- Turn Key Contracts for Cable Manufacturers : Complete Civil Works, Cable Laying and Accessories Installation.
- Premolded or Prefabricated Joints
- Dry or Plug-in Terminations
- Cable Laid in Concrete Troughs or in PEHD pipes for Road Crossings
- Excavation by Open Trenches or NDRC/HDD for Roads crossings
- HV Resonant Tests for Commissioning and PD measurements

400 kV Cable Systems

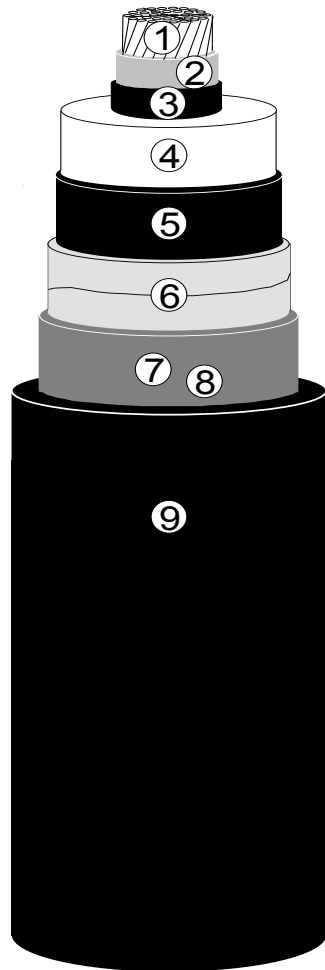
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- Dry or Plug-in Terminations
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- Excavation by Open Trenches or NDRC/HDD for Roads crossings
- HV Resonant Tests for Commissioning and PD Measurements

Transco is planning to change the installation conditions for the 400kV Cable Systems to Open Cut Culverts and Shielded-boring/pipe jacking for Road Crossings.

132 kV Cable Specifications



- 1/2 – Conductor
- Cross-section : 1200 mm²
- Material : Copper /Water blocked/ 4segments
- Indicative diameter :44.7 mm
- 3 – Conductor screen
- Indicative thickness : 2.4 mm
- 4 – XLPE Insulation
- indicative average thickness : 16 mm
- 5 – Insulation Screen
- indicative thickness : 2.4 mm
- 6 – Water Blocking tapes
- 7 – Lead Sheath (3.5 mm)
- 8 – Bitumen Compound
- 9 – HDPE Outer Sheath(5.2mm) with extruded semi-conductive layer



10 kV Cable Specifications

- 1/2 – Conductor
 - Cross-section : 1200 mm²
 - Material : Copper/ Water blocked/ 4segments
 - Indicative diameter : 44.7 mm
- Conductor screen
 - Indicative thickness : 2.4 mm
- XLPE Insulation
 - Indicative average thickness : 23mm
- Insulation Screen
 - Indicative thickness : 2.0 mm
- Water Blocking tapes
- Lead Sheath (2.5 mm)
- Bitumen Compound
- HDPE Outer Sheath (5.2mm) with extruded semi-conductive layer

Type tests on 220 kV Cable system



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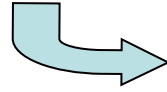


Water
Immersion

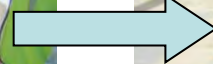
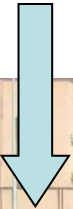
Nashville, March 23rd , 2010

Cable Installation Specifications

- 220 kV: Cable Laid in Troughs



- 132 kV: Cable direct buried



Accessories Installation Specifications



Joint Pit Installation



Jointing Activities

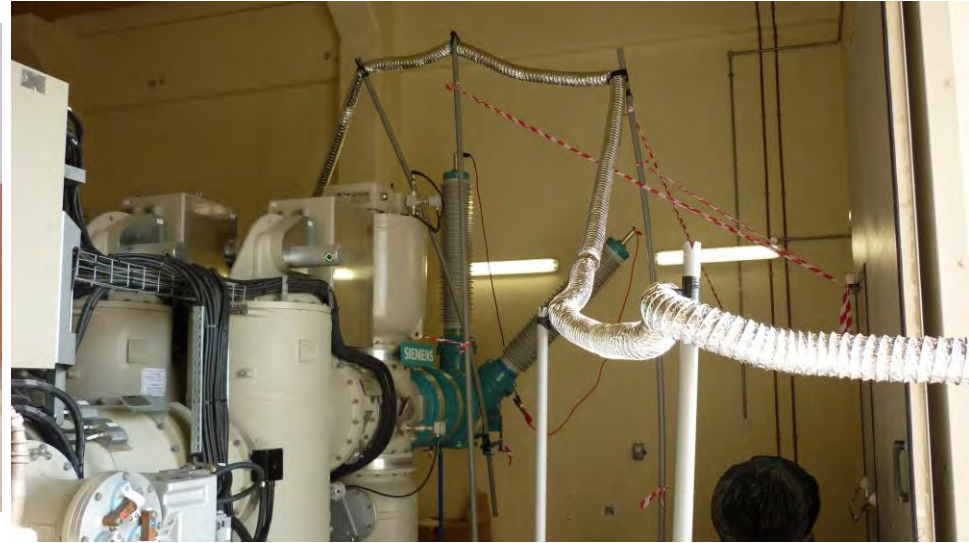


Termination Activities



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HV Testing & Commissioning



Each truck is 260 kV
82 Amps

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Silec Cable 132 kV & 220 kV Commissioned Cable Systems Projects



Silec's Projects in Abu Dhabi Already Commissioned

220 kV Cable System

Mussafah – ICAD Project (2007-2009)

Transco (ADWEA)

48 km of 1200mm² CU XLPE 220kV with lead sheath and bitumen

20 km of 32-Optical Fibers Cable

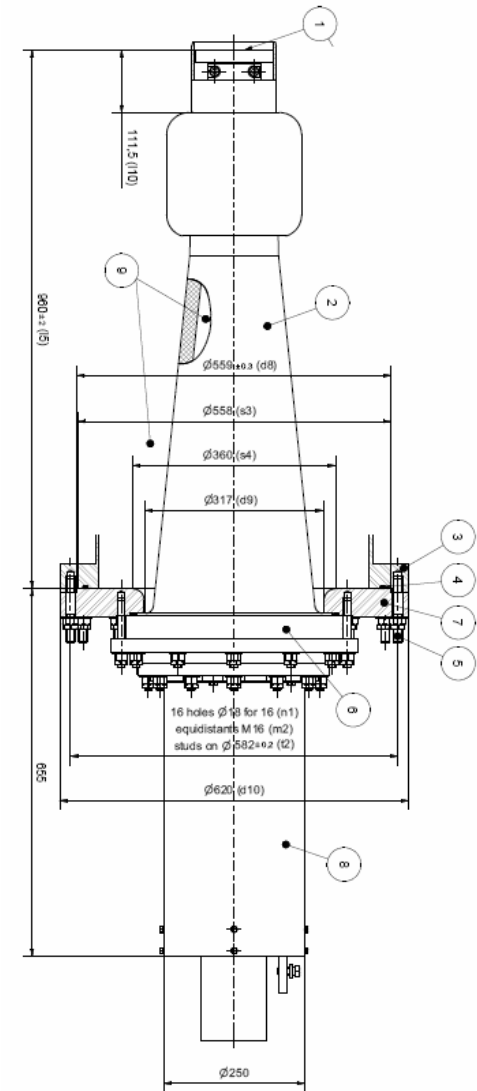
16 km of 6-Optical Fibers Cable

DTS System

12 GIS Terminaisons

6 Outdoor Terminations

72 premolded joints with copper casing and coffin box filled with bitumen



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Nashville, March 23rd , 2010

132 kV Cable System

Yas Island Project

2007-2010

Transco (ADWEA)

115 km of 1200mm² CU XLPE 132kV

Cable with lead sheath and bitumen

80 km of 32-Optical Fibers Cable

12 GIS Terminaisons

6 Outdoor Terminations

216 premolded joints with copper casing
and coffin box filled with bitumen



Silec's Project in Abu Dhabi Ongoing

132 kV Cable System

Raha Beach Project

2007-2012

Transco (ADWEA)

6 Circuits Project

130 km of 1200mm² CU XLPE

132kV with lead sheath and
bitumen

90 km of 32-Optical Fibers Cable

36 GIS Terminaisons

243 premolded joints with copper
casing and coffin box filled with
bitumen



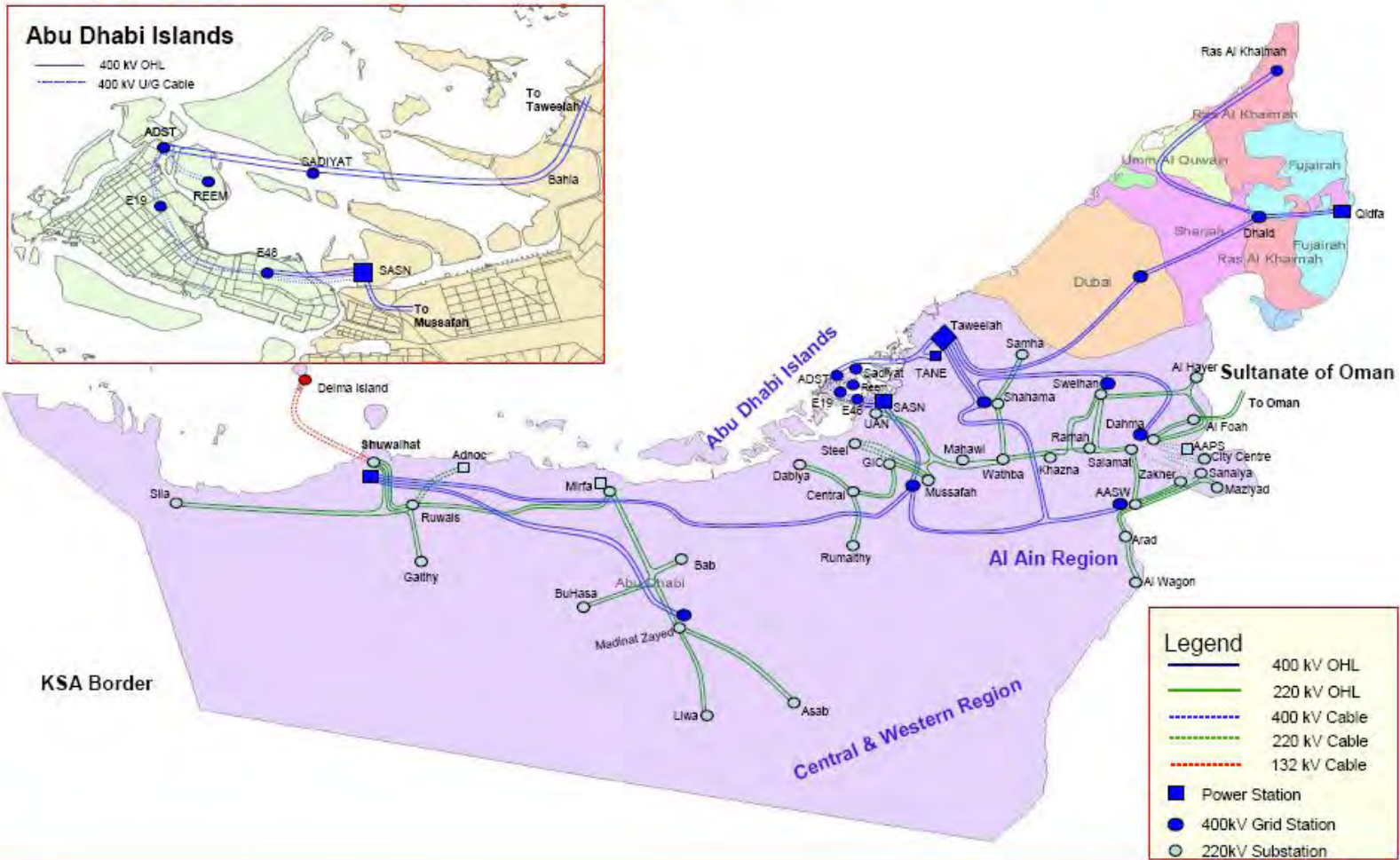
Silec's Coming Project in Abu Dhabi



132 kV Cable System
Sowa, Al Reem, Yas Islands Project
2010-2012
Transco (ADWEA)

6 Circuits Project
80 km of 1200mm² CU XLPE 132kV with
lead sheath and bitumen
55 km of 32-Optical Fibers Cable
60 GIS Terminaisons
117 premolded joints with copper casing
and coffin box filled with bitumen

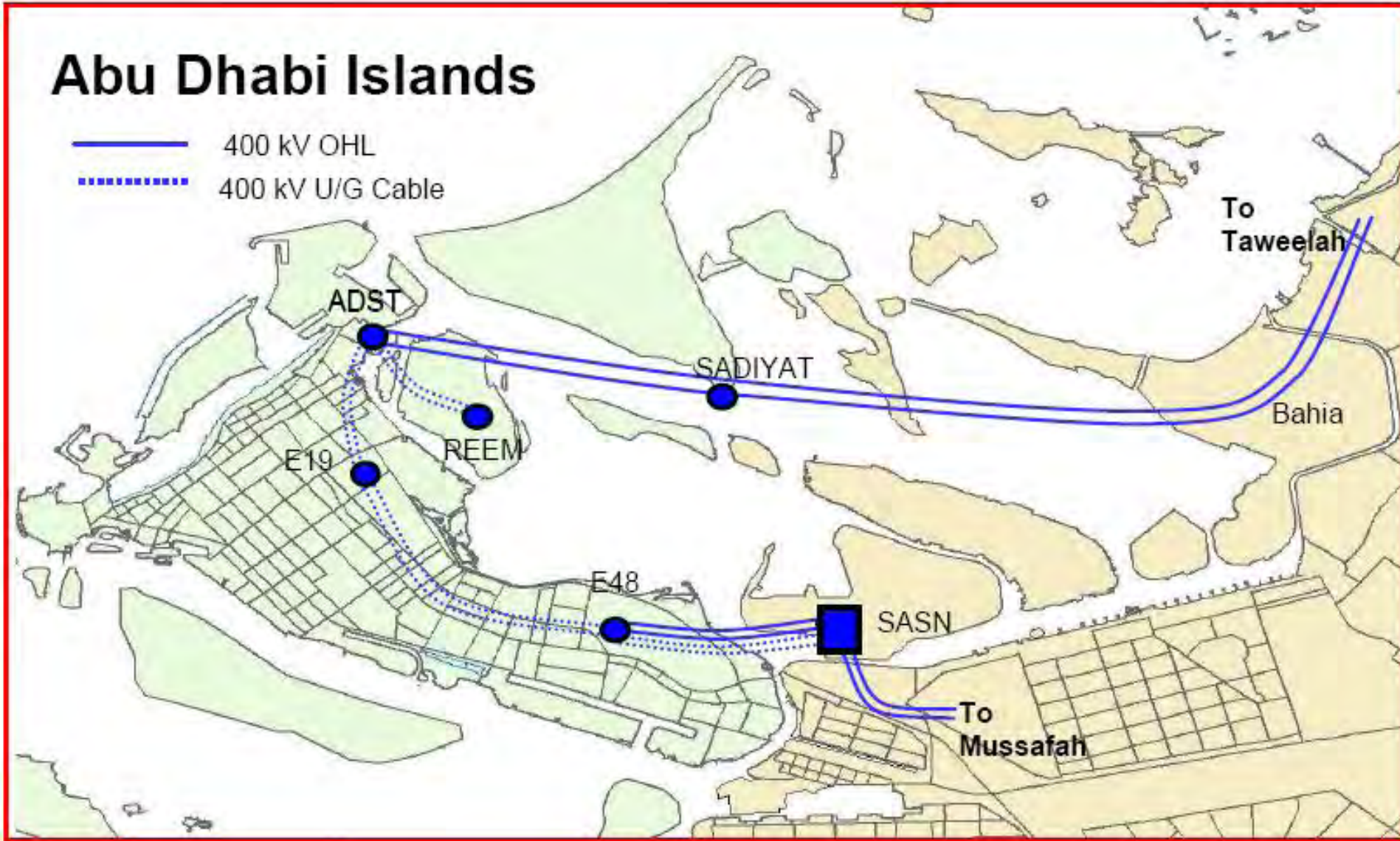
TRANSCO 400kV & 220kV Transmission System – Year 2009



Transco 400kV & 220kV Transmission System – Year 2009

Abu Dhabi Islands

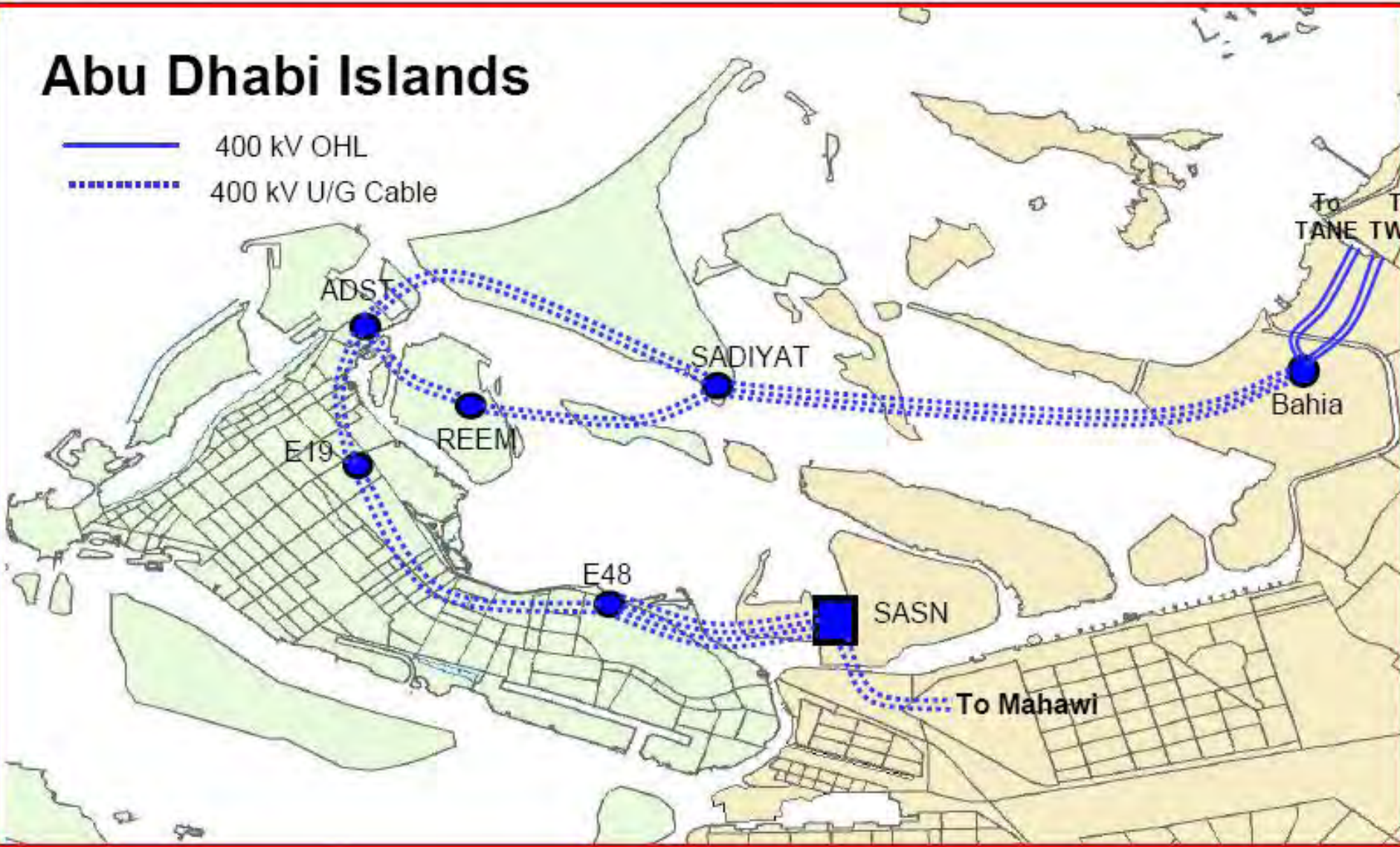
- 400 kV OHL
- ⋯ 400 kV U/G Cable



Transco 400kV & 220kV Transmission System – Year 2014

Abu Dhabi Islands

- 400 kV OHL
- ⋯ 400 kV U/G Cable

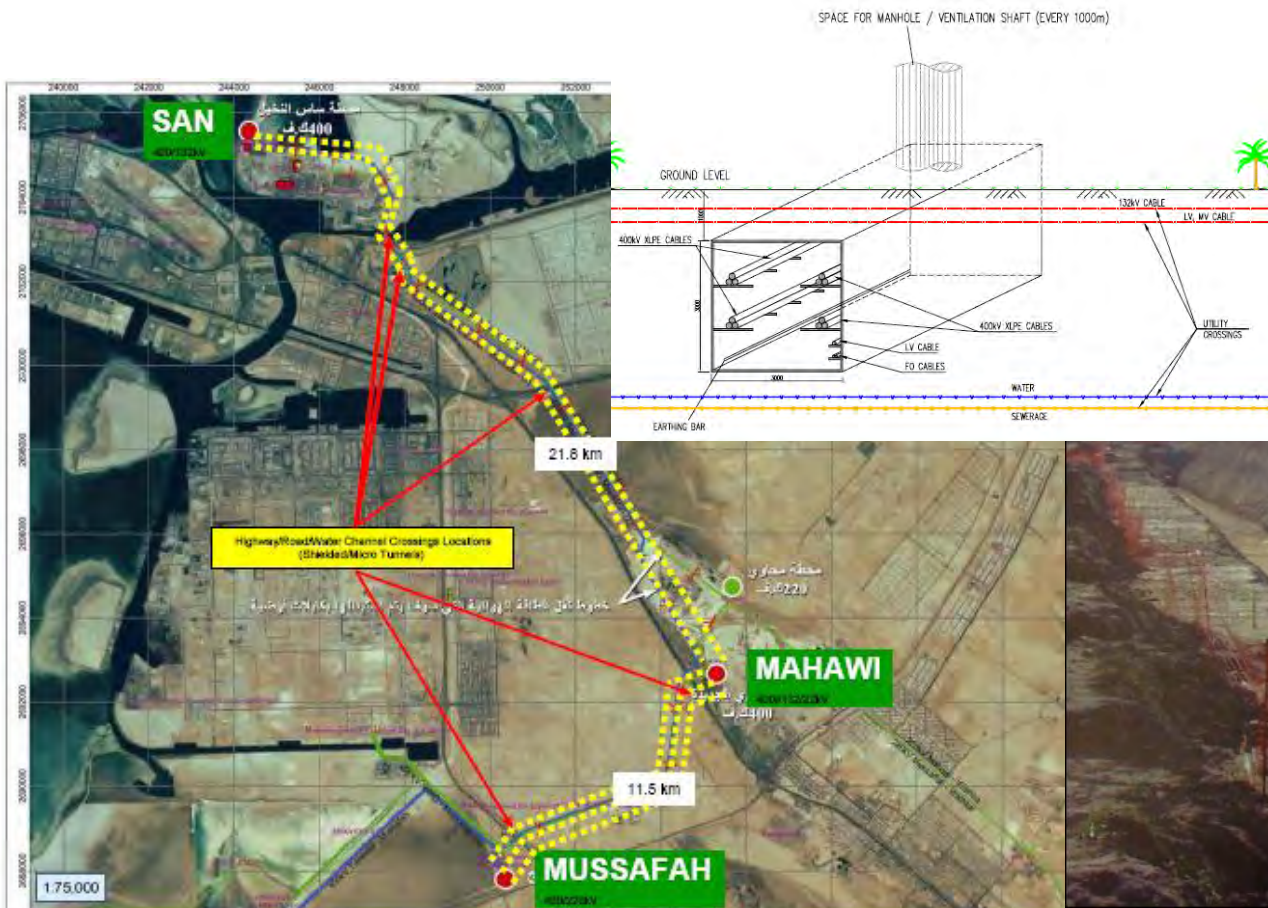


Transco 400kV Planned Projects

Today, there are 230 km of 400kV cable currently at the tendering stage for Mahawi project.

More than 1000km of new 400kV underground cable are planned to be installed by the year 2014 in Abu Dhabi !!

The way of installation actually studied is Open-cut culverts in order to avoid the environmental and electrical matters due to troughs for the 400kV transmission lines.



Open-Cut Culvert Construction:
Prefabricated Culvert Elements

400 kV

- Two types of installations are being considered
 - Filled Concrete Trough in flat configuration with lead sheathed cable and insulated wires conductor
 - Culvert (open trench tunnel) with aluminum water barrier (laminated aluminum covering to increase the length on drum) and insulated wires conductor

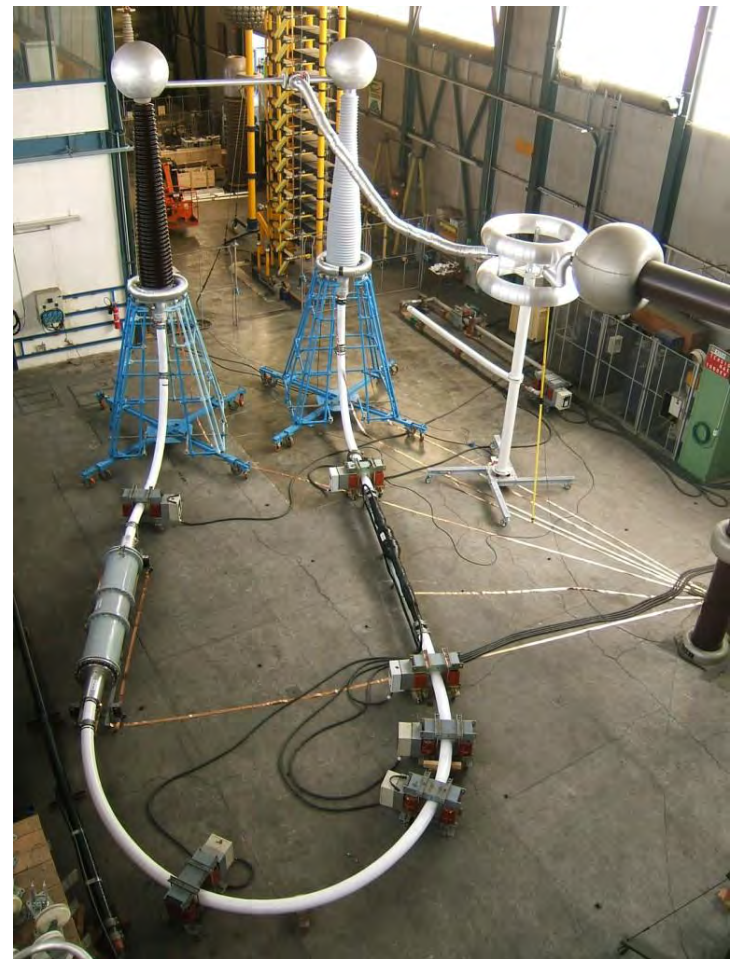


Electrical Type Tests on 400kV Cable System

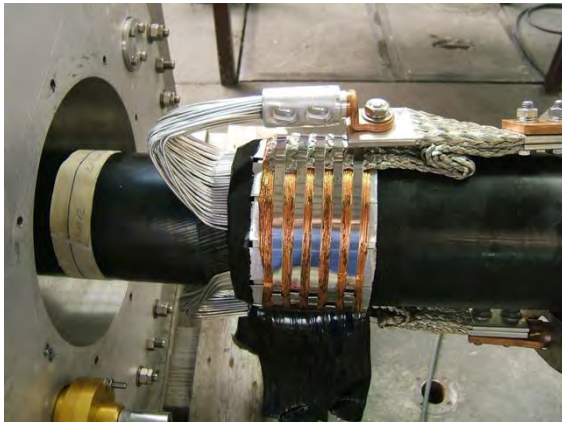
- ✓ Bending test on the cable
- ✓ Partial discharge test at ambient temperature
- ✓ Tang δ measurement
- ✓ Heating cycle voltage test
- ✓ Switching impulse voltage test
- ✓ Lightning impulse voltage test
- ✓ Partial discharge tests
 - ✓ - at ambient temperature and
 - ✓ - at high temperature
- ✓ Test of outer protection for buried joint



400 kV Type Tests



✓ Examination



Requirements for a Dynamic Thermal Rating System

- A software package should be created (existing RTTR- software's could be used as sub routines) that provides the following outputs which could be very useful for Power Utility Engineers involved in following subjects:
 - a.) Network Operating and Control (LDC)
 - b.) Network Planning
 - c.) Maintenance
 - d.) Assets

Requirements for a new software

The new Software package to be developed shall provide the followings:

1. **Displaying temperature profile** (including daily average transmission values in MVA or A for each temperature monitored cable circuit separately).
2. **Generating historical development graphs** (starting from energizing date of the concerned circuit) of five most critical hot spots (including daily average transmission values in MVA or A for each temperature monitored cable circuit separately).
3. **Showing historical development graph** (starting from energizing date) of most critical hot spot (including daily average transmission values in MVA or A by double-mouse click on its peak value shown on the monitor screen).
4. **Providing the following on-line digital displays at LDC of each temperature monitored cable circuit:**
 - a) *Present cable circuit load in MVA or A*
 - b) *Maximum permissible cable circuit load in MVA or A*
 - c) *Maximum permissible cable circuit overload time in minutes of the healthy of two parallel running cable circuits between sub/grid stations in case of one cable circuit breaks down.*
 - d) *Maximum permissible cable circuit overload time for two hours of radial running cable circuits between sub/grid stations.*
 - e) *Alarm and distance of sudden temperature drop (caused by exposing the cables by third parties) of each monitored cable circuits.*

Conclusion

- Numerous projects to come at 132 kV, 220 kV & 400 kV
- Projects are Turnkeys projects with numerous Civil Works issues to address
- New Installation techniques are being considered for 400 kV cables circuits
- Cable design is following the changes in installation techniques.
- Cable system qualification is a long and costly step to achieve
- Dynamic Thermal Rating according to the User's need is a new challenge!

Thank you for your attention!

Questions?