Enabling Smart Grid with GIS, Common Information Model and Utility Network

A Journey Towards Digital Transformation

Orsted

Gaurav Grigo and Ninna Samsøe-Jensen
"Our vision is a world that runs entirely on green energy. We want to be a company that provides real, tangible solutions to one of the world’s most difficult and urgent problems."
Wind Power
- Maintain the position as global market leader
- Support profitable growth by realising our current build-out plan for the period towards 2020
- Expand installed capacity to 11-12GW (ambition) by 2025 provided that the risk and return profile is sound
- Continue to reduce the cost of electricity for offshore wind through industrialisation, economies of scale and innovation

Bioenergy & Thermal Power
- Continuously strengthen operational excellence
- Continue the conversion of Danish CHP plants to sustainable biomass
- Phase out the use of coal and stop using coal from 2023
- Continue the commercial development of our enzymatic waste technology REnescence

Distribution & Customer Solutions
- Maintain a high level of security of supply and customer satisfaction in our distribution business
- Further strengthen competitiveness and customer satisfaction among residential and business customers in our sales business
- Optimise our energy portfolio and provide competitive market access

Oil & Gas
- Adapt to new market realities
- Transform Oil & Gas into a lean cash-generating business to fund investments in renewables
- Prepare for new ownership

Sold to INEOS
Radius Connects ~1m Customers: Largest Power Distribution Company in Denmark

Radius connects customers to the energy market

**Transmission** → **Distribution**

**SUPPLIER CENTRIC MODEL**

Energy retailers

**Grid Operations** is a part of S&D (DCS) and operates as contractor to **Radius Elnet A/S**

- Ørsted A/S
- Ørsted Sales & Distribution A/S
- RADIUS Elnet A/S

**Radius Elnet A/S Power Distribution**

- 1,000,000 connections /meters
- 19,000 km of lines and cables
- 116 Primary substations
- 10,700 substations
- 1,200 MV Feeders
- 145,000 cabinets

**Distribution licence, Northern Zealand & Copenhagen**
Projects: Smart Grid & GIS
Strategic Orientation at Ørsted

Digital Transformation

<table>
<thead>
<tr>
<th>Safety &amp; Security</th>
<th>Customer</th>
<th>Innovation</th>
<th>Grid Modernization</th>
<th>Analytics</th>
</tr>
</thead>
<tbody>
<tr>
<td>GIS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Safety Campaign
- Synergi System
- ADMS Switching Plans
- Certified on ISO 55001
- Workflow & Integration of GIS, SAP and ADMS
- POC on Field GIS Esri Apps
- New IT / OT Projects
- Address Regulations on Renewables
- New Automatic Switches and 10kv Stations
- Outage Management System, Resilience in Network
- Outage Notification System
- Customer Registration 45min → 4 min
- Condition Based Maintenance data
- Long Term Grid Planning Tools
- Open Grid Hub
<table>
<thead>
<tr>
<th>Year</th>
<th>Projects</th>
<th>People</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>2</td>
<td>30</td>
</tr>
<tr>
<td>2015</td>
<td>3</td>
<td>35</td>
</tr>
<tr>
<td>2016</td>
<td>3</td>
<td>40</td>
</tr>
<tr>
<td>2017</td>
<td>4</td>
<td>80</td>
</tr>
<tr>
<td>2018</td>
<td>3</td>
<td>60</td>
</tr>
<tr>
<td>2019</td>
<td>3-4</td>
<td>60</td>
</tr>
</tbody>
</table>

Above figures are only for Core IT and Business Teams.

- **Already in place**
- **Work in progress / in Pipeline**
- **Long term planned / not yet started**
Systems Dependent over GIS at Ørsted (Distribution)

Integration Interfaces

- **ADMS**
- **SAP-PM**
- **ONS**

Integrations:

**Communication**
- **Esri Field Apps**

**Integration Interfaces**

- **SAP WM**
- **Kortkigger**
- **RPM & RPM Web**

**Mobile - Interfaces**

- **Feature Service SAP WM**
- **Shape file extract of Dist. N/W Data**
- **Feature Service (In Future)**

**Integration Interfaces**

- **SAP BI**
- **TomTom**
- **Excel & Access Reports**
- **TODO**

**Features**

- **Feature Services Consumer Data**
  - For new connections — ArcGIS Server
- **Feature Services (Distribution Network Data)**
- **Plot Service**
- **LER Service**
- **Export Layout Service**
- **Plot Archive**
- **Digitale ledninger**
- **SAP-ISU**
- **IPM Web**
- **TomTom Feature Service**
- **Feature Services (Fiber Network Data)**
- **Feature Services (Distribution Network Data)**

**Todo**

- **Daily tasks assigned to a GIS Doc User**

**To be decommissioned after ADMS**

**Future**

- **Feature Services**
- **Consumer Data**
- **For new connections — ArcGIS Server**

**Grundkort**

- **Connection Object**
- **Device Location**

**Integration**

- **Interface between ISU and GIS**
- **Integration Interfaces**
- **CIM/Patch Exports**
- **Consumer export**
- **Asset Information posted in GIS version**
- **Consumer Address**
- **TODO**
- **Daily tasks assigned to a GIS Doc User**

**User**

- **Koblingsap**
- **To be decommissioned after ADMS**
ADMS Upgrade Project
ADMS Upgrade: Added Key Capabilities

- Mesh Feeder Tracker
- Patch with MV & LV Feeder Elements
- Patch with new feeders
- Find all MV & LV dirty and related Feeders to send them to ADMS
- Common Naming of Network Elements
- New asset release from inventory
- LV Schematics
- Request Feeder Export from GIS on Demand (Auto)
- Send Remarks to GIS
- Black Light
- Common Naming of Network Elements
- Fault Correction Work Order

Patch: an incremental feeder update sent from a GIS version to ADMS
An example: ADMS Patch Integration vs. Radius Business Teams

1. I create a new design in Designer Express and send to ADMS model manager & field crew

2. I apply the new design in ADMS and validate the design and create switching scheme

3. I build the new design and commission it in the field, together with ADMS operator

4. The same day, the design will be commissioned in the field, I will commission the design in GIS, together with the as build data from the surveyor

5. I collect the surveying data form the field, and send it to the GIS team
An Example of ADMS Patch Integration

Overview of DCS Documentation and Control Room Processes / Systems

This Integration reflects upon interactions, data exchange and processes of IT systems to complete a Project/Outage in DCS for construction or maintenance.
CIM and Esri Utility Network
A Typical Day at Work

Hello!!
,, the recent export file from GIS is missing some elements!!

GAP

Because, CIM Integration Tool synthesise those elements for ADMS

UN datamodel bridges this gap!!
Utility Network Datamodel Benefits: Close to CIM Model

Reflects Real World like CIM Model
Why CIM for Utilities: Enterprise Level Integration

- **ADMS/O MS**
- **MDM**
- **GIS**
- **WFM**
- **EU Regulatory**
- **SAP**

**CIM**

- **Recognition on International Level**
- **Semantic model describes components and structure of electric power systems**
- **IEC 61970 (Transmission) and IEC61968 (Distribution) standards**
- **Defined in UML**
- **Objects and properties for overall Utility domain**
- **Single source of truth**
- **Simplified Integration across organization**
- **Adopted by EU TSO and DSO regulatory**
GIS elements to CIM elements

- Circuit Breaker
- MV UndergroundLine
- Switch
- Transformer
- LV BusBar
- LV Fuse
- LV Cable

RDF

MV Circuit
- Breaker
- Location
- PositionPoints
- CoordinateSystem
- ACLineSegment
- Location
- PositionPoints
- CoordinateSystem
- LoadBreakSwitch
- Location
- PositionPoints
- CoordinateSystem

Station
- FaultIndicator
- MV BusNode
- Primary Winding
- Transformer
- Secondary Winding
- LV BusNode
- LV Fuse
- LV Cable

Integration
Integration
Integration
Integration
Mapping the Medium Voltage Switch in Utility Network

- Mapping the Highvoltage switch in a secondary substation
- Minimum 3 feature mappings
  - Disconnect to 3 features
  - 2 Connectivity Associations
  - 3 Containment Associations
Example of an Electric Station (10KV) – UN vs. CIM
POC on Esri Mobile Apps
Field GIS Capabilities : POCs
Common European Data Model
Our mission:

Develop and publish an open standard data model for electrical network that:
✓ Supports a European grid configuration
✓ Is in line with the international IEC & CIM standards whenever possible
✓ Represents the real-world appropriately
✓ Supports business processes (forecasting, design, operation and maintenance)

Our goal:

Ensure that Esri supports the European electrical grid model and business processes in the best possible way by giving timely input and feedback

Our ambition:

Encourage other utilities and partners to adopt the model:
✓ To lower cost of migration and developing solutions
✓ To support innovation in the utility industry
European Electric Utilities forming a
UTILITY NETWORK COMMUNITY
to impact, collaborate and co-develop around
Esri’s Utility Network
ARE YOU INTERESTED?

A COOPERATION AMONG
https://www.utilitynetworkcommunity.com