Smart Grid Control Center

The «Next-gen» control room

*Enrico Amistadi*, Network Manager Forum, October 8th 2013
Guten Tag!

Enrico Amistadi
Industry Solution Director
Smart Grid SME for EMEA
enrico.amistadi@ventyx.abb.com
Agenda

- Introduction
  - The «broader» Smart Grid
- Project Scope
  - Requirements
  - Scenarios
- Screenshots
- Q&A
Introduction
Ventyx Smart Grid and its components

- Generation, Load, Price Forecasting and Planning
- Plant Operations and Workforce Management
- Network Management and Optimization
- Virtual Power Plants
- Asset Health and Asset Management
- Smart Grid Intelligence
- Sensors, Intelligent Devices, Intelligent Substations, Building Automation Equipment, Communications and Services, ...
Project Scope
The «Next-Gen» Control Room
Customer Bio

- EON Elnät is the E.ON distribution division in Sweden
- They supply energy to approx. 1,000,000 customers in Sweden
- They are the main distributor of South Sweden and are headquartered in Malmo
- Distribution responsibilities in Sweden include also of a portion of the HV network (130 KV)
In E.ON’s own words...

"... Due to a more complex power system environment with increasing generation and consumption variations, automation and control, the task of the future Smart Grid Control Centre (SGCC) will be significantly more extended compared with today’s traditional control centre task. ..."
In E.ON’s own words...

"... focus on **planning, forecasting, estimation, risk analysis, control of operations** (voltage, power production etc). This with the purpose to **ensure security, stability and system availability** with all relevant energy system actors...

... *ensure high competence with people, with high availability and quality of communication and system operational data, and efficient support systems* for supervision and control to underpin the decision making process in the control centre.

..."
Project Goal

- Adding pro-activity to the grid

- SGCC User comes at the office
- Supervises current events
- Reacts to current events
- Checks and plans for predicted events
- «Pro-acts» to predicted events
- Looks at future Events
Functional Flow

Weather Data (Historical & Forecast)

Load and Generation Forecast

Network Topology and Simulation

Predicted Events and Corrective Suggestions
Architecture

Scada

VPP Management
- Substation Weights
- Load Reduction Requests
- Reduction Plans

Network Management
- Predicted Events
- Load and Renewable Generation Forecasts

Operational Forecast
- Historical Weather
- Weather Forecast

Smart Grid Intelligence

©2013 Ventyx, an ABB company | Confidential & Proprietary | 12
## Business Scenarios

<table>
<thead>
<tr>
<th>Scenario #</th>
<th>Name</th>
<th>Metrics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Transformer Mode Switching Optimization</td>
<td>Hourly Data Daily Calculation</td>
</tr>
<tr>
<td>2</td>
<td>Voltage-Reactive Power Optimization</td>
<td>15 mins data Hourly calculation</td>
</tr>
<tr>
<td>3</td>
<td>Subscription Exceeding and Demand Response</td>
<td>Hourly data Hourly calculation</td>
</tr>
<tr>
<td>4</td>
<td>Congestions and DLR</td>
<td>15 mins data Hourly calculation</td>
</tr>
</tbody>
</table>
Scenario #1 – Substation Switching Optimization

Transformers can run in both single and parallel mode with specific losses depending on the load. In a future with an increased amount of wind power in the network, the situation will be more volatile and we can foresee an increased number of switches to be more optimal.

1. Input
   - Substations with 2 or 3 transformers
   - Load forecasting at substation level
   - Scada system with 130kV grid model

2. Analysis
   - Predict the optimal operation mode for the transformers at each substation in order to minimize energy losses.

3. Actions
   - Dashboards with configured alerts allow to view the substations where the operation mode requires changes to enable proactive operation.

Achieve:
- Operational Performance
  - transformers are switched twice a year today when optimal is around 10+.
Scenario #1 - Flowchart

- **The solution**
  - Calculation is done once a day with hourly data
  - Check is performed against the 50 substation with multiple Transformers
Scenario #2 – Voltage/Reactive Power Optimization

This scenario focuses on optimizing the reactive power flow and voltage on the 400kV/132 kV network based on forecasts by minimizing the expected reactive power losses.

1. Input
   - Load forecasting at zone level.
   - Scada system modeling the 130kV network to calculate voltage at each station.

2. Analysis
   - Continuous calculation of losses for alternative operation of capacitors and reactors.
   - Control that the loss levels remain within the thresholds.

3. Actions
   - Dashboards with configured alerts will display some operation guidelines when Voltage/reactive power is predicted to cross the limits.

Achieve:
- Operational Performance
  - Proactive operation of capacitors and reactors in the network
Scenario #2 - Flowchart

- **Ventyx solution**
  - The calculation is done every hour with 15 mins data
  - Check is performed against the 20 identified substations
Distribution Network Operators (DNO) can look at demand response for load peak shaving at specific locations in the grid in order to **lower TSO subscription penalty fees**.

### Scenario #3 – Subscription Peak Exceeding

1. **Input**
   - Industrial customers with alternative *boilers* of up to 15MW
   - Scada + forecasting system to predict *subscription exceeding*

2. **Analysis**
   - Compute the impact of each customers at the substations in a *meshed network*.
   - Select the optimal set of customer to call for the DR event

3. **Actions**
   - Dashboards notify in advance which customers the DSO must call in order to **minimize the costs** during the exceeding

---

**Achieve:**

- **Operational Performance:**
  - Proactive operation
  - Increase operator’s efficiency
Scenario #3 - Flowchart

- Forecast calculation is performed every hour with hourly data
The solution

- VPP management, based upon capacity and weights calculates the optimal reduction plan
- Post-event actual reduction is evaluated and used for pre-billing purposes
Transmission line can be equipped with Dynamic Line Rating (DLR) system to measure congestion level and dispatch load excess. This scenario looks at alleviating the congestion in transmission lines based on forecasts.

1. Input
   - connection lines with DLR system.
   - Wind farm generation forecasting

2. Analysis
   - Compute the line temperature in a similar way as the DLR but based on wind generation forecast.

3. Actions
   - Assess forecast quality against DLR measurements.
   - Display control recommendations to manage the congestion at the connection line.

Achieve:
- Operational Performance
- Experience for future projects.
- Introduce monitoring and DLR system in a more structured way in the future based on lessons from the DLR.
Scenario #4 - Flowchart

- **The solution**
  - The calculation is done every hour with 15 mins data
  - Check is performed for the identified lines

```
[Diagram showing the flowchart with steps:
  1. Historical Gen.
  2. Historical Loads
  3. Historical Weather
  4. Weather Forecast
  5. Load and Generation Forecast Calculation
  6. DLR Calculation is performed
  7. Is expected net load within the DLR tolerance
     - Yes: END
     - No: Future DLR alert event is created]
```
Screenshots
SGCC screenshots
SGCC screenshots
SGCC screenshots
SGCC screenshots
SGCC screenshots
SGCC screenshots
Conclusion
Smart Grid...

...it's not just the Grid

Generation, Load, Price Forecasting and Planning

Plant Operations and Workforce Management

Network Management and Optimization

Virtual Power Plants

Generation Planning Optimization

Asset Health and Asset Management

Smart Grid Intelligence

Sensors, Intelligent Devices, Intelligent Substations, Building Automation Equipment, Communications and Services, ...
Vielen Dank!