NEXT GENERATION SUBSTATIONS

Developing a high functionality low cost smart substation concept to drive the next phase of the utility digital transformation

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BACKGROUND

- Rapidly aging substation automation systems together with limited life time of modern DSAS devices.
- Big gap in reinvestments.
- Mix of old standardized/new non-standardized substations.
- Procurement strategy based on functional requirements could lead to unique solutions.
- Need a new standardized concept to efficiently replace SAS
DEPLOYMENT OF STANDARD SUBSTATION CONCEPT

- Affects both organisational and technical issues.
- Development of tool based IEC 6850 process
- Update of technical specifications
SCOPE OF NEW IEC 61850 PROCESS

- Strategic direction to standardize Protection, Automation and Control Systems (PACS) by implementing IEC 61850.

Key issues:
- Overcoming the engineering challenges of multi-vendor systems through the lifecycle of the system.
- Defining and utilizing templates that ease the engineering process in new and refurbished substations.
- Leveraging the latest vendor-independent tools to improve speed and accuracy of engineering from a customer perspective.*

*A DSO perspective on IEC 61850 specification and engineering, presented at IEC 61850 Europe 2016
NEW TECHNICAL SPECIFICATION

- Move to IEC 61850-8-1 station bus for all remote and local monitoring and control.
- Keep hard wired separate backup control at each bay unit or cabinet.
- Station-HMI part of RTU-solution
- Station specific signal list based on common template.
- Frame agreements on IEDs
DRIVERS, NEEDS AND EXPECTED BENEFITS

Vattenfall Eldistribution
Starting point

Aging primary substations
IEC61850 Pilot
Maintenance calendar based

Ongoing R&D activities
Deliverables

Next Generation Protection and Control concept
New primary equipment
Reference architecture to enable Condition-Based Maintenance

Future Benefits

Faster replacement additional cost reductions
Ability to buy "batches"
Implemented new primary equipment
Reduced maintenance costs
## DIGITAL SUBSTATION R&D ACTIVITIES

### Main activities

<table>
<thead>
<tr>
<th>Description</th>
<th>Main Deliverable</th>
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<tbody>
<tr>
<td>For faster <strong>substation PACS</strong> replacement process &amp; additional cost reductions</td>
<td><strong>Basic concept for next generation protection and control</strong></td>
</tr>
<tr>
<td>Implementation of new <strong>primary equipment</strong>, saving environment and costs</td>
<td><strong>Indoor Substation Concept</strong></td>
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<tr>
<td><strong>Condition based maintenance</strong> to reduce maintenance costs, optimize use of substation equipment, optimize planning</td>
<td><strong>Pilot identification of reference architecture</strong></td>
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<tr>
<td>Short term <strong>Implementation support</strong></td>
<td><strong>Routines to find faults in IEC 61850 systems</strong></td>
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Developing a high functionality low cost smart substation concept...

- Next step towards more standardized, cost effective and resource effective technical solutions for protection and control.
- Continuous technology development provides opportunities for improvements of the IEC 61850 PACS concept.
- Developing next generation P&C equipment as a successor and continuator of the deployment of IEC 61850 work processes.
EVALUATION OF NEXT GENERATION P&C CONCEPT

Evaluation parameters
- Standard HW for different P&C applications.
- P&C functions according to Vattenfall needs.
- Standardization for the system engineering, over the entire lifespan of equipment.
- Contribution to more efficient FAT/SAT.
- Shortening of installation time on site.
- Efficient procurement IEC 61850 work process
- Improved quality assurance of the P&C delivery
EVALUATION RESULTS

Highest scores
- Bay digitization marshalling kiosks
- Modularized protection & control unit

VS

Other concepts evaluated
- Centralised soft P&C and,
- Integrated bay P&C into single IED.

Other companies may have other parameters and thus come to other conclusions.
# DETAILED RESULTS

<table>
<thead>
<tr>
<th>Category</th>
<th>Total sum</th>
<th>General issues</th>
<th>Procurement process</th>
<th>Project execution</th>
<th>Operation &amp; maintenance</th>
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<tbody>
<tr>
<td>Bay digitization marshalling kiosks</td>
<td>55</td>
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<td>8</td>
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<td>Modularized P&amp;C unit</td>
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<td>13</td>
<td>7</td>
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<tr>
<td>Concept X</td>
<td>46</td>
<td>14</td>
<td>2</td>
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<tr>
<td>Concept Y</td>
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<td>5</td>
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<tr>
<td>Concept Z</td>
<td>39</td>
<td>9</td>
<td>2</td>
<td>6</td>
<td>22</td>
</tr>
</tbody>
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NEXT STEP

- Integration of newly identified concepts in a basic design
- Development of conceptual basic design – digitizing information & data
- Business case for pilot installation
- Broader set of functions has to be considered for the communication network architecture.
REFERENCE ARCHITECTURE TO SUPPORT INFORMATION EXCHANGE FROM PROCESS TO CENTRAL CONDITION MONITORING SYSTEM

Example - Information exchange for calculation of Asset Health Index – Breaker

- Creation of realtime Process information
- Reporting of disturbance recording files
- Creation of historic process information
- Make process information and disturbance records available for analysis system
- Make asset information available for analysis system
- Provide calculated AHI for maintenance.
... to drive the next phase of the utility digital transformation.

Digital PACS
- Extended digitalisation
- CM data
- Process bus
- Software independent of hardware
- Distribution automation and FLISR

Primary equipment
- Indoor substation concept and compact design
- NCIT

Access to data
- Enterprise Service Bus
- Asset health index
- Close the loop NIS/PACS
QUESTIONS?

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