Smart solutions for fleets of all types & sizes of power generation

Marcus König, E F IE SGS / September 2013
The Siemens structure:
Four Sectors close to the customer

<table>
<thead>
<tr>
<th>Energy</th>
<th>Healthcare</th>
<th>Industry</th>
<th>Infrastructure &amp; Cities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Divisions</td>
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<tr>
<td>• Fossil Power Generation</td>
<td>• Imaging &amp; Therapy Systems</td>
<td>• Industry Automation</td>
<td>• Rail Systems</td>
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<tr>
<td>• Wind Power</td>
<td>• Clinical Products</td>
<td>• Drive Technologies</td>
<td>• Mobility and Logistics</td>
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<tr>
<td>• Oil &amp; Gas</td>
<td>• Diagnostics</td>
<td>• Customer Services</td>
<td>• Low and Medium Voltage</td>
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<tr>
<td>• Energy Service</td>
<td>• Customer Solutions</td>
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<td>• Smart Grid</td>
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<tr>
<td>• Power Transmission</td>
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<td>• Building Technologies</td>
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</table>

1) In fiscal 2011, Siemens announced its intention to publicly list OSRAM and retain a minority stake as anchor shareholder in OSRAM AG for the long term.

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Top performance in five Divisions

- **Fossil Power Generation (E F)**: World record 60.75% efficiency for combined cycle power plants.
- **Wind Power (E W)**: New performance dimensions 6 MW for wind turbines.
- **Oil & Gas (E O)**: Deep-sea capable 36 kV seabed power distribution at depths of up to 3,000 m.
- **Energy Service (E S)**: Additional 200 MW through modernization in 2011.
- **Power Transmission (E T)**: World record 800 kV for direct current transmission.
**Energy Sector – Fossil Power Generation Division**

<table>
<thead>
<tr>
<th>Product Business Unit (E F PR)</th>
<th>Energy Solutions Business Unit (E F ES)</th>
<th>Instrumentation &amp; Electrical Business Unit (E F IE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Gas turbines (112 MW to 375 MW)</td>
<td>• Gas turbine power plants</td>
<td>• Highest availability – proven SPPA-T3000 in over 380 units</td>
</tr>
<tr>
<td>• Steam turbines (90 MW to 1,900 MW)</td>
<td>• Combined cycle power plants</td>
<td>• World record conversion time for a full I&amp;C modernization</td>
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<tr>
<td>• Generators (25 MVA to 2,235 MVA)</td>
<td>• single-/multi-shaft configuration</td>
<td>• Immense savings – at least one complete I&amp;C system less during a plant’s lifecycle</td>
</tr>
<tr>
<td>• Fuel gasifier</td>
<td>• Integrated solar combined cycle power plants</td>
<td>• Smart Generation Solutions – to manage decentralized energy generation and optimization</td>
</tr>
<tr>
<td>• System integration</td>
<td>• Steam power plants</td>
<td></td>
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<tr>
<td></td>
<td>• The comprehensive range of offerings extends to complete turnkey solutions.</td>
<td></td>
</tr>
</tbody>
</table>

**Gas turbine power plants**

**Combined cycle power plants**

**Integrated solar combined cycle power plants**

**Smart Generation Solutions**

– to manage decentralized energy generation and optimization

**World record conversion time** for a full I&C modernization

**Immense savings** – at least one complete I&C system less during a plant’s lifecycle

**Highest availability** – proven SPPA-T3000 in over 380 units
Siemens E F IE: The leading global solution provider for enterprise-wide power generation management

- Waste Incineration Plants
- Wind Power Plants
- Nuclear Power Plants
- Industrial Power Plants
- Biomass Plants
- Fossil fired Power Plants
- Combined Cycle Plants
- Desalination Plants
- Coal Gasification Plants
- District Heat Power Plants
Power supply becomes increasingly decentralized, volatile and complex
Economics, weak-grids and market liberalization are predominant factors – with clear requirements

New Energy Mix
- Shifts in the energy mix with significant regional differences

Changing Economics
- Rising OPEX for fossil energy, falling CAPEX for wind and PV

Liberalization of energy markets
- Fluctuating prices and market integration of renewables

Weak / overloaded grids
- Little investment & high volatility through renewables

Environmental aspects
- Ramp-up of renewables accepted goal in all societies

1. Increased Flexibility of Fossil Plants
2. Smooth integration of Renewables
3. Fleet Optimization (Economic Dispatch)
4. Hybridization Fossil + Renewables
5. Sizing the right mix of generation types
6. Services for Operations & Maintenance
Centralized and distributed power generation units have to interact – in real-time
Siemens provides solutions for highest efficiency, reliable power supply and reduced emissions

Smart Generation Solutions

1. Performance Monitoring
2. “Flex Power Plant Solutions”
3. Hybrid Power Solutions
4. “Modular Power Plant Solutions”

- Flexibility improvements of thermal power plants
- Smooth integration of volatile renewables
- Off-Grid power solutions with minimized cost of energy
- Fleet optimization for best profitability in liberalized energy markets
Performance Monitoring Solutions
Remote Performance Monitoring of distributed renewable generation units and fleets

- Spare parts
- Service
- O&M

Remote monitoring and operation

SPPA-T3000
SPPA-M3000

Yield forecast via fish-eye camera
The Monitoring Portal provides all key performance indicators at the click of a button.
Performance Monitoring Solutions: from planning to service solutions for maximum yield

Our solution:

- Monitoring solution for renewables incl. yield forecasting, real-time diagnosis
- Remote control of all electric devices, remote diagnostics and remote operation
- Data processing and evaluation via Energy Asset Management software
- Information platform for plant data
- Selection, configuration and integration of battery storage
- Customer-specific service packages that range from remote monitoring and operation through to maintenance and complete plant operation

Customer Benefit:

- Proven technology for reliable generation
- Worldwide remote monitoring and control
- Dependable forecasts for optimal marketing
- Individual service for maximum revenue
- Data security that meets the strictest standards
- Expandability and scalability for maximum future-proofing
Performance Monitoring Solutions – successfully implemented in large PV plants

Ketura Solar Park, Israel
- Arava Power Company
- 5 MW PV plant
- Scope: full EPC incl. EBOP
- Advanced service package
- Performance ratio guarantee

Droogfontein & De Aar, South Africa
- Mainstream Renewable Power
- 2 x 50 MW PV plant
- Scope: full EPC incl. EBOP
- Advanced service package
- Performance ratio guarantee
“Flex Power Plant Solutions”
„Flex Power Plant Solutions”: more flexibility for existing conventional plants and fleets

- Fleet Dispatcher
- Grid Operator
- Fleet Control System
- Central Control Room
- CHP plant
- District heating
- Public Communication Network
- Thermal storage
- Electrical storage
- Distributed generation units
- Power trading (e.g. EEX)

Energy: solid line
Information: dashed line
Heat: dotted line

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Page 16 Smart Generation Solutions
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Fleet Control System – basis for an optimized and solid system

Central Control & Operation

Fleet Generation Optimization

Combined solution provides highest availability, lowest OPEX and maximum earnings
“Flex Power Plant Solutions”: from planning to service solutions for maximum yield

Our solution:
- For single plants:
  - Usage of thermal storage for decoupling of power and heat generation
  - Integration of boilers and heat pumps for active usage of price advantages caused by excess supply of renewable power
- For fleets:
  - Optimal fleet monitoring and control, and resource optimization out of one central control room
  - Automated dispatch and optimization of distributed, heterogeneous generation units

Customer Benefit:
- Increased flexibility
- Minimized third-party supply
- Participation in energy markets (incl. reserve power) also for smaller plants
- Increased transparency of plant status and costs allover the entire fleet
- Increased profitability through automated fleet optimization
- Cost reduction through centralized operation
Centralized control and optimization of fleets:
Origin Energy, Australia

Integration of 13 power stations
(gas, wind, coal, hydro): total 2,6 GW
Hybrid Power Solutions integrate renewables efficiently into diesel plants

- Diesel Gensets
- Fuel Tanks
- Fleet Control System incl. Power Management
- Consumption
- Wind Park
- Solar Park
- Energy storage

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Energy

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Information
Hybrid Power Solutions – reliable power supply for islands or remote installations

Our solution:

- One-stop turnkey solutions including planning, engineering, installation & commissioning, and service
- Integration with existing diesel generators or delivery of new diesel power plants
- Delivery of wind and/or solar parks
- Technology selection, sizing and delivery of energy storage (e.g. batteries)
- Siemens Fleet Control System with power management for economically optimized, automated operation
- Complete electrical package including electrical balance of plant and grid integration

Customer Benefit:

- Reliable power supply with high grid stability and power quality
- Fuel savings of up to 60 %
- Reduced logistic/ transportation costs
- Emission reduction of up to 60 %
- Up to 100 % peak penetration of renewables
“Modular Power Plant Solutions”
“Modular Power Plant solutions”: Bundling fossil and renewable generation units and storage

- Fossil power plant
- Battery storage
- Diesel generators
- Forecasts
- Fleet Control System incl. Power Management
- Grid
- District heat
- CHP plant
- Wind park
- PV park
- Thermal storage
- Biomass plant

Types of energy and information transfer:
- Energy (solid lines)
- Information (dashed lines)
- Heat (orange lines)
“Modular Power Plant Solutions“ – the answer for new power plant projects

Our solution:
- Intelligent combination of fossil and renewable generation units
- Integration of battery and thermal storage as well as boilers and heat pumps for optimized operation
- Fleet Control System for control and optimization of the entire fleet from one central control room
- Participation in energy markets
- Flexible expandability by distributed generation modules

Customer Benefit:
- Reduced complexity by combining distributed generation units
- Optimized power and heat generation based on availability, forecasts and costs
- Maximum flexibility by intelligent integration and control of the pooled generation modules
- Reduced operation and maintenance costs of the whole fleet
Smart solutions for highest efficiency, reliable power supply and reduced emissions

Reliable Power Supply ✓

Climate Protection ✓

Economic Efficiency ✓

Resource Efficiency ✓

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