Power management system
Content

- Introduction
- System configuration
- Functionality
- Reference
- Summary
- Live demonstration
- Q & A
Content

- Introduction
  - Definition
  - Task
  - Operational Drivers
  - Application Areas
- System configuration
- Functionality
- Reference
- Summary
- Live demonstration
- Q & A
Terminology

- **PMS** – Power Management System
- LMS – Load Management System
- PDCS – Power Distribution Control System
- ENMC – Electrical Network Monitoring & Control System
- ECS – Electrical Control System
- ELICS – Electrical Integrated Control System
- IPCS – Integrated Protection & Control System

PMS is a control system:
- To monitor and control electrical switchgear and equipment
- To optimise electricity generation and usage and to prevent major disturbances & plant outages (blackouts)
- To coordinate power generation & large loads.
Task of Power Management System

Avoiding blackouts in industrial plants!

- Power Sharing
- Load Shedding
Operational Drivers for PMS

Critical Loads
Limited In-plant Generation
Insufficient reliability of grid supply

Several Generators
Power Sharing with other plants/grids

Generator Modes and Operation
Transformer Control and Monitoring
Circuit Breaker Operation

Connection to other plants/grids
Bus-Tie operation

} Load Shedding
} Power Control
} Object Control
} Synchronization
Main Application Areas in O&G Supply Chain
Content

- Introduction
- **System configuration**
- Functionality
- Reference
- Summary
- Live demonstration
- Q & A
Content

- Introduction
- System configuration
- Functionality
  - Load Shedding
  - Turbine Control
  - Generator Control
  - Active Power & Reactive Power Control
  - SCADA & Integration
  - Synchronization
- Reference
- Summary
- Live demonstration
- Q & A
Load Shedding: The types

- **Fast load shedding**
  The fast load shedding function is initiated when the position change of a critical breaker will result in a network where the maximum available power produced is less than the total consumed power. The fast load shedding is essential to the power management system because it acts fast and determines if a trip of a critical breaker will require load shedding.

- **Under-frequency load shedding**
  The under-frequency load shedding function is triggered when an input signal from a dedicated underfrequency relay detects that the frequency level has dropped below a predetermined value. The function supports four levels (stages) of under-frequency. The under-frequency load shedding is important because it acts as a secondary (backup) function to the fast load shedding function, in case a trip of a critical breaker is not detected or the actual shed power is not adequate to recover the frequency level.

- **Overload load shedding**
  The overload shedding function applies when a network configuration is connected to a grid and power is imported from the grid, as consequence of an imbalance. If the amount of the imported power exceeds a predetermined allowed limit for a time duration which also exceeds a predefined limit, the overload shedding is initiated.
Generator trip
Turbine Control

- Primary Turbine Controller
  - Droop or isochronous

- PMS provides:
  - Manual control (Droop)
  - Manual MW setpoint
  - Automatic frequency control
  - Automatic setpoint control (MW sharing)
  - Automatic mode change:
    - CB trip
    - Turbine trip etc.
Generator Control

- **Primary AVR:**
  - Droop or voltage control

- **PMS provides:**
  - Manual control (Droop)
  - Manual setpoint control (setpoint is PF)
  - Automatic Voltage Control (AVR receives raise/lower from PMS)
  - Automatic setpoint control (MVar sharing)
  - Automatic mode change:
    - CB trip
Capability Diagram

- Minimum Excitation
- Rotor Instability Line
- Operating Minimum
- Minimum PF-Leading
- Minimum Excitation
- Maximum Excitation (Rotor Heating)
- MVA-circle (Stator Heating)
- Minimum PF-lagging
- Operating Minimum
- P
- Q-Lead
- Q-Lag
Active and Reactive Power Control

- In island operation:
  - Maintain system frequency
  - Maintain system voltage
- Connected to grid:
  - Control active power exchange
  - Control re-active power exchange
- Share active and reactive power amongst the machines
  - Participation factors
  - Efficient Power Generation optimization
  - Spinning Reserve optimization
  - Standby optimization
  - NOx constraints
- Objectives
  - Coordinated control of power generation
  - Achieve stable operation
Supervision, Control, and Data Acquisition

- Clearly Structured Presentation
- Controls - Select Before Execute
- Status Indications
- Time Tagged Events (1 ms resolution)
- Alarm handling, Reports, Trends
- Supervision and Self Diagnostics
- Single Window concept
- Interface with upper-level control system, such as DCS
Integration with Protection & Control Units

- Measuring of U,I,E, calculation of P & Q
- Monitoring & Control
- Interlockings
- Alarm annunciation
- Event Time Tagging
- Disturbance Recording
- Local storage of trip-events
- Time synchronization
- Relay parameterization
Synchronisation

- **Local Manual**
  - Perform on the synchronization panel
  - Manually raise/lower using push button
  - Issue close command by using a dedicated close button by mean of watching indication of synchronoscope

- **Local Automatic**
  - Perform on the synchronization panel
  - Push start synchronization button
  - Synchrotact to start generating lower/raise commands in search for synchronism.
  - Once this is achieve, the synchrotact will automatically issue the close command.

- **Remote Automatic**
Synchronisation Panel
Content

- Introduction
- Functionality
- Reference
- Summary
- Live demonstration
- Q & A
Named Customer References
ABB delivers Industrial IT solution to the Statoil Hammerfest, Norway LNG Plant

ABB Helps Statoil Set New Records with Europe’s First LNG Facility

A competitive multi-scope delivery by ABB that seamlessly integrates Automation and Safety system, Power Distribution Control system, Power Management system, Electrical Equipment, Field instruments, and Analyzers. ABB’s IndustrialIT systems and equipment put Statoil operators and engineers in complete control of the new energy efficiency benchmark for LNG plants.

Client: Statoil
Location: Melkøya island, Norway
Scope of Work: Safety and Automation System, Power distribution control system, power management systems, operator and engineer stations, training simulator

Competitiveness is a matter of keeping your price at the most competitive level, but also demonstrating the capacity and skill set, competence, and solutions to provide us with a professional deliver. We felt comfortable with ABB’s ability.

Ole Hausken,
Senior Advisor for Statoil’s Hammerfest LNG plant
ABB delivers Industrial IT solution to the Sakhalin II LNG Plant, Russia

ABB Leads Telecom and Electrical Project for World’s Largest LNG Plant

The world’s largest LNG processing plant is being built in an extreme environment with a multicultural work force, under complex regulations. But ABB’s experts are used to such challenges. That’s why SEIC chose ABB to provide the telecommunications and electrical distribution systems.

Client: Sakhalin Energy Investment Company Ltd.
Location: Russia’s Far East – Sakhalin Island
Scope of Work: Telecommunication and Electrical distribution equipment, engineering, installation, testing

“ABB is responsible for all telecommunications equipment for the project on a turnkey basis... ABB has always remained focused and dealt with the challenges, and in the process has forged successful partnerships with Russian companies.”

Ian Johnston, Telecommunications Project Manager, SEIC “We were able to win the client’s confidence because we provided one window for them to all of ABB’s global abilities and responded with fast feedback on any inquiries they had.”

Hugh Clayton, Vice President of Process Automation at ABB K.K.
Content

- Introduction
- Functionality
- Reference
- Summary
- Live demonstration
- Q & A
Summary: ABB PMS allows you to:

- Avoid black-outs (up to 500 kUSD / hour)
  - Power control including voltage control, frequency control, sharing power among generators and tie-line(s).
  - High Speed Contingency Load Shedding (< 100 ms.)

- Reduce electricity costs
  - Peak-shaving
  - Re-active Power Control & Sharing

- Minimize operational costs
  - Decreased number of operators
  - Event driven maintenance
  - Transformer Overload Management
  - Single Window concept

- Reduce investment costs
  - Minimized cabling and engineering
  - Optimized network design
Summary: Why ABB PMS?

- In-depth knowledge of the electrical process
- 20 years experience in PMS implementations across the world (green-field and brown-field plants)
- Standard software, well documented, tested, proven technology
- Fast Response Time for: Load Shedding, Mode Control, Power Control, Re-acceleration
- High Resolution and Accuracy of Sequence of Event recording
- Comply to class 3 EMC immunity
- Single responsibility: One supplier for PMS integrated with switchgear, protection, governor, excitation, transformer, tap changer, Motor Control Centre, Variable Speed Drive, etc.
- Experience with EPC’s like: CB&I, Bechtel, Chiyoda, Fluor Daniel, Foster Wheeler, JGC, Kellogg, Larson & Tubro, Mitsubishi, Snamprogetti, Technip, Toyo, Toshiba, Hyundai, etc.
Live Demonstration

Q&A

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