POWERMAX® [ˈpou (ə)r ˈmaks] noun: a system designed to maintain stability

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Agenda

- POWERMAX – Power Management System Introduction
- POWERMAX – Functionalities (IDDS, LSP, GCS, A25A)
- POWERMAX – Simulators
- MOTORMAX – LV Motor Management System Introduction
Agenda

- **POWERMAX** – **POWER MANAGEMENT SYSTEM INTRODUCTION**
- **POWERMAX** – Functionalities (GCS, A25A)
- **POWERMAX** – Simulators
- **MOTORMAX** – LV Motor Management System Introduction
POWERMAX Functions

- HMI / SCADA
- IDDS
- GCS
- A25A and Tie Flow
- High-Speed Load Shedding
- Engineering Management
Generation Control System (GCS)

- Non-islanded (utility-connected)
  - Active / reactive power sharing
  - Active / reactive power flow across tie / power factor
- Generation shedding and runback
- Automatic synchronization

- Islanded
  - Voltage and frequency control for each island
  - Active / reactive power sharing
  - Active / reactive power sharing between islands
AGC Features

- Controls system frequency for each island
- Maintains allowable operational region of kW
- Does not use traditional PID
- Dispatches governor set point for % active power load sharing
- Quickly calculates set points under all islanded conditions
- Commissioning tools and method
- SOEs and system monitoring
AGC Regulates Frequency

Island Detection
Frequency Control
Tie Flow Control

Optimal Load-Sharing Dispatch

+  -

Unit Megawatt Control

Set Points to n Governors

MW Set Point
Generator Power (MW)

Governor

Speed Error

Speed Control

To Turbine Valve

Speed (Hz)
Voltage Control System (VCS) Features

- Controls bus voltage for each island
- Maintains allowable operational region of kVAR
- Does not use traditional PID
- Dispatches AVR set point for % reactive power load sharing

- Quickly calculates set points under all islanded conditions
- Commissioning tools and method
- SOEs and system monitoring
VCS Regulates Bus Voltages

VCS

Island Detection
Bus Voltage Control
Power Factor Control

Optimal VAR Dispatch (to \( n \) Generators)

Generator MVAR Set Point

VAR Control

AVR

Exciter Control

\( V_{\text{GEN}} \) Feedback

MVAR_{\text{GEN}} Feedback

\( n = 18 \)
ICS Features

• Tracks each system island
• Allocates the available spinning reserves of generators to island
• Displays voltage and frequency for each island
• Exciter control mode changes
**Typical GCS HMI Screen**

### Grid Export/Import Control

<table>
<thead>
<tr>
<th>Tie Breaker</th>
<th>Status</th>
<th>HW Control Mode</th>
<th>Reactive Power (MVAR)</th>
<th>Power Factor</th>
<th>MVAR Control Mode</th>
<th>Power (MW)</th>
<th>Voltage (kV)</th>
<th>Frequency (Hz)</th>
<th>Peak (MW)</th>
<th>Off-Peak (MW)</th>
<th>Partial Peak (MW)</th>
<th>Super Off-Peak (MW)</th>
<th>Selected Setpoint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tie Breaker 01</td>
<td>Open</td>
<td>Disabled</td>
<td>0.00</td>
<td>0.00</td>
<td>Disabled</td>
<td>0.00</td>
<td>120.00</td>
<td>59.97</td>
<td>-5.00</td>
<td>1.00</td>
<td>-6.50</td>
<td>1.40</td>
<td>0.00</td>
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<tr>
<td>Tie Breaker 02</td>
<td>Close</td>
<td>Enabled</td>
<td>-1.60</td>
<td>21.58</td>
<td>-0.07</td>
<td>1.00</td>
<td>120.45</td>
<td>59.96</td>
<td>-3.00</td>
<td>1.00</td>
<td>-4.70</td>
<td>4.00</td>
<td>-5.90</td>
</tr>
</tbody>
</table>

**Autosync in Progress 121 sec**

### Automatic Generation Control

<table>
<thead>
<tr>
<th>Description</th>
<th>Controls</th>
<th>Setpoints</th>
<th>Status</th>
<th>Alarms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generator GT101A</td>
<td>Disabled</td>
<td>Droop SP</td>
<td>17.00</td>
<td>20.89</td>
</tr>
<tr>
<td>Generator GT101B</td>
<td>Disabled</td>
<td>Droop SP</td>
<td>15.60</td>
<td>18.00</td>
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<tr>
<td>Generator GT101C</td>
<td>Disabled</td>
<td>Droop SP</td>
<td>10.00</td>
<td>17.00</td>
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</tbody>
</table>

### Voltage Control System

<table>
<thead>
<tr>
<th>Description</th>
<th>Controls</th>
<th>Setpoints</th>
<th>Status</th>
<th>Alarms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generator GT101A</td>
<td>Disabled</td>
<td>Regulation</td>
<td>-2.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Generator GT101B</td>
<td>Disabled</td>
<td>Regulation</td>
<td>-2.00</td>
<td>3.00</td>
</tr>
<tr>
<td>Generator GT101C</td>
<td>Disabled</td>
<td>Regulation</td>
<td>-5.00</td>
<td>3.00</td>
</tr>
</tbody>
</table>
Generator – Capability
Generation Runback Philosophy

Contingency Detected (breaker trips)

Maximum Runback MW Set Point

30 MW (runback target MW load)

Signal Sent by Generation-Shedding System

60 MW (actual load)

MW

t
Automatic Synchronization

BACK SYNCHRONIZATION

GENERATOR AVR MANUAL MODE

SYNCHROSCOPE

BSR-A

<table>
<thead>
<tr>
<th>BUS 1B FREQUENCY</th>
<th>60 Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEC-A FREQUENCY</td>
<td>60 Hz</td>
</tr>
<tr>
<td>SLIP FREQUENCY</td>
<td>0</td>
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<tr>
<td>ANGLE DIFFERENCE</td>
<td>107</td>
</tr>
<tr>
<td>BUS 1B VOLTAGE</td>
<td>113.5 kV</td>
</tr>
<tr>
<td>SEC-A VOLTAGE</td>
<td>124.5 kV</td>
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</tbody>
</table>
Automatic Synchronization