UTILIZING IEC 61850 FOR A POWER MANAGEMENT SYSTEM OF AN OFFSHORE PLATFORM

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Overview of Topics

- Introduction
- Owner’s Challenges and Requirements
- Electrical Design of FPS Platform
- Power Management System (PMS) Design
- Load Shedding
- Load Inhibition
- Cyber Security
- PMS Testing
- Conclusions
A Floating Electrical Island
A Floating Electrical Island
No Connection to a Stable Utility Grid!

Generators

Large Motor Loads

Consumer Loads

Large Motor Loads

Generators
Owner’s Perspective

Challenges and Requirements

- Safety of Personnel
- Electrical Power is essential to Operations
- Balance of Generated and Consumed Power
- Maintaining Stability following loss of a Main Generator
- Maintaining Stability following loss of a Large Motor Load
- Avoid a Total Blackout!
Electrical Design

- Multiple Generators - Dual Fuel
- Combined Cycle (GTG+STG)
- N+1 Number of Generators
- Double-fed Switchgear Line-ups
- Avoid Single Failure impact on Operations
Stability – Balanced Electrical Power
Nominal Balance of Generated and Consumed Power
Stability – Balanced Electrical Power

Loss of Generation – Risk of Under-Frequency Trip!
Stability – Balanced Electrical Power

Loss of too much Load – Risk of Over-Frequency Trip!
PMS Design – Utilization of IEC 61850

Protocols

• MMS – Manufacturing Message Specification
  • Information and Commands from devices to HMI System
• GOOSE – Generic Object Oriented Substation Event
  • Relay – to – Relay Communications
  • Relay – to – PMS Controller Communications
• File Transfer – Fault Record transfer from Relays to Engineer Station
Open System Interconnection (OSI)
Open System Interconnection (OSI)

- GOOSE speed achieved by using only two layers
- Security benefits since non-routable
PMS Design – Communication Network
Fast - Power Based - Load Shedding

PMS Controllers

- GTG Status
- GTG Load
- STG Status
- STG Load

Spinning reserve

Arm Reset

Load IED

Load IED

Load IED

Load Status

Load Trip

Load Coast Stop

Start “Shedding”
Load Shedding – Key Principles

- Continuous Power Balance Calculation
  - Generated Power – Generator IEDs
  - Consumed Power – Motor and Switchgear IEDs
  - Spinning Reserve – Generator Local Controllers
- Fast Detection of Loss of Generation
- Selective Tripping of Loads
- Flexible Prioritization of Loads to be Shed
Start Inhibit for Large Motors

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Load Inhibition – Key Principles

- Prevent pre-defined motors to start, to avoid the overloading
- PMS will be continuously monitoring the spinning reserve
- Pre-defined list of loads will be programmed in the system
- Only one motor will be started at a time
- Compare the remaining generation capacity to the offline equipment rating, one by one
- In case that the motor rating is larger than the total spinning reserve PMS will inhibit starting specific motor(s)
Cyber Security

- Adherence to Owner’s Corporate IT Requirements
- The defined electronic security perimeter is maintained by segregating the PMS network from any other external networks
- Restricting user level access to the HMI based on user credentials, specifically the following three (3) levels:
  - Monitoring only
  - Control and Monitoring
  - Configuration Changes
Cyber Security – (Continued)

- After an elapsed time, the HMI returns to the so-called “kiosk” mode, which shows the simplified single-line screen in “view only” mode.
- Logging of system activities, i.e. event list with actions logged in.
- Segregation of the VLANs
- HMI Login for PMS is Integrated with Owner’s Corporate Network
Conclusions

An Effective PMS:

• Addresses Owner’s requirements
• Provides safety benefits
• Helps maintain stability during contingency events
• Highly available and easy to use
• Utilizes modern technologies
• Can facilitate project modifications without extensive work
• Adheres to Owner’s IT security requirements
• Offers Speed, Selectivity and Flexibility
Questions?