



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

Rick Preston

Rodrigo Munoz

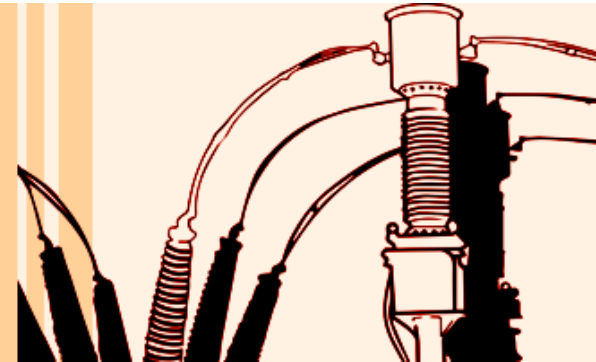
Louis Bevrotte

Quinton Houston



72nd Annual Conference for
***Protective Relay
Engineers***

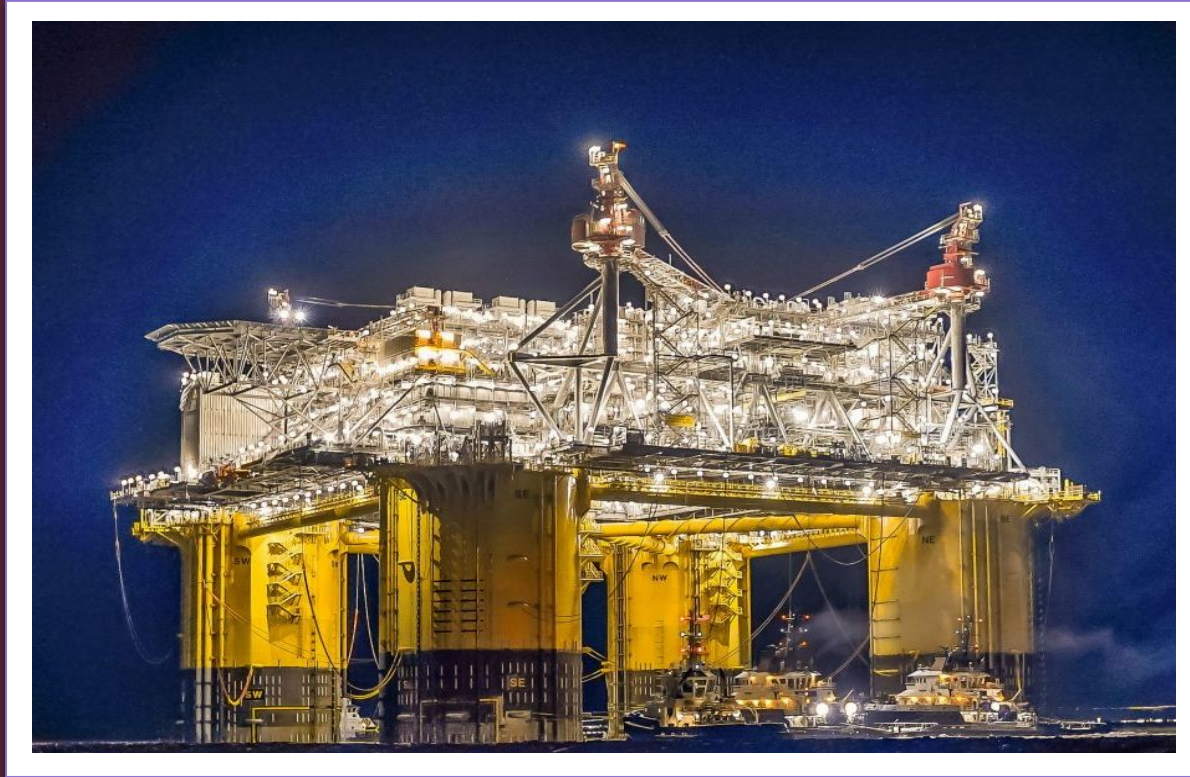
March 25–March 28, 2019



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

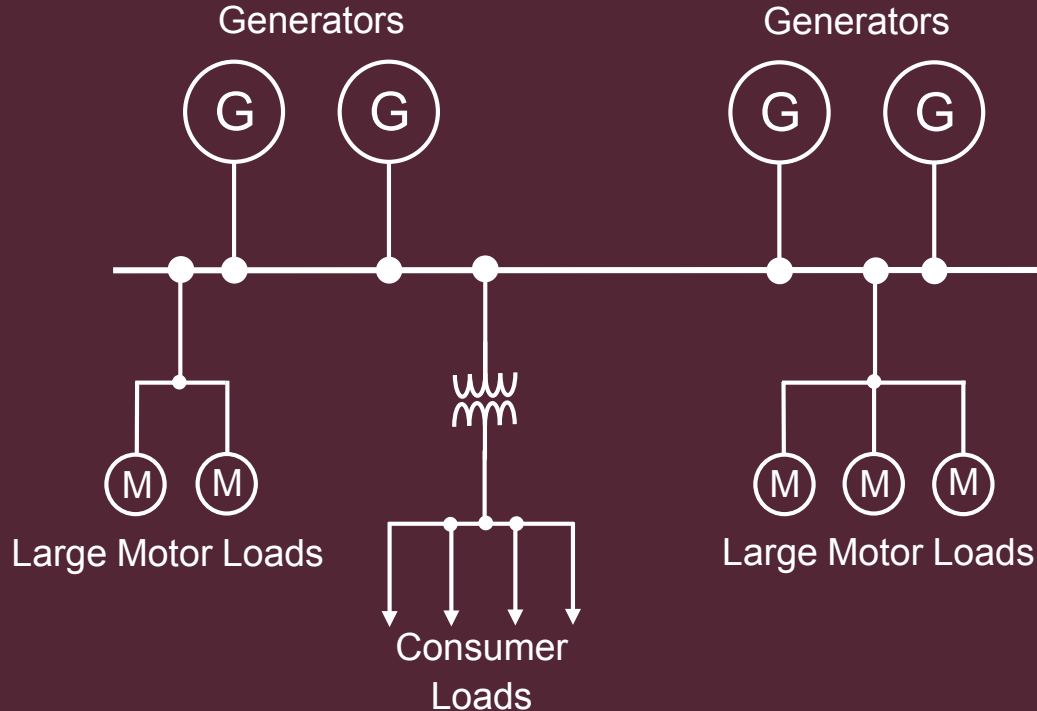
A Floating Electrical Island



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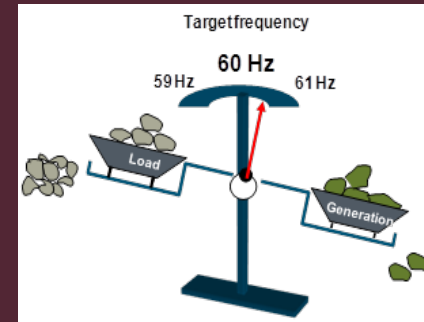
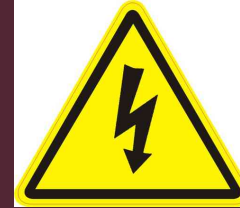
No Connection to a Stable Utility Grid!



Owner's Perspective

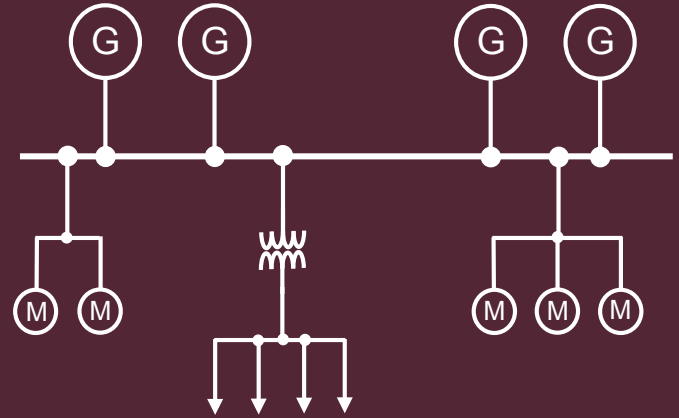
Challenges and Requirements

- 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!



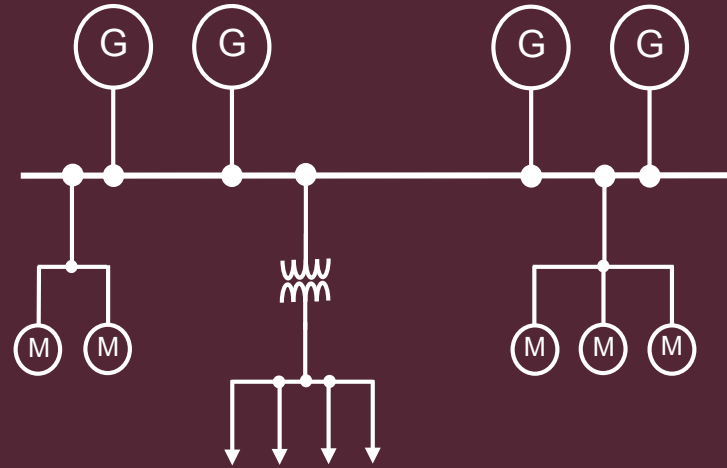
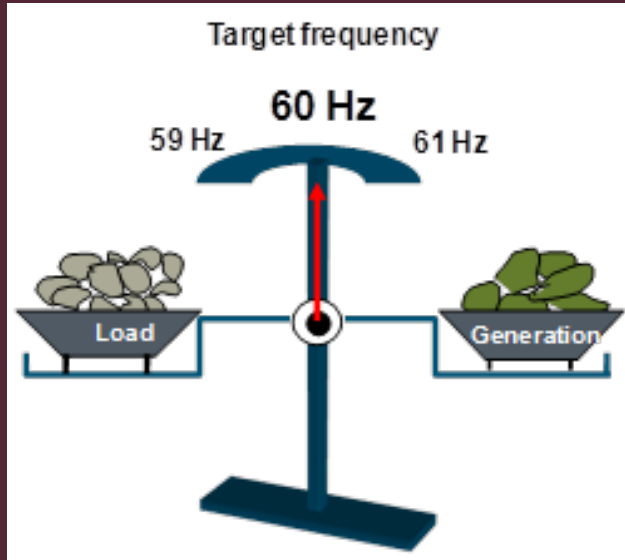
Electrical Design

- Multiple Generators - Dual Fuel
- Combined Cycle (GTG+STG)
- N+1 Number of Generators
- Double-fed Switchgear Line-ups
- Avoid Single Failure impact on Operations



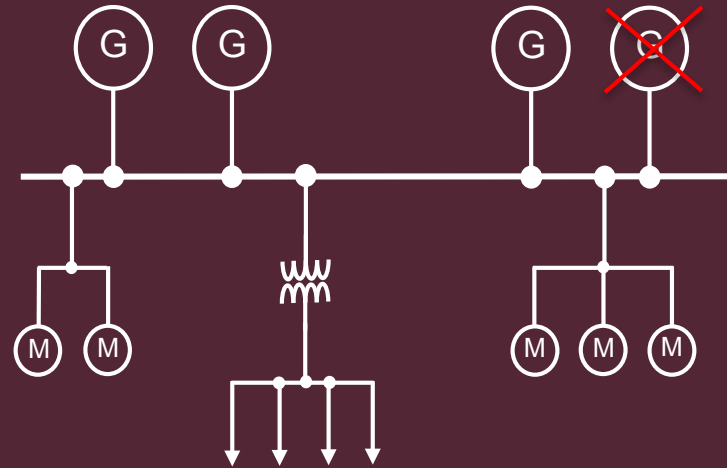
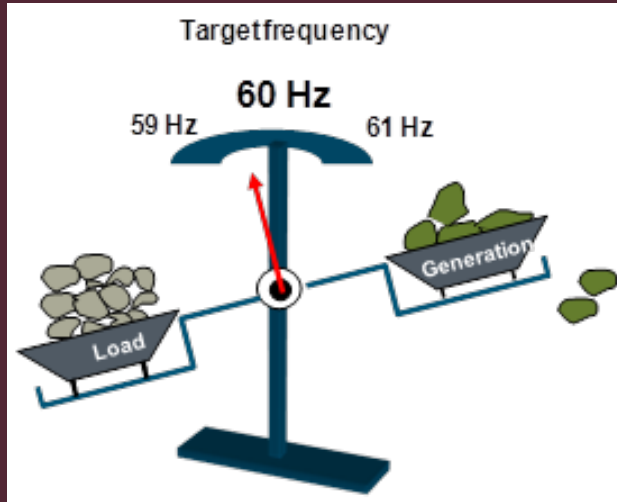
Stability – Balanced Electrical Power

Nominal Balance of Generated and Consumed Power



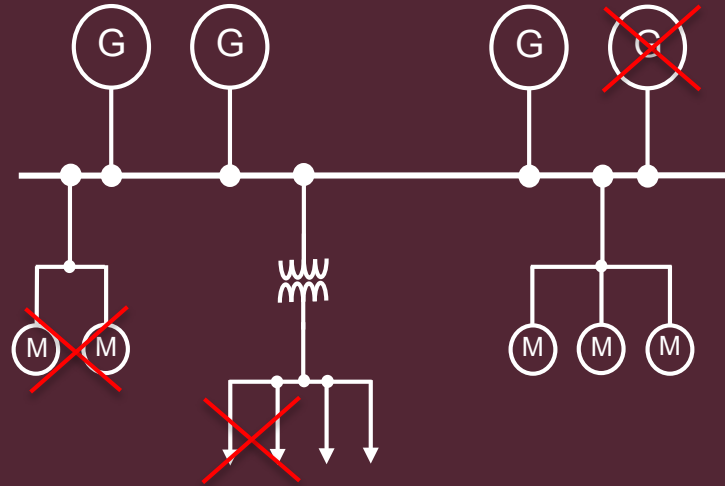
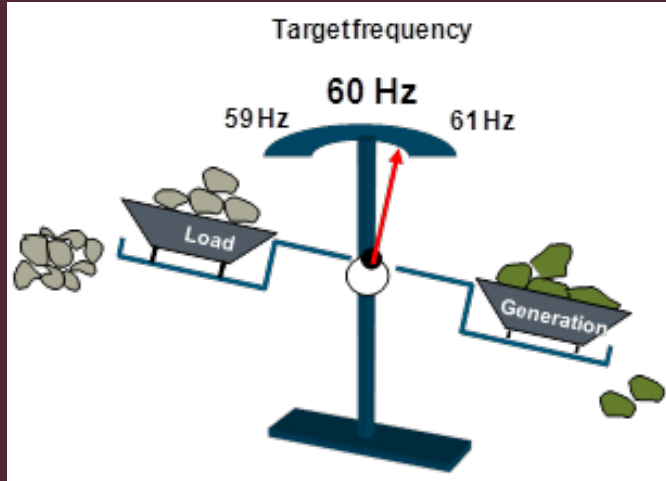
Stability – Balanced Electrical Power

Loss of Generation – Risk of Under-Frequency Trip!



Stability – Balanced Electrical Power

Loss of too much Load – Risk of Over-Frequency Trip!



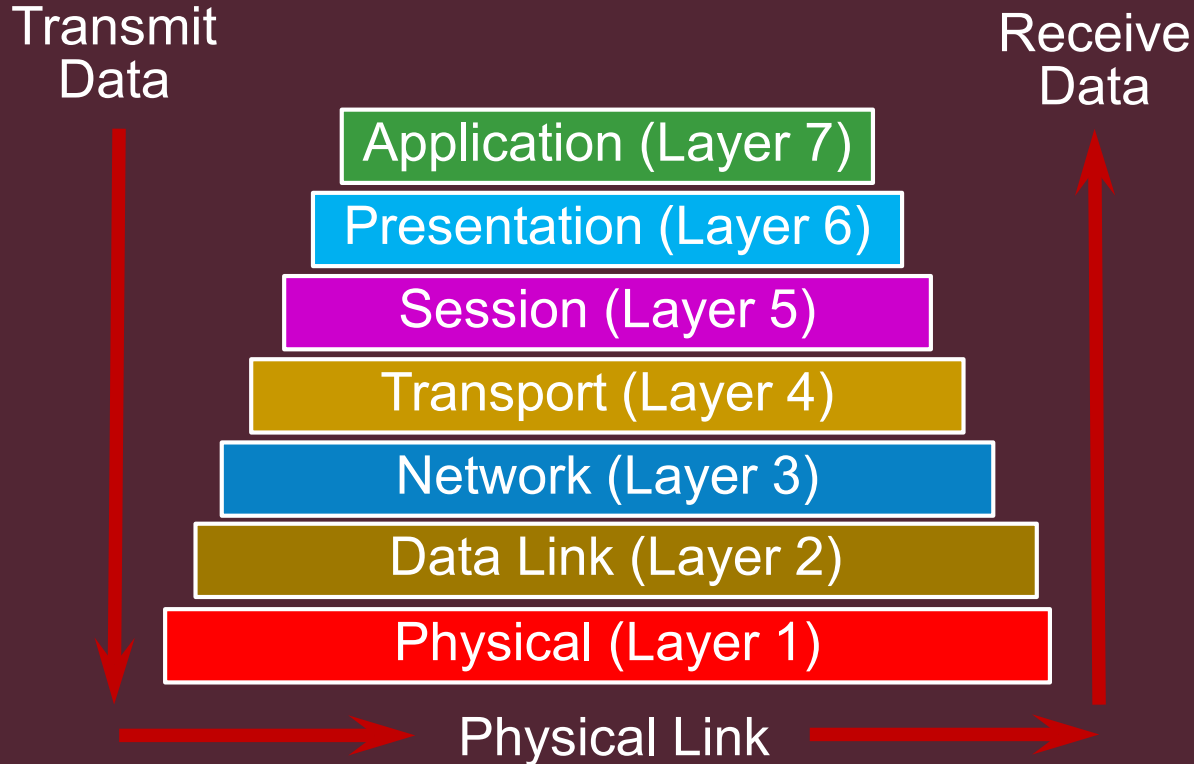
PMS Design – Utilization of IEC 61850

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

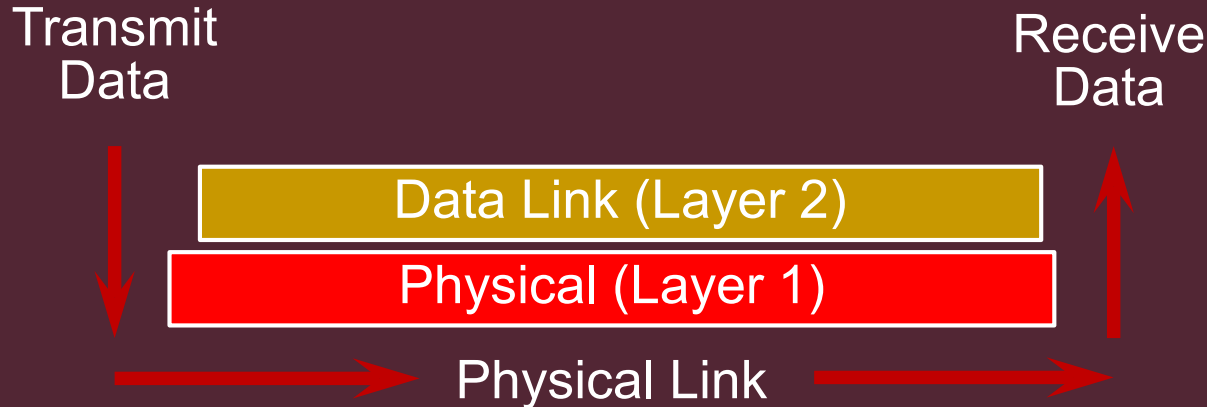


Open System Interconnection (OSI)

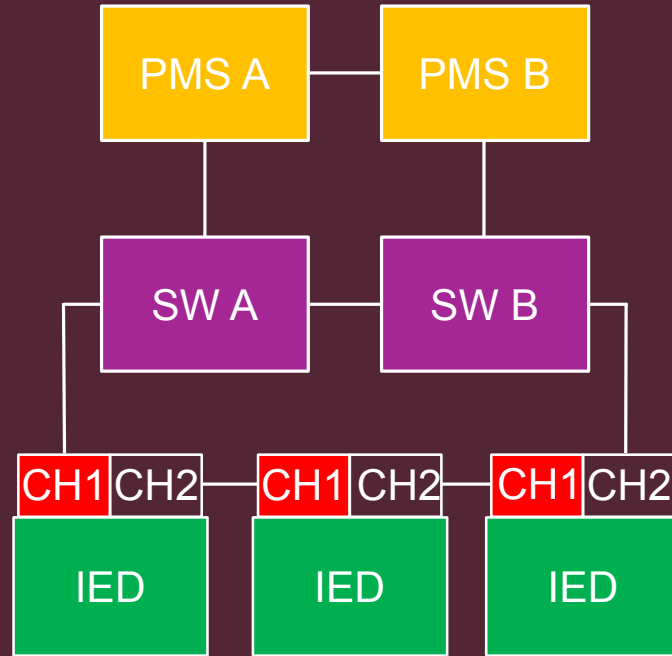


Open System Interconnection (OSI)

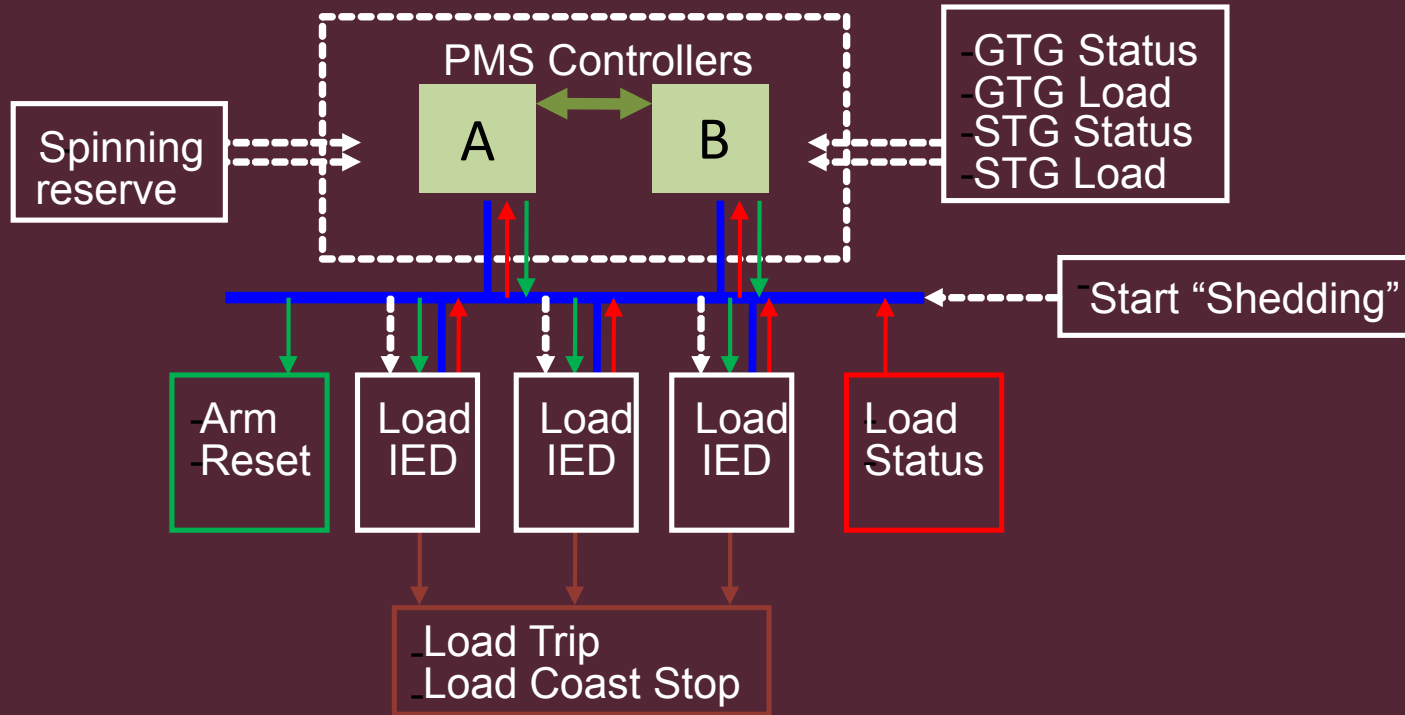
- GOOSE speed achieved by using only two layers
- Security benefits since non-routable



PMS Design – Communication Network



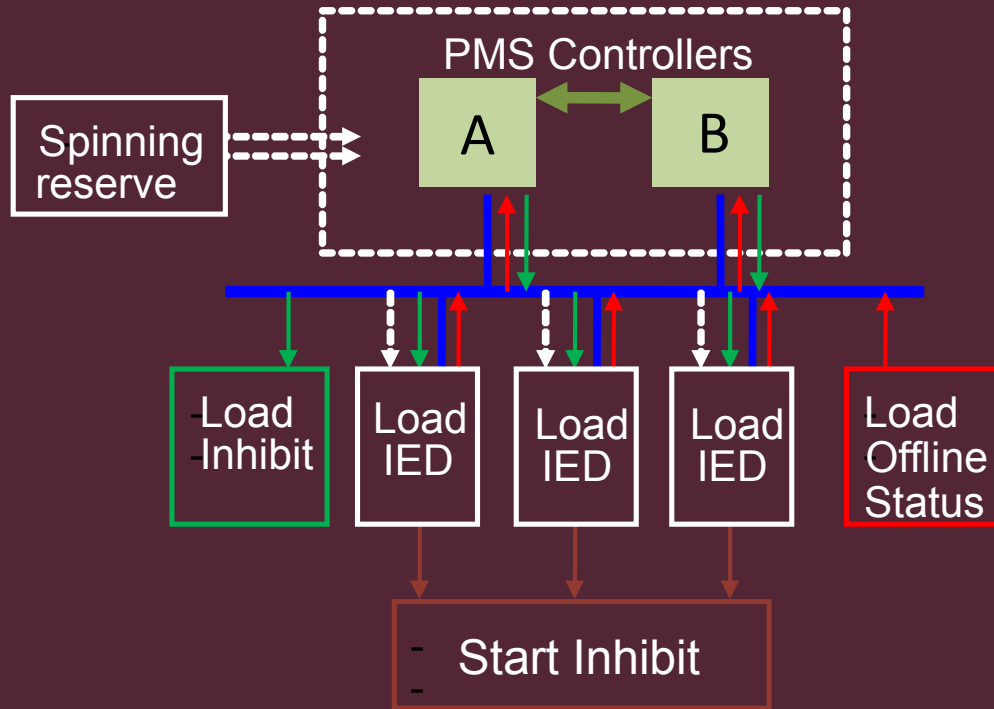
Fast - Power Based - Load Shedding



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



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?