Load Management Systems Critical Equipment for Successful CHP Projects

Presented by

CHA Consulting, Inc.

Saqib Khattak, P.Eng, M.Eng

Section Manager- High Voltage Electrical Group

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design/construction solutions

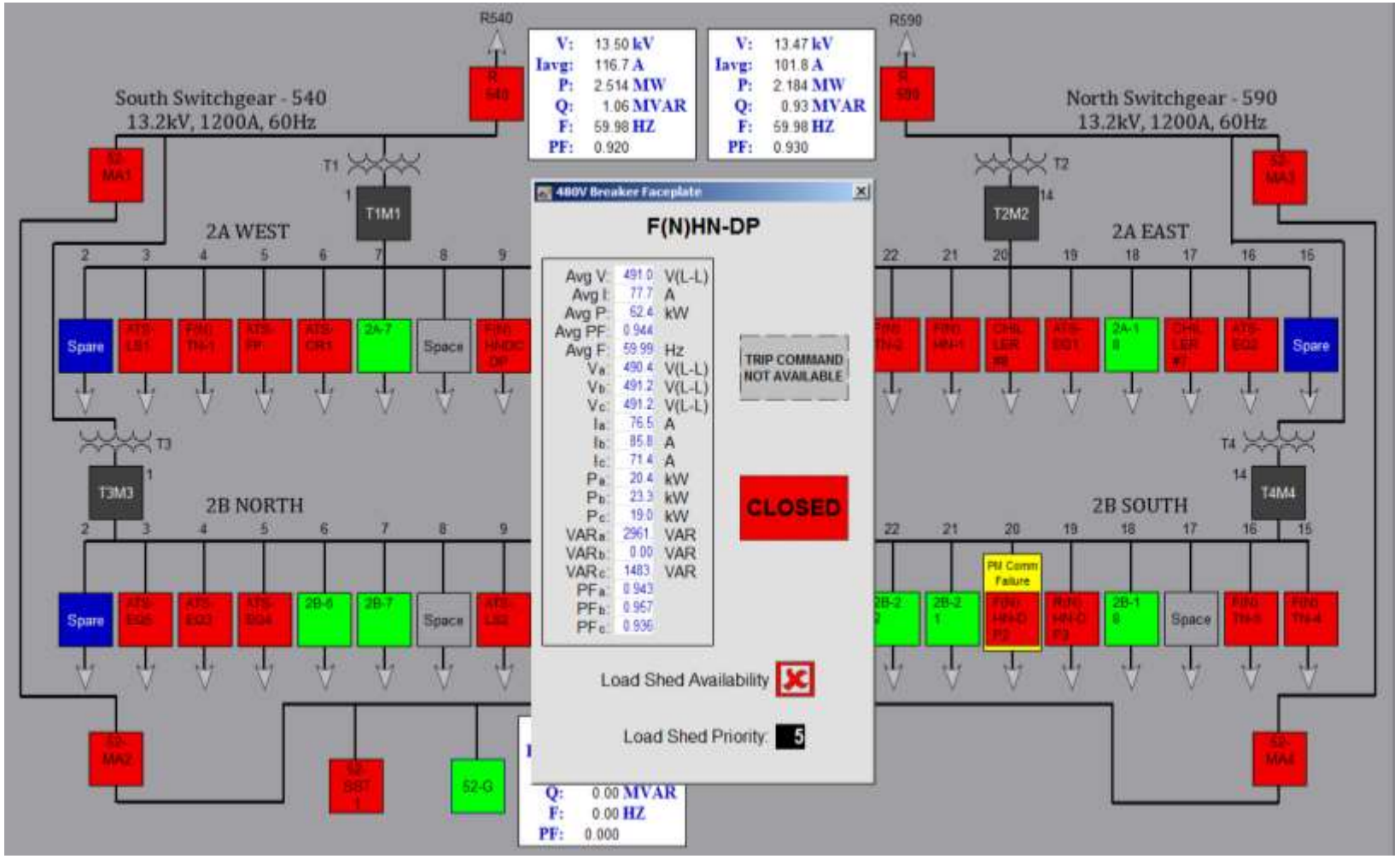
Introduction

- For successful CHP Projects LMS plays a very important role
- Key LMS features are Loadshedding, local and remote HMIs for better plant operations, Historian, Sequence of events recorder
- In a CHP design it is important to have bumpless transfers between the utility and generation and where utility permits close transitioning between buses.
- Successful islanding means upon utility outage the CHP unit survives load swings and stays on line without shutting out the entire facility.
- Integration into the plant existing system of any platform for example Siemens, delta V, Allan Bradley etc.

Overview

The following control are available through the HMI:

- Import / export control
- Emergency load shedding
- Under frequency load shedding
- Manually initiated automatic synchronization
- Automatic bus transfer
- Distribution system monitoring



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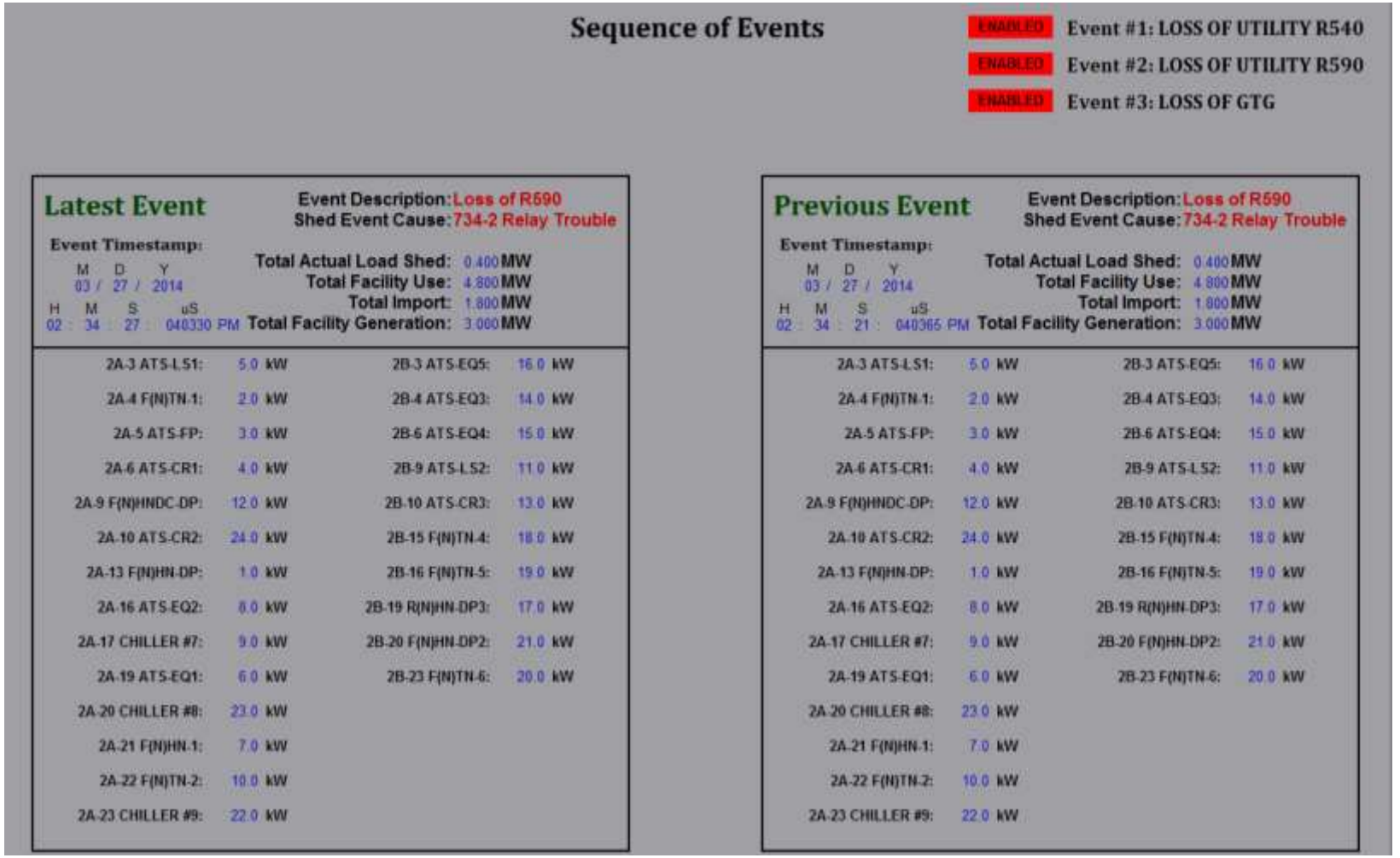
Overview

The following control are available through the HMI:

- Tap changer and protective relay control
- Spinning reserve calculations
- Topology management
- Communications
- General display functionality
- Alarm logging



Sequence of Events

ENABLED Event #1: LOSS OF UTILITY R540
ENABLED Event #2: LOSS OF UTILITY R590
ENABLED Event #3: LOSS OF GTG

Latest Event

Event Description: Loss of R590
Shed Event Cause: 734-2 Relay Trouble

Event Timestamp:
M 03 / D 27 / Y 2014
H 02 : M 34 : S 27 : uS 040330 PM

Total Actual Load Shed: 0.400 MW
Total Facility Use: 4.800 MW
Total Import: 1.800 MW
Total Facility Generation: 3.000 MW

2A-3 ATS-LS1:	5.0 kW	2B-3 ATS-EQ5:	16.0 kW
2A-4 F(N)TN-1:	2.0 kW	2B-4 ATS-EQ3:	14.0 kW
2A-5 ATS-FP:	3.0 kW	2B-6 ATS-EQ4:	15.0 kW
2A-6 ATS-CR1:	4.0 kW	2B-9 ATS-LS2:	11.0 kW
2A-9 F(N)HNDC-DP:	12.0 kW	2B-10 ATS-CR3:	13.0 kW
2A-10 ATS-CR2:	24.0 kW	2B-15 F(N)TN-4:	18.0 kW
2A-13 F(N)HN-DP:	1.0 kW	2B-16 F(N)TN-5:	19.0 kW
2A-16 ATS-EQ2:	8.0 kW	2B-19 R(N)HN-DP3:	17.0 kW
2A-17 CHILLER #7:	9.0 kW	2B-20 F(N)HN-DP2:	21.0 kW
2A-19 ATS-EQ1:	6.0 kW	2B-23 F(N)TN-6:	20.0 kW
2A-20 CHILLER #8:	23.0 kW		
2A-21 F(N)HN-1:	7.0 kW		
2A-22 F(N)TN-2:	10.0 kW		
2A-23 CHILLER #9:	22.0 kW		

Previous Event

Event Description: Loss of R590
Shed Event Cause: 734-2 Relay Trouble

Event Timestamp:
M 03 / D 27 / Y 2014
H 02 : M 34 : S 21 : uS 040365 PM

Total Actual Load Shed: 0.400 MW
Total Facility Use: 4.800 MW
Total Import: 1.800 MW
Total Facility Generation: 3.000 MW

2A-3 ATS-LS1:	5.0 kW	2B-3 ATS-EQ5:	16.0 kW
2A-4 F(N)TN-1:	2.0 kW	2B-4 ATS-EQ3:	14.0 kW
2A-5 ATS-FP:	3.0 kW	2B-6 ATS-EQ4:	15.0 kW
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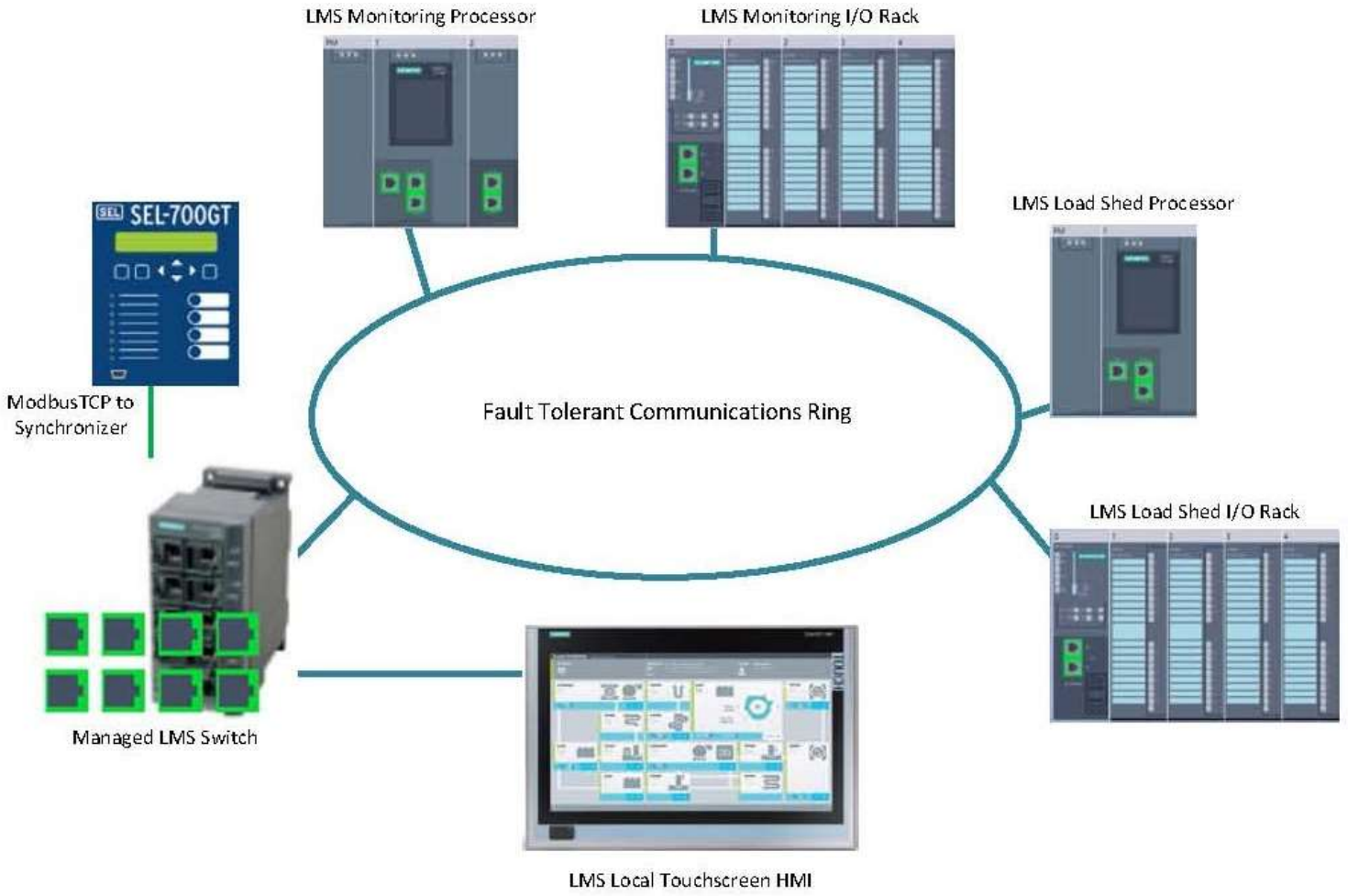
2A-23 CHILLER #9:	22.0 kW		

Communications

- All the protective relays and Metering devices are connected to the LMS via Ethernet switch
- EtherNet/IP is used for communication between the LMS monitoring controller, local HMI, Generator control system, and the remote I/O rack.
- The LMS system communicates to various kinds of power meters over Modbus RS485. to report apparent power, active power, reactive power, power factor, voltages, currents, and frequencies
- Modbus is an open Master/Slave application protocol that can be used on several different physical layers. Modbus-TCP means that the Modbus protocol is used on top of Ethernet-TCP/IP. The LMS communicates to modern SEL/GE etc. devices through this protocol.
- The ControlNet network allows the monitoring and load shed processors to communicate with each other

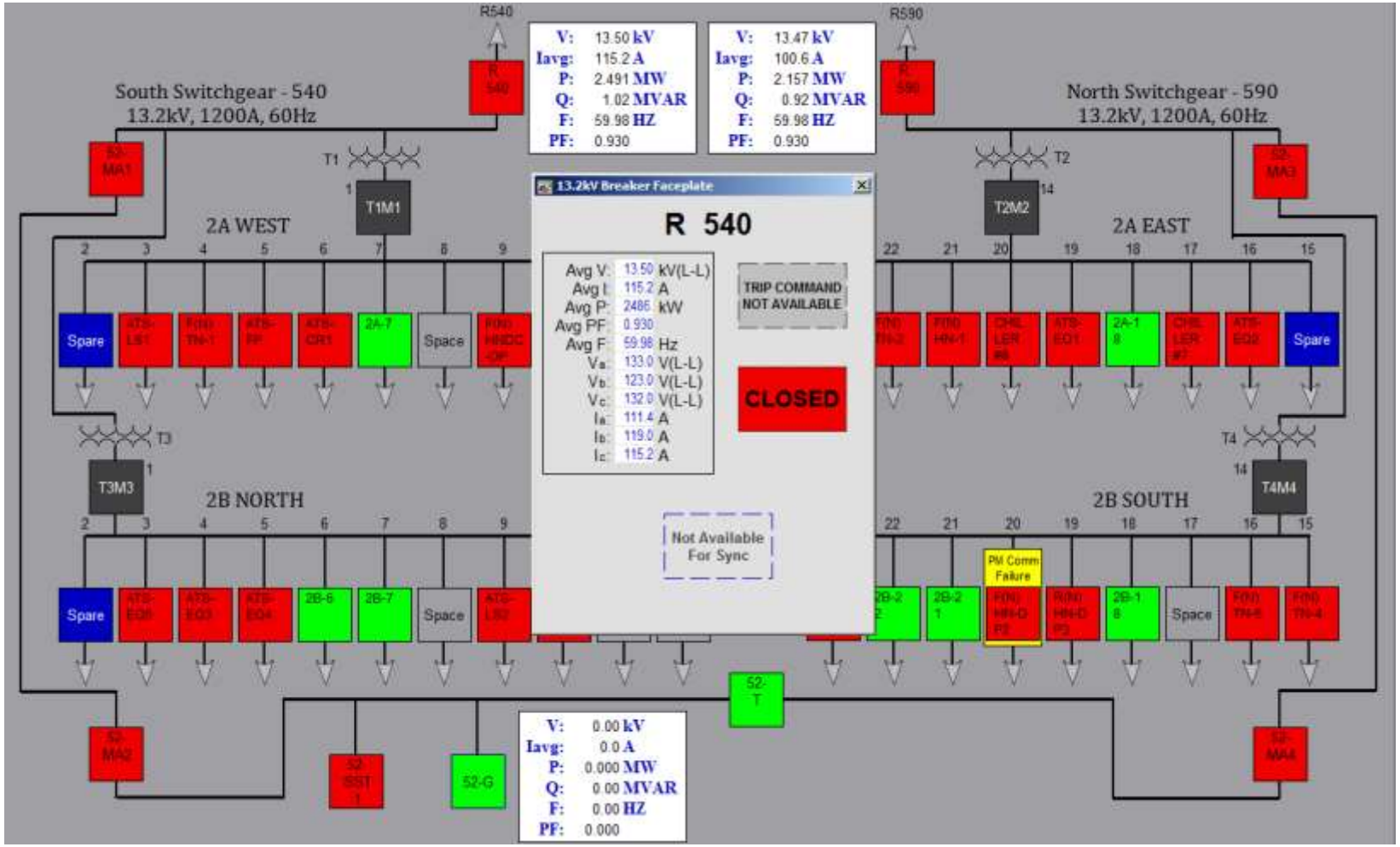
Typical System Architecture



Synchronization

- Synchronizer can be a SEL 700GT or a CGCM (Combination Generator Control Module)
- One synchronizer can synchronize multiple breakers.
- Synchronization of multiple breakers can be achieved via drive relays and feed the synchronizer with the PTs associated to the synch. breaker.
- Sync Voltage High/ Low Limit (1 % Typical)
- Frequency Match Error Limit (+/- .04Hz Typical)
- Sync Frequency High/ Low Limit (.2 Hz/0.02Hz Typical)
- Timed Delay (5 Seconds Typical)
- Sync Phase High/ Low Limit (+5 Deg./-5 Deg. Typical)
- Phase Match Error Rate of Change Limit (1 Degree per second Typical)

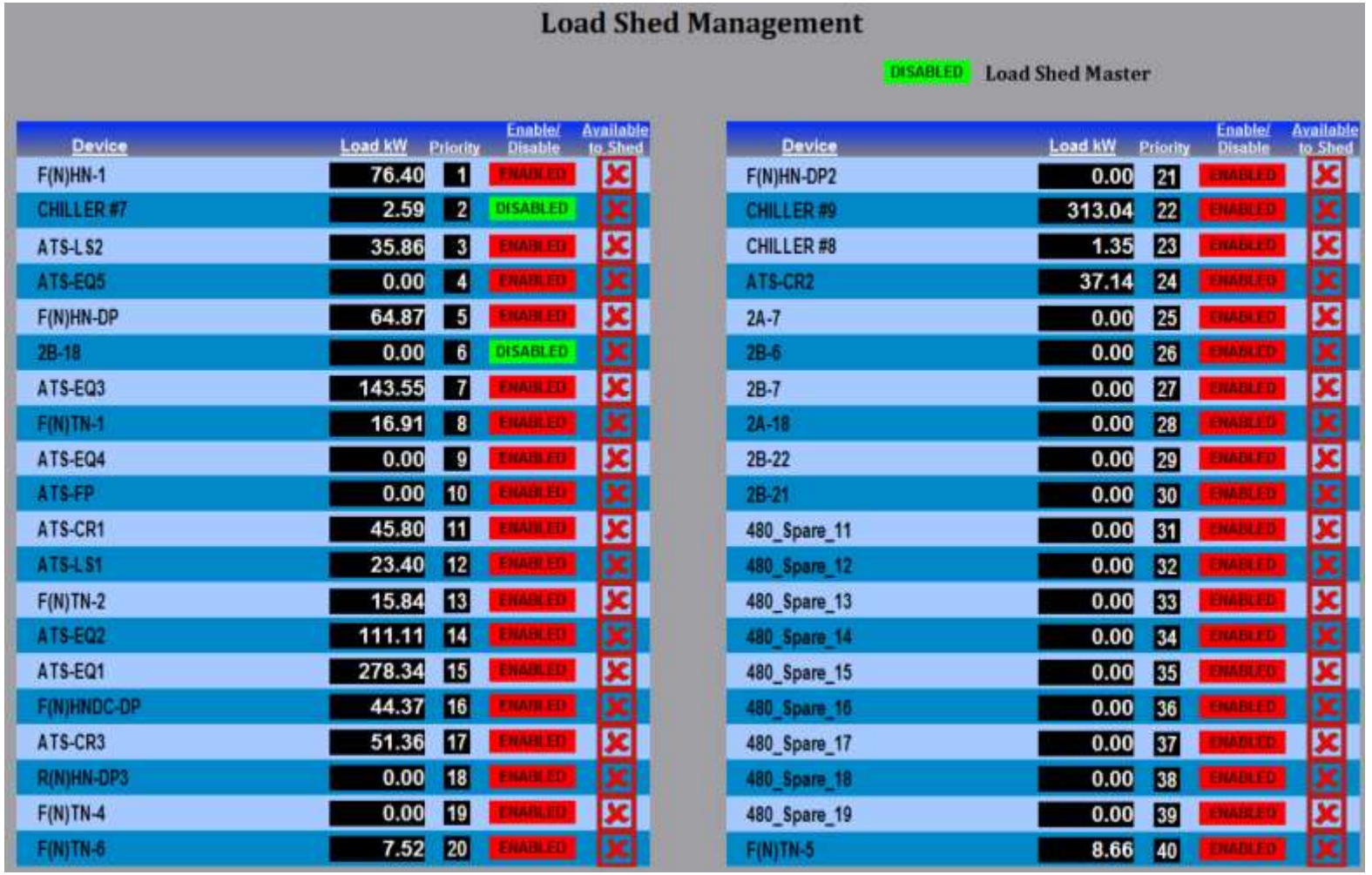
Synchronization



Loadshed

- For Loadshed all the feeder breaker metering data is required.
- Loadshed happens once the facility is running in islanded operation.
- Loadshed can be frequency based or capacity based.
- The LMS will take into consideration the distribution topology so that loads that have been shed do not affect other loads on its partnered bus.
- The system topology allows the LMS to know the bus and electrical load distribution connection states.
- Various breaker statuses are monitored to determine the connection state of each load and bus.
- Loadshedding can be prioritized based on operator's selectivity and operational requirements.
- During a load shed event the LMS reacts within 38 milliseconds to shed as many loads needed to retain the configured amount of spinning reserve.

Loadshed Management



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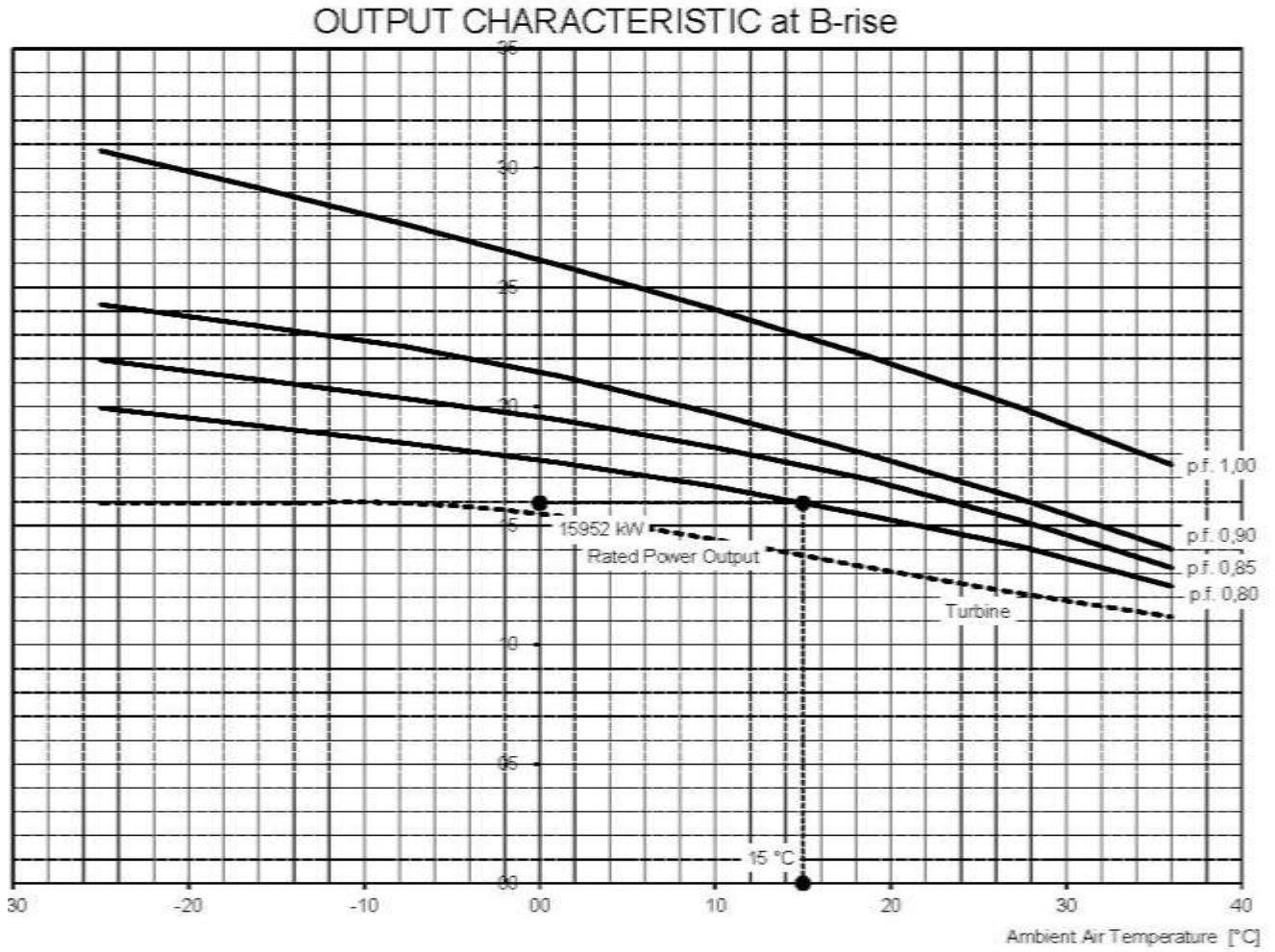
Spinning Reserve

Load Shed MW =

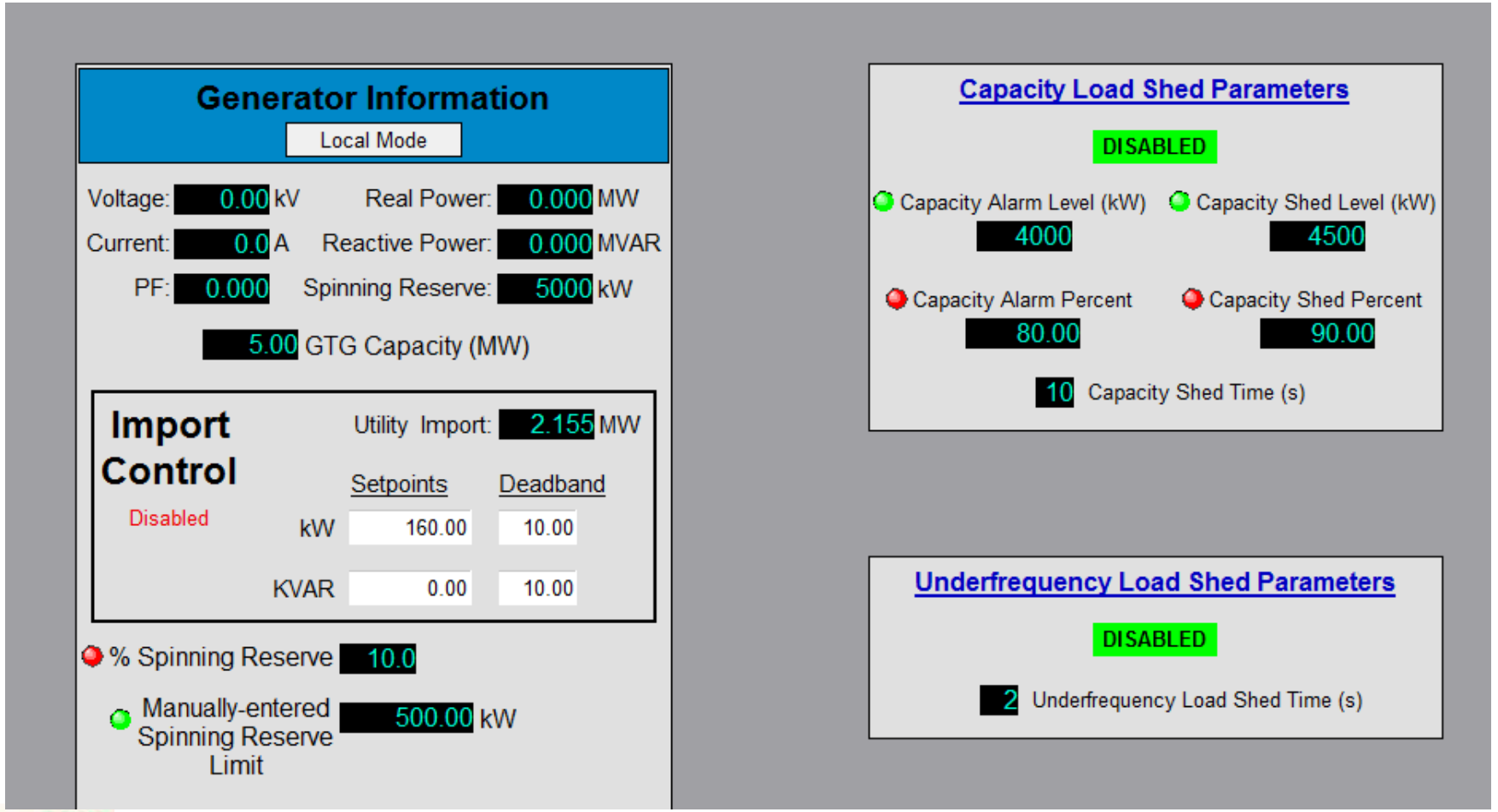
(Loss of critical source MW + GEN Power Generated) – (GEN Capacity - Spinning Reserve)



Import Export Control

- The LMS controls the amount of import power from the utility. This utility import power is controlled by maintaining the power output of the Generator.
- The LMS compares the import power of the utility breaker with the configured deadband and will raise/lower the frequency and voltage of the Generator to regulate the import power.
- Raise and lower pulses will continue until the import power is within the specified deadband.
- In order for the raise and lower signals to control the genset, the genset must be in “remote” mode.
- Import control will not allow a kW setpoint to be less than 100 kW.
- The operator has the ability to select between import control and base-load control from the HMI. Base-load control will allow the operator to control the GTG at a constant load output

Import Export Control Screen



Conclusion

- LMS helps in the import/export control of Power between the grid and CHP facility.
- LMS helps in successfully islanding the Cogeneration facility by accurately calculating loads vs generation and decides if loadshedding is required or not.
- Calculation of available generation in comparison to facility using the generator capability curve, thus making the system very dynamic.
- Integration of Utility RTU and making the points available to be communicated to the RTU
- Serves as a local SCADA system for the operators
- One stop shop where all the information is available for the operators to make decisions and control critical equipment
- No worries of Arc Flash factor, since the operator is able to operate breakers at the LMS HMI located remotely.

Thank You.

For more information, please contact:

Saqib Khattak, P.Eng, M.Eng
Section Manager – High Voltage Electrical Group
p. 289-273-7179
e. skhattak@chacompanies.com

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design/construction solutions