Load Management Systems Critical Equipment for Successful CHP Projects

Presented by

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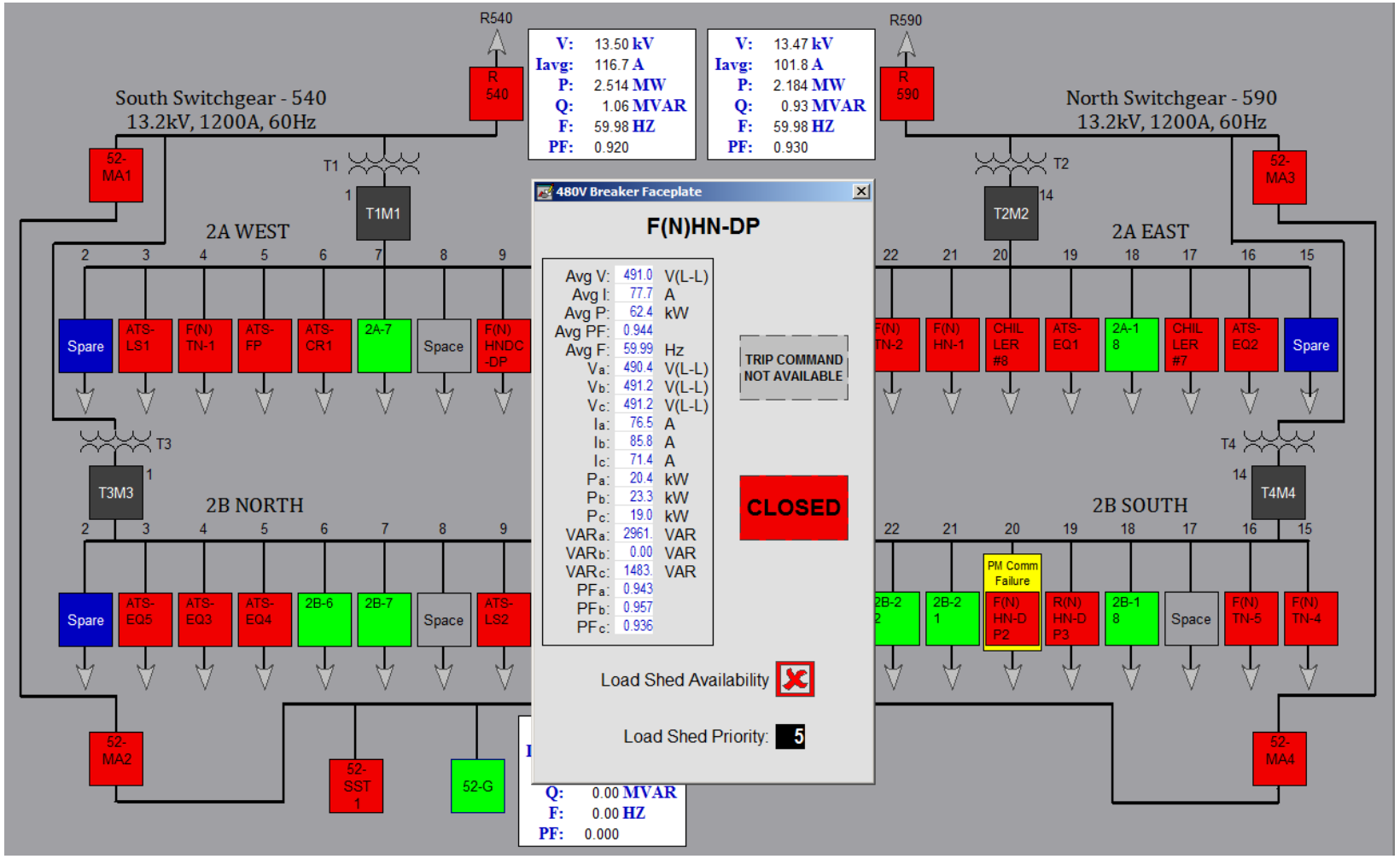
CHA design/construction solutions

Overview

The following control are available through the HMI:

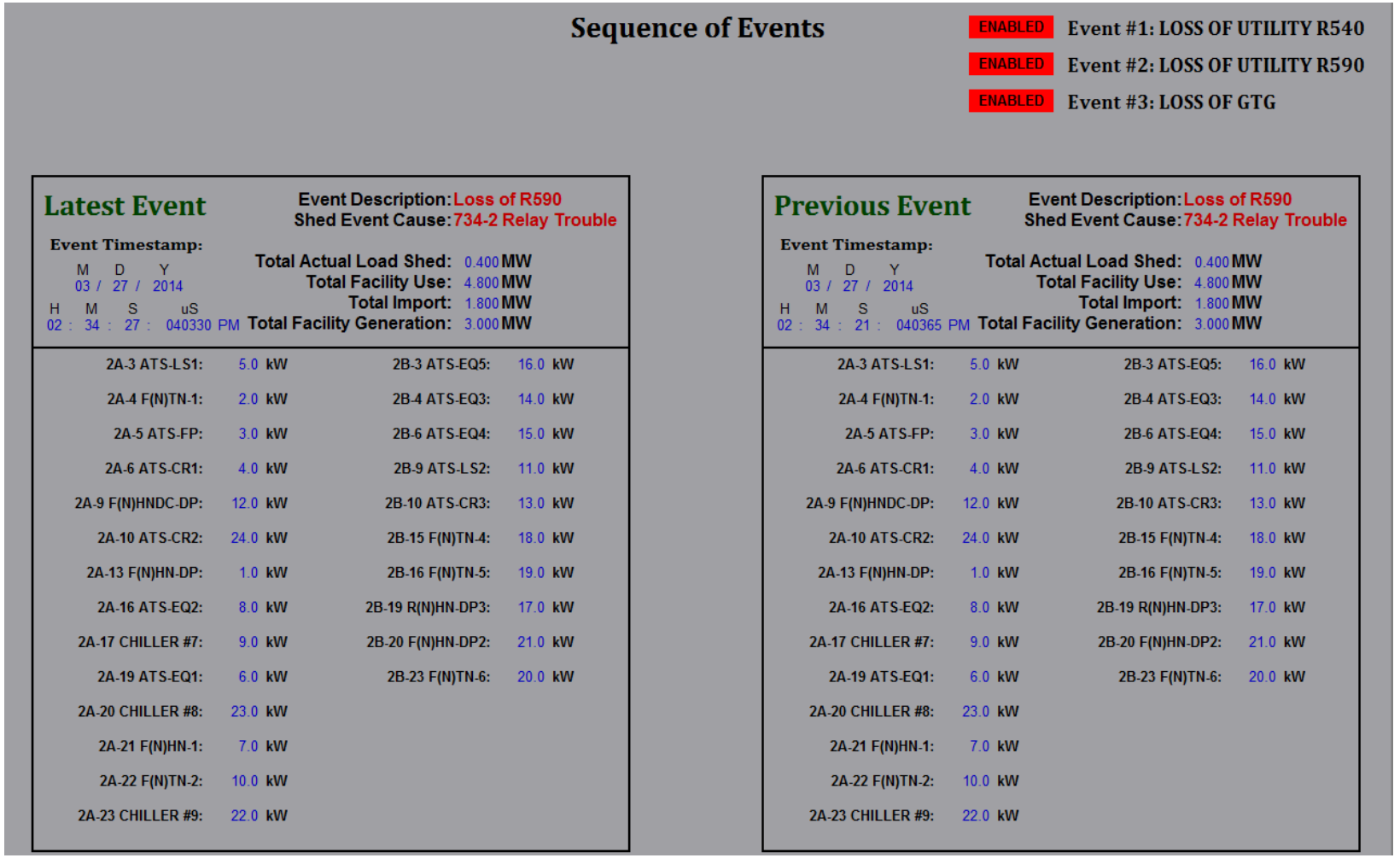
- Import / export control
- Emergency load shedding
- Under frequency load shedding
- Manually initiated automatic synchronization
- Automatic bus transfer
- Distribution system monitoring



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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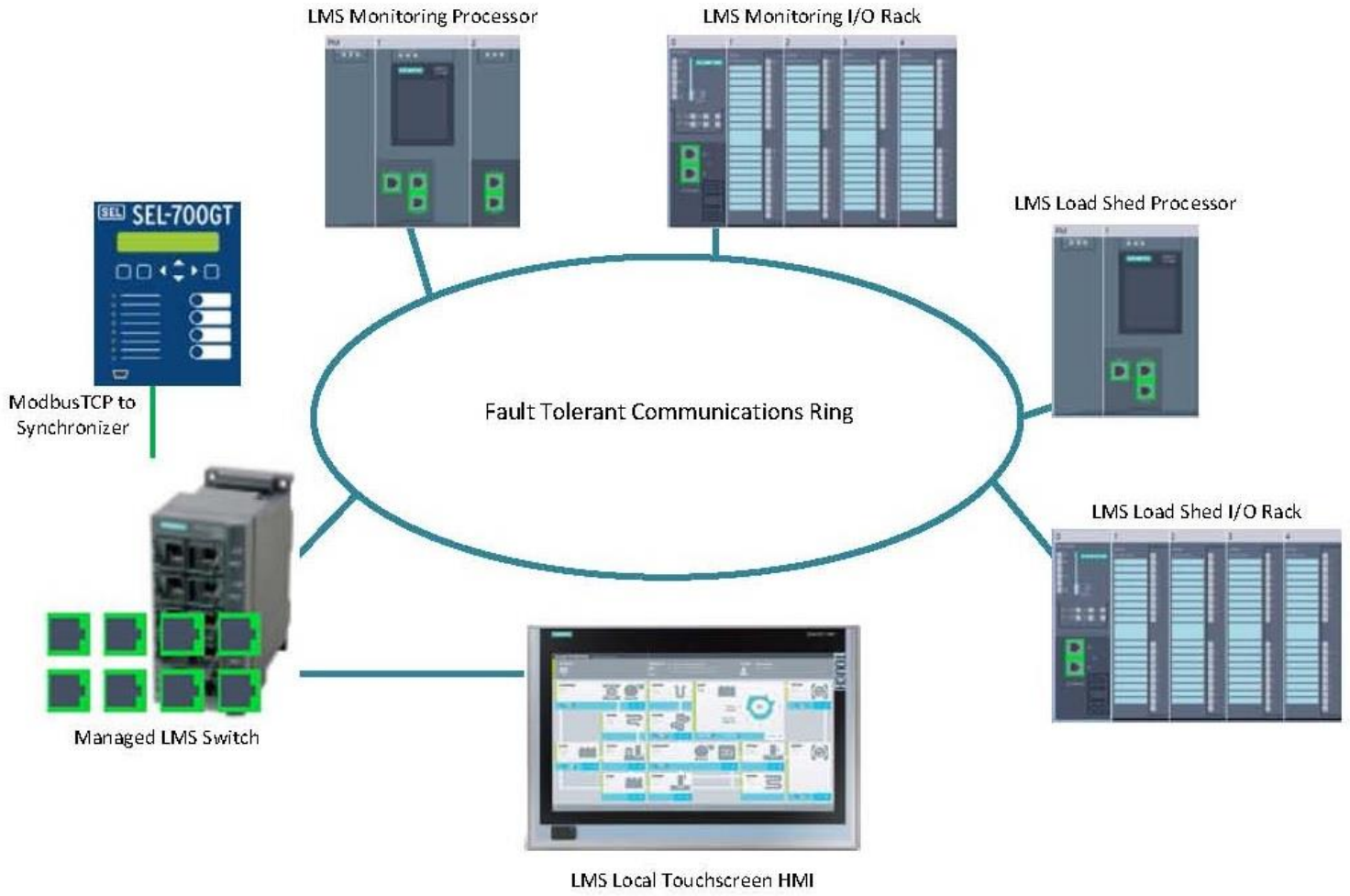
2A-22 F(N)TN-2:	10.0 kW		
2A-23 CHILLER #9:	22.0 kW		

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

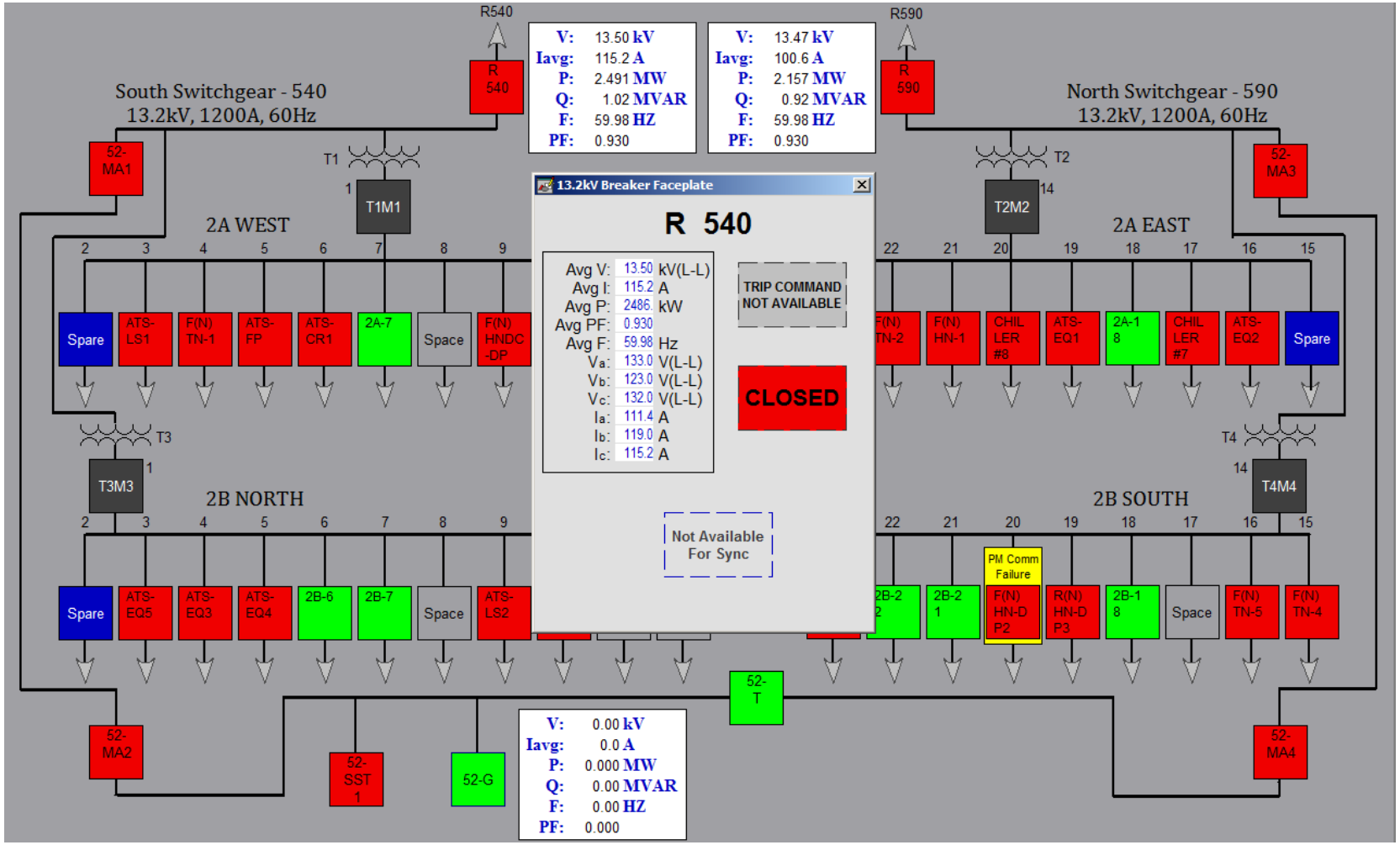
Typical System Architecture



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)

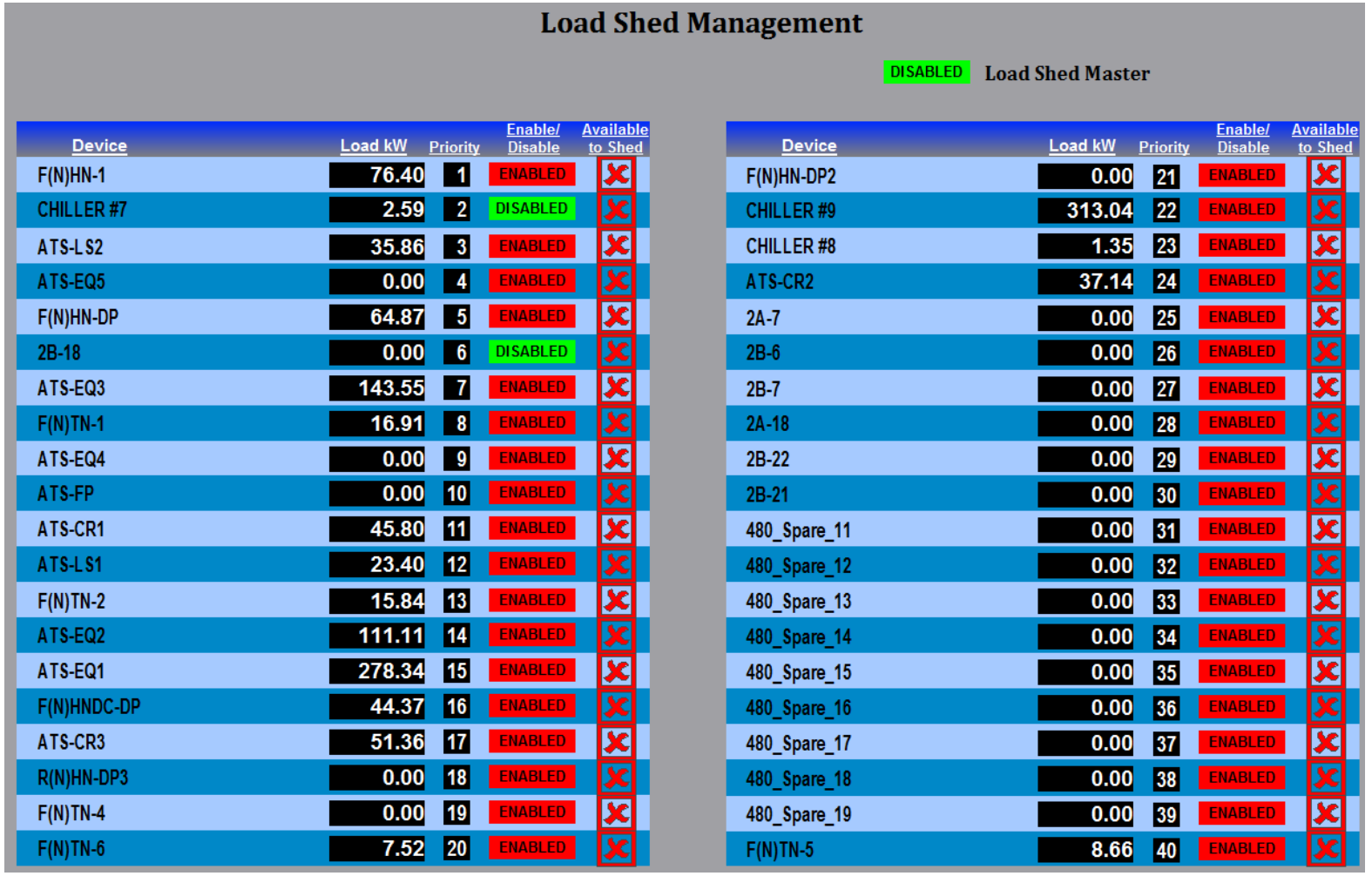
Synchronization



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



Load Shed Management

DISABLED Load Shed Master

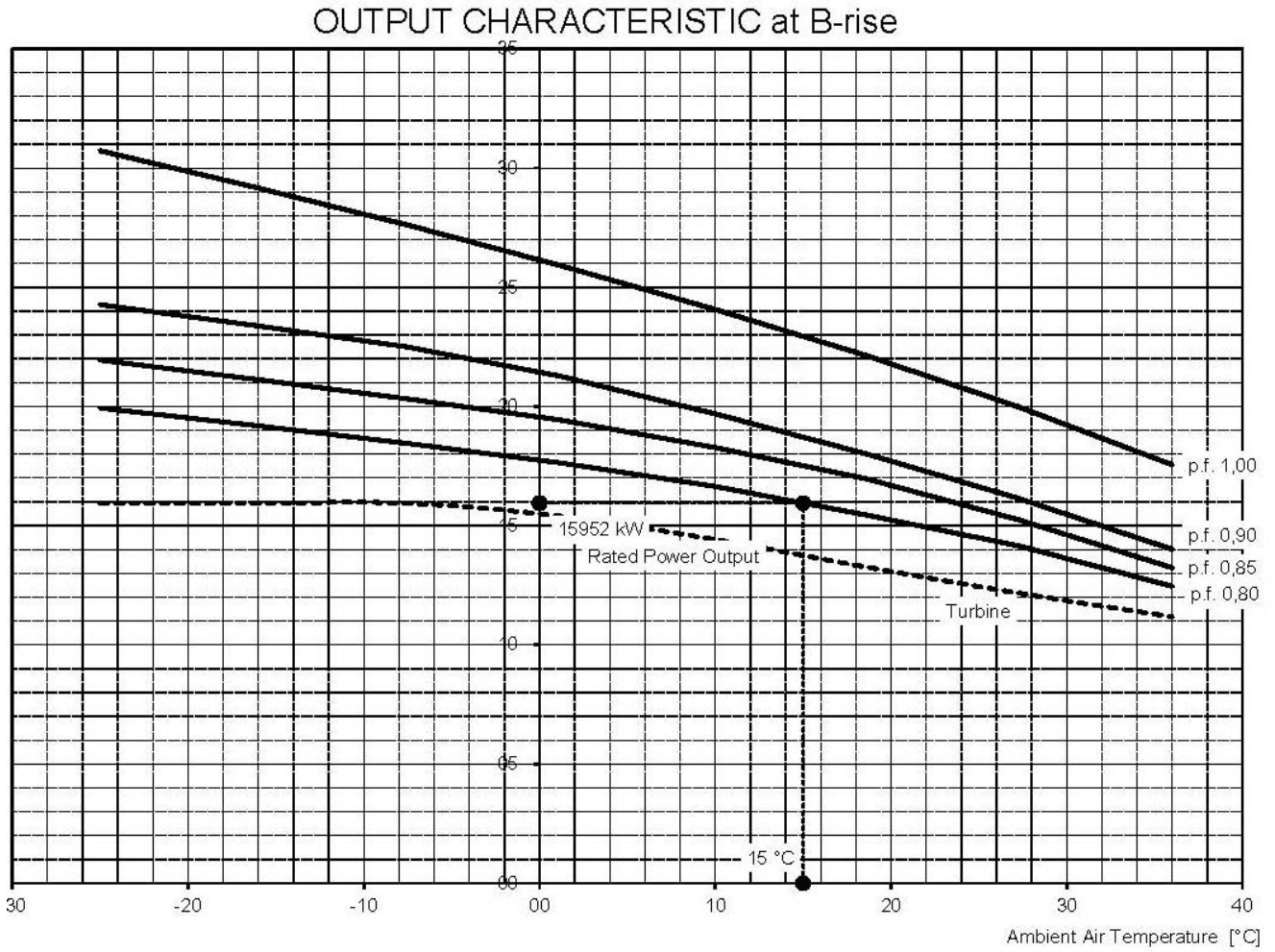
Device	Load kW	Priority	Enable/ Disable	Available to Shed
F(N)HN-1	76.40	1	ENABLED	
CHILLER #7	2.59	2	DISABLED	
ATS-LS2	35.86	3	ENABLED	
ATS-EQ5	0.00	4	ENABLED	
F(N)HN-DP	64.87	5	ENABLED	
2B-18	0.00	6	DISABLED	
ATS-EQ3	143.55	7	ENABLED	
F(N)TN-1	16.91	8	ENABLED	
ATS-EQ4	0.00	9	ENABLED	
ATS-FP	0.00	10	ENABLED	
ATS-CR1	45.80	11	ENABLED	
ATS-LS1	23.40	12	ENABLED	
F(N)TN-2	15.84	13	ENABLED	
ATS-EQ2	111.11	14	ENABLED	
ATS-EQ1	278.34	15	ENABLED	
F(N)HNDC-DP	44.37	16	ENABLED	
ATS-CR3	51.36	17	ENABLED	
R(N)HN-DP3	0.00	18	ENABLED	
F(N)TN-4	0.00	19	ENABLED	
F(N)TN-6	7.52	20	ENABLED	

Device	Load kW	Priority	Enable/ Disable	Available to Shed
F(N)HN-DP2	0.00	21	ENABLED	
CHILLER #9	313.04	22	ENABLED	
CHILLER #8	1.35	23	ENABLED	
ATS-CR2	37.14	24	ENABLED	
2A-7	0.00	25	ENABLED	
2B-6	0.00	26	ENABLED	
2B-7	0.00	27	ENABLED	
2A-18	0.00	28	ENABLED	
2B-22	0.00	29	ENABLED	
2B-21	0.00	30	ENABLED	
480_Spare_11	0.00	31	ENABLED	
480_Spare_12	0.00	32	ENABLED	
480_Spare_13	0.00	33	ENABLED	
480_Spare_14	0.00	34	ENABLED	
480_Spare_15	0.00	35	ENABLED	
480_Spare_16	0.00	36	ENABLED	
480_Spare_17	0.00	37	ENABLED	
480_Spare_18	0.00	38	ENABLED	
480_Spare_19	0.00	39	ENABLED	
F(N)TN-5	8.66	40	ENABLED	

Spinning Reserve

Load Shed MW =

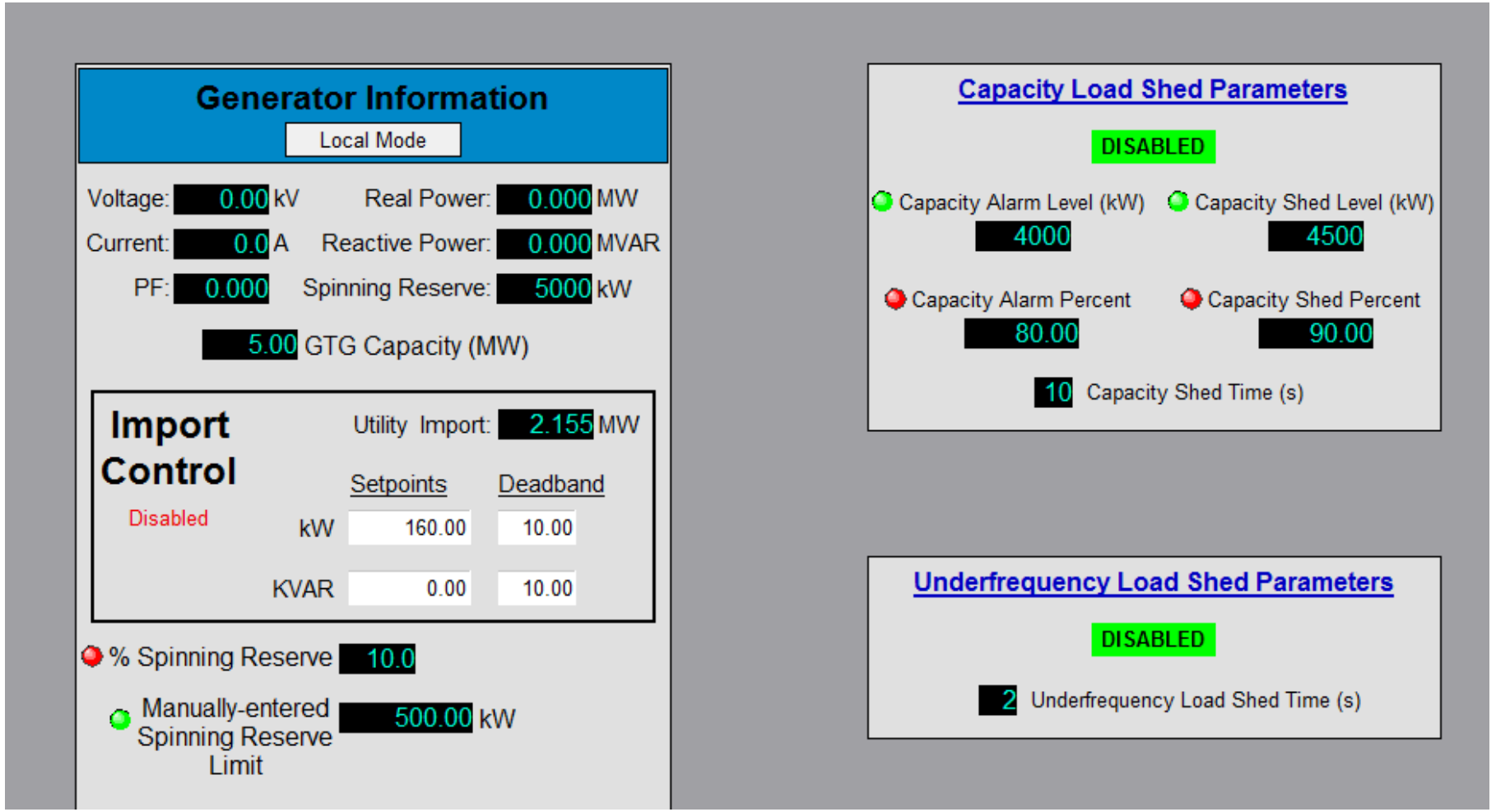
(Loss of critical source MW + GEN Power Generated) – (GEN Capacity - Spinning Reserve)



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



Thank You.

For more information, please contact:

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