



POWERMAX[®] ['pou (ə)r 'maks] *noun*:
a system designed to maintain stability

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SPS Branch of SEL Engineering Services Inc.



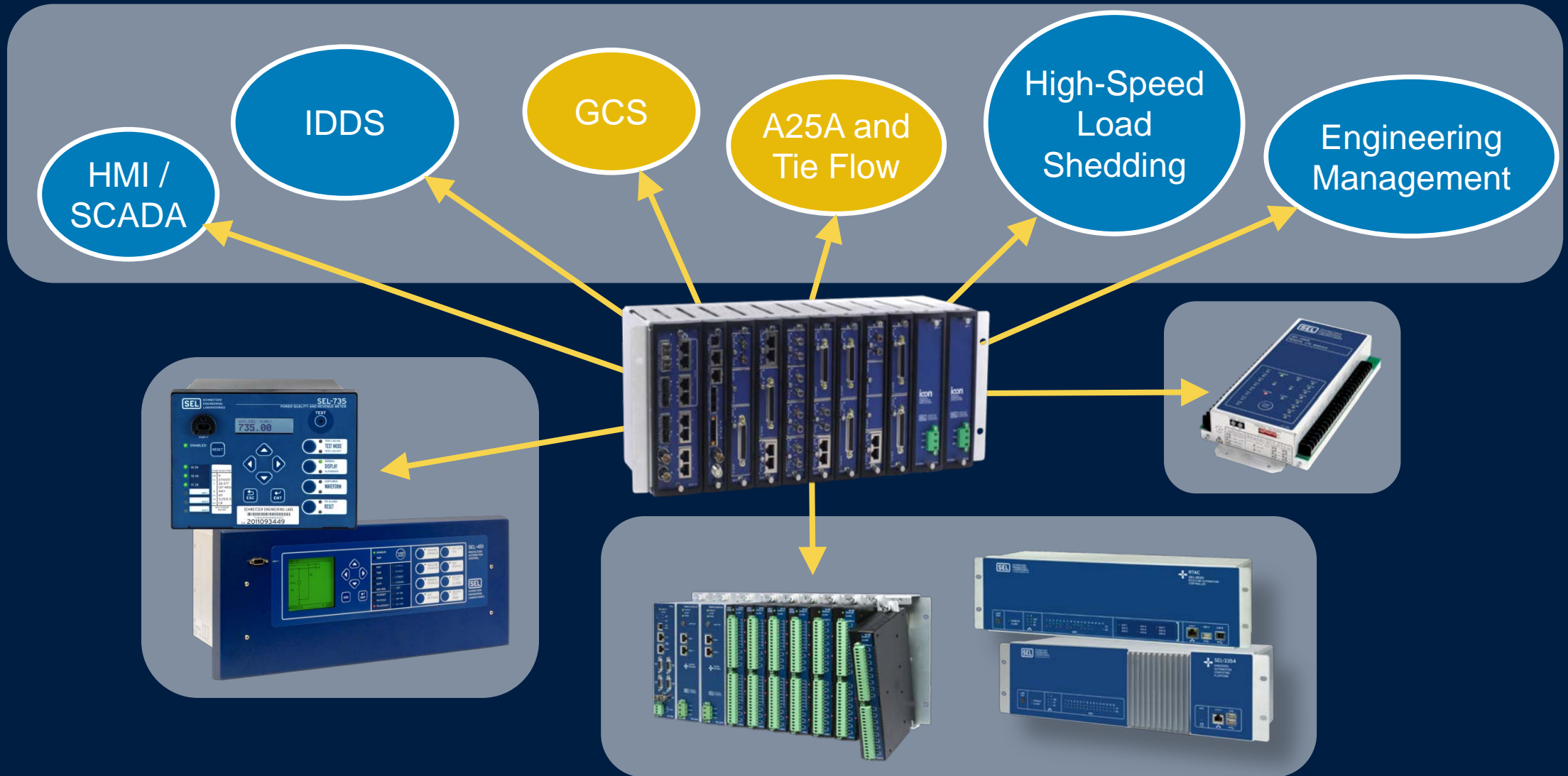
Agenda

- 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



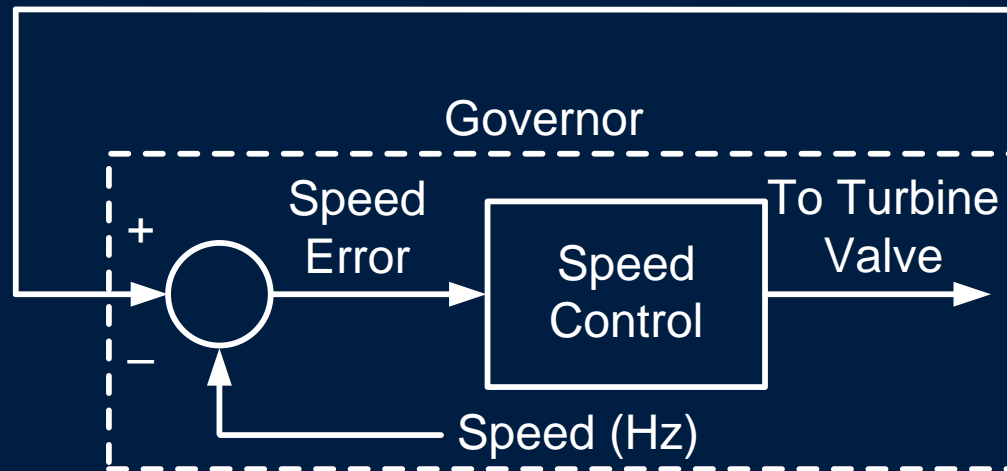
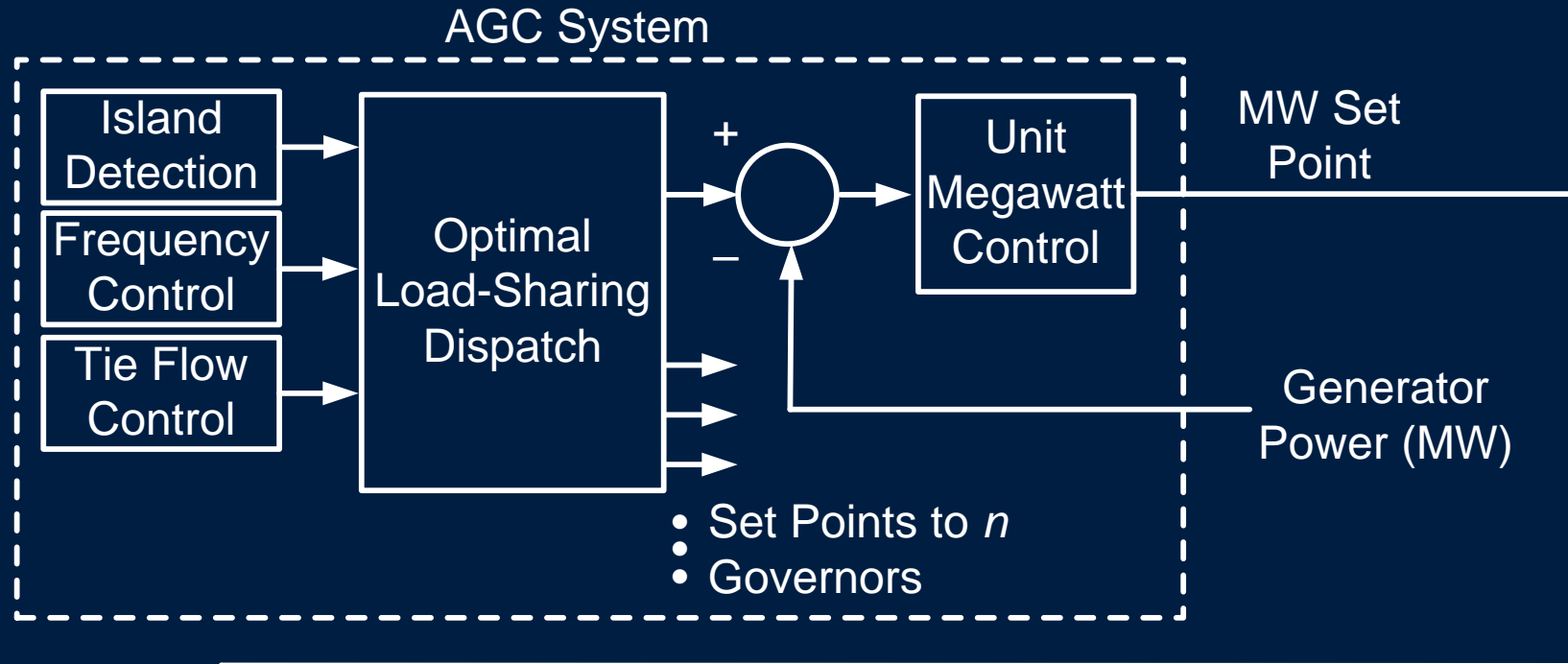
Generation Control System (GCS)

- 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

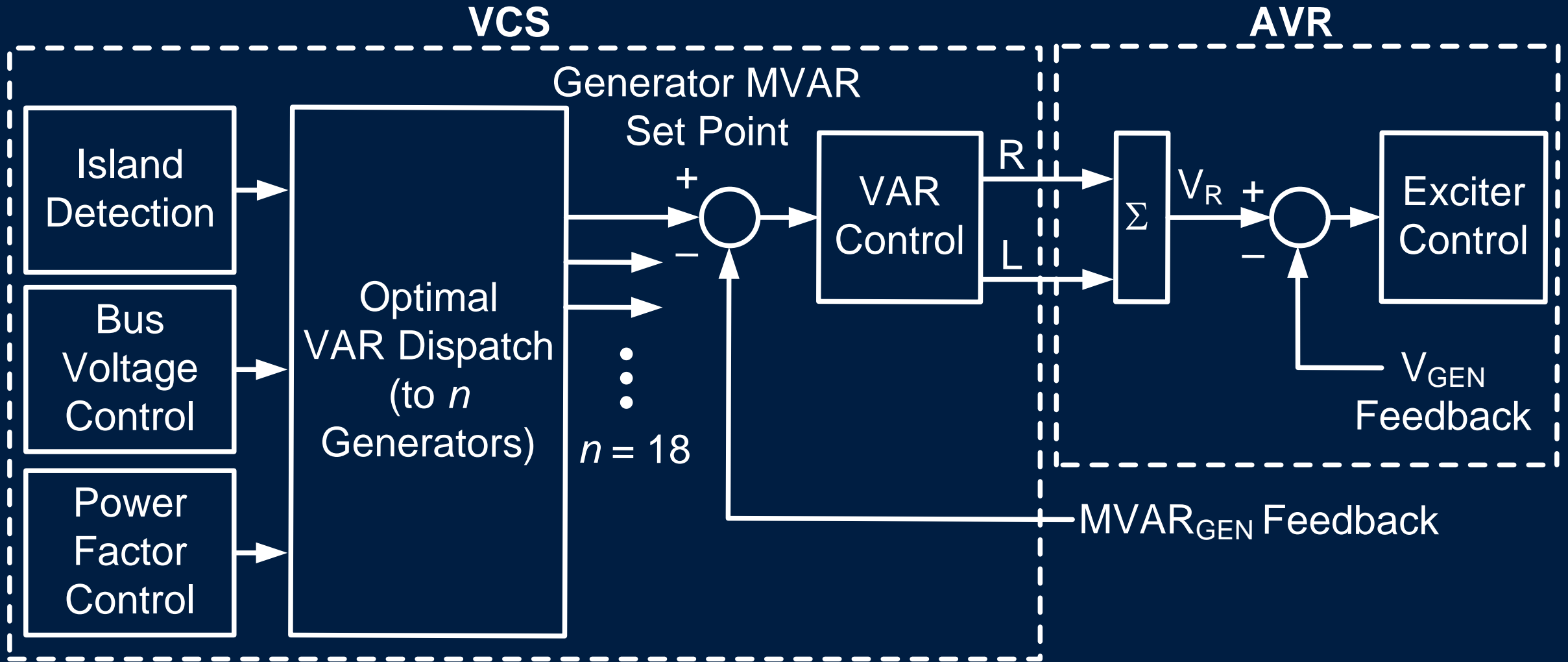
AGC Regulates Frequency



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



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											CB 101	Single Tie			
Tie Breaker	Breaker Status Open <input type="checkbox"/> Close <input type="checkbox"/>	MW Control Mode	MVAR Control Mode	Power (MW)	Reactive Power (MVAR)	Power Factor	MVAR Setpoint	Voltage (kV)	Frequency (Hz)	Peak (MW)	Off-Peak (MW)	Partial Peak (MW)	Super Off-Peak (MW)	Selected Setpoint	
Tie Breaker 01	Open	Disabled	Disabled	0.00	0.00	0.00	1.00	120.00	59.97	-5.00	1.20	-6.50	1.40	0.00	
Tie Breaker 02	Close	Enabled	Enabled	-1.60	21.58	-0.07	1.00	120.45	59.96	-3.00	-4.70	4.00	-5.90	0.00	
Autosync in Progress 121 sec															

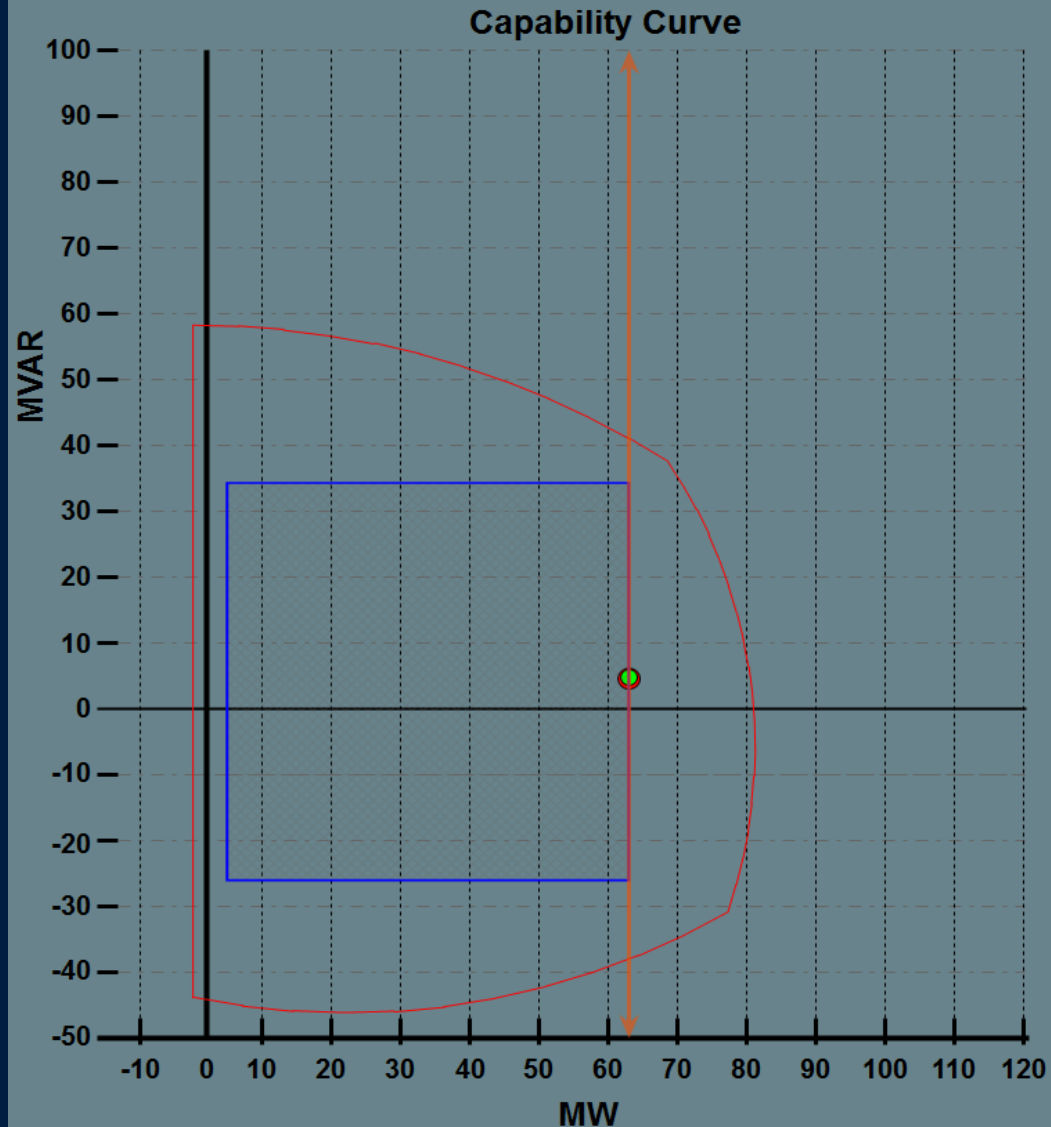
Automatic Generation Control																
Description	Controls		Setpoints			Status							Alarms			
Generator	MW Enable Control	MW Control Mode	MW Lower Regulation	MW Base Setpoint	MW Upper Regulation	Generator Mode Droop/Isoc	Breaker Status Open <input type="checkbox"/> Close <input type="checkbox"/>	Present Power (MW)	Requested Setpoint (MW)	Measured Frequency (Hz)	Under PMS Control	Control In Progress	Run Permissive	Remote	At Max Capacity	Following Error
Generator GT101A	Disabled	Droop SP	17.00	20.89	21.56	Droop	Close	21.84	21.84	59.96			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
Generator GT101B	Disabled	Droop SP	15.00	18.00	18.22	Droop	Open	0.00	0.00	60.00			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
Generator GT101C	Disabled	Droop SP	10.00	17.00	20.60	Droop	Close	20.60	20.62	59.97			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		

Voltage Control System																
Description	Controls		Setpoints			Status							Alarms			
Generator	MVAR Enable Control	MVAR Control Mode	MVAR Lower Regulation	MVAR Base Setpoint	MVAR Upper Regulation	Generator Mode Volt / PF	Breaker Status Open <input type="checkbox"/> Close <input type="checkbox"/>	Present Q (MVAR)	Requested Setpoint (MVAR)	Measured Voltage (kV)	Under PMS Control	Control In Progress	Run Permissive	Remote	At Max Capacity	Following Error
Generator GT101A	Disabled	Regulation	-2.00	0.00	10.00	Gen PF	Close	0.04	21.84	119.36			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
Generator GT101B	Disabled	Regulation	-2.00	3.00	10.00	Gen PF	Open	0.00	0.00	119.13			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
Generator GT101C	Disabled	Regulation	-5.00	3.00	15.00	Gen PF	Close	0.26	0.26	119.13			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		

GT101A - Misc Alarms	GT101B - Misc Alarms	GT101C - Misc Alarms	Enable	Disable	MVAR Sharing Disabled
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Gen101A/B MVAR Share (PMS)

Generator – Capability



Generator Select

NGL 230kV GIS	GOSP 4 230kV GIS	GOSP 4 115kV GIS	GOSP 2 69kV AIS
B48-P-0013A	B24-P-0008D	B24-P-0008A	B08-P-0003A
B48-P-0013B	B24-P-0008E	B24-P-0008B	B08-P-0003B
B48-P-0013C	B24-P-0008F	B24-P-0008C	B08-P-0003C
B48-P-0013D			B08-P-0003D
B48-P-0013E			
B48-P-0013F			
B48-P-0013G			
B48-P-0013H			

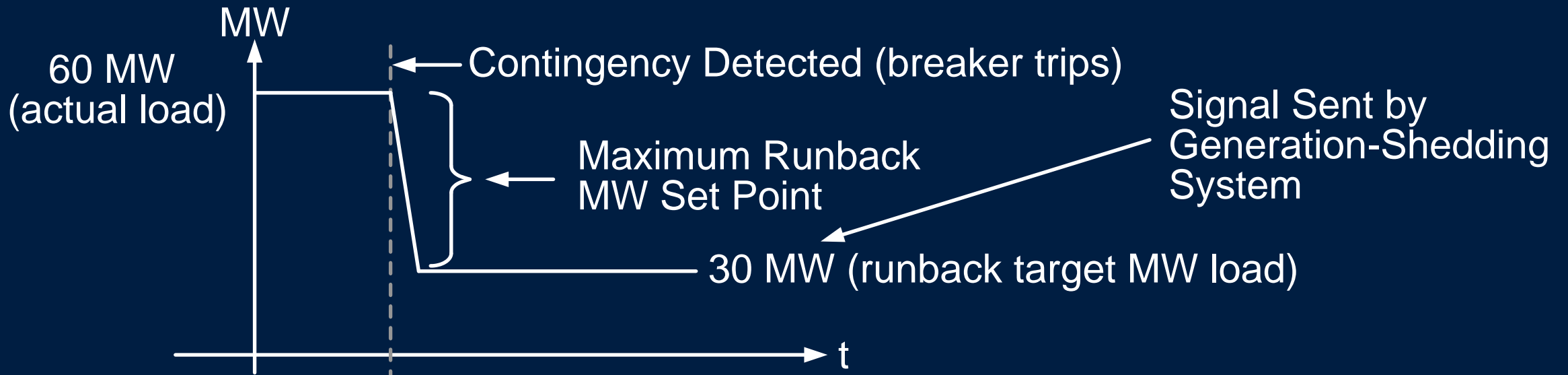
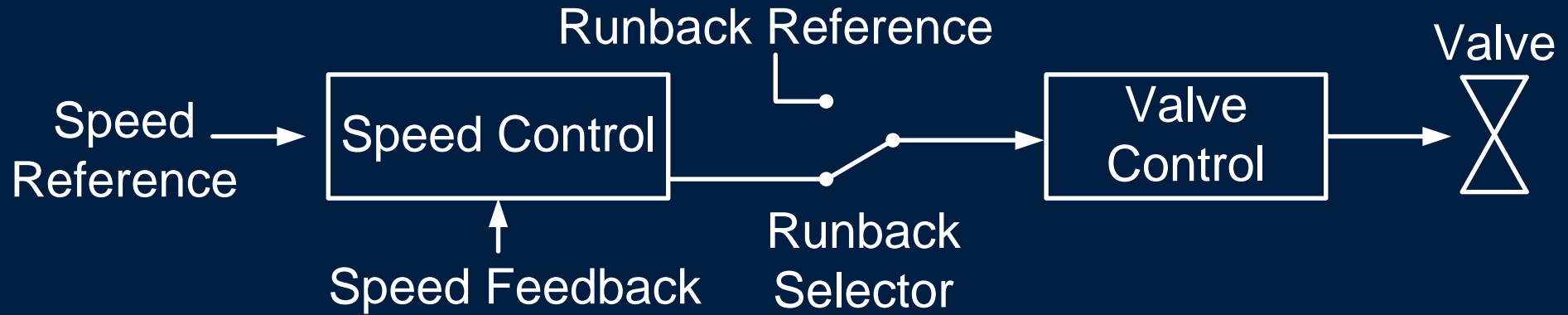
Legend

- Current Operation Point ●
- Ideal Operating Point ●
- Generator Capability ⬮
- Upper / Lower Operation Points
- Generator Maximum Capability ↕

Generator Maximum Capability (MW)	63.0
Lower MW Regulation Limit	5.0
Upper MW Regulation Limit	63.0
Present Power (MW)	63.0

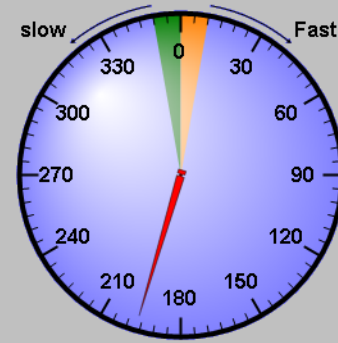
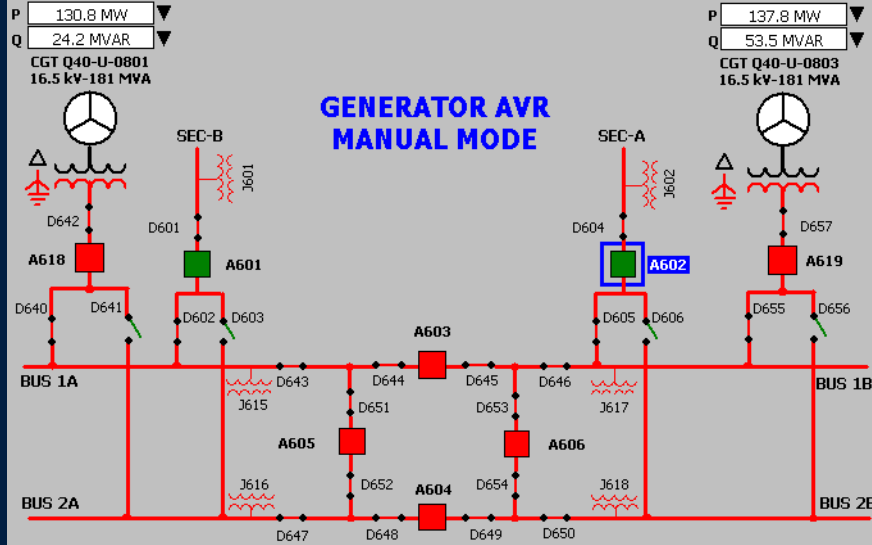
Ambient Temperature (C)	63.0
Lower MVAR Regulation Limit	-25.0
Upper MVAR Regulation Limit	35.0
Present Q (MVAR)	3.1

Generation Runback Philosophy



Automatic Synchronization

BACK SYNCHRONIZATION



SYNCHROSCOPE



BUS 1B VOLTAGE



SEC-A VOLTAGE

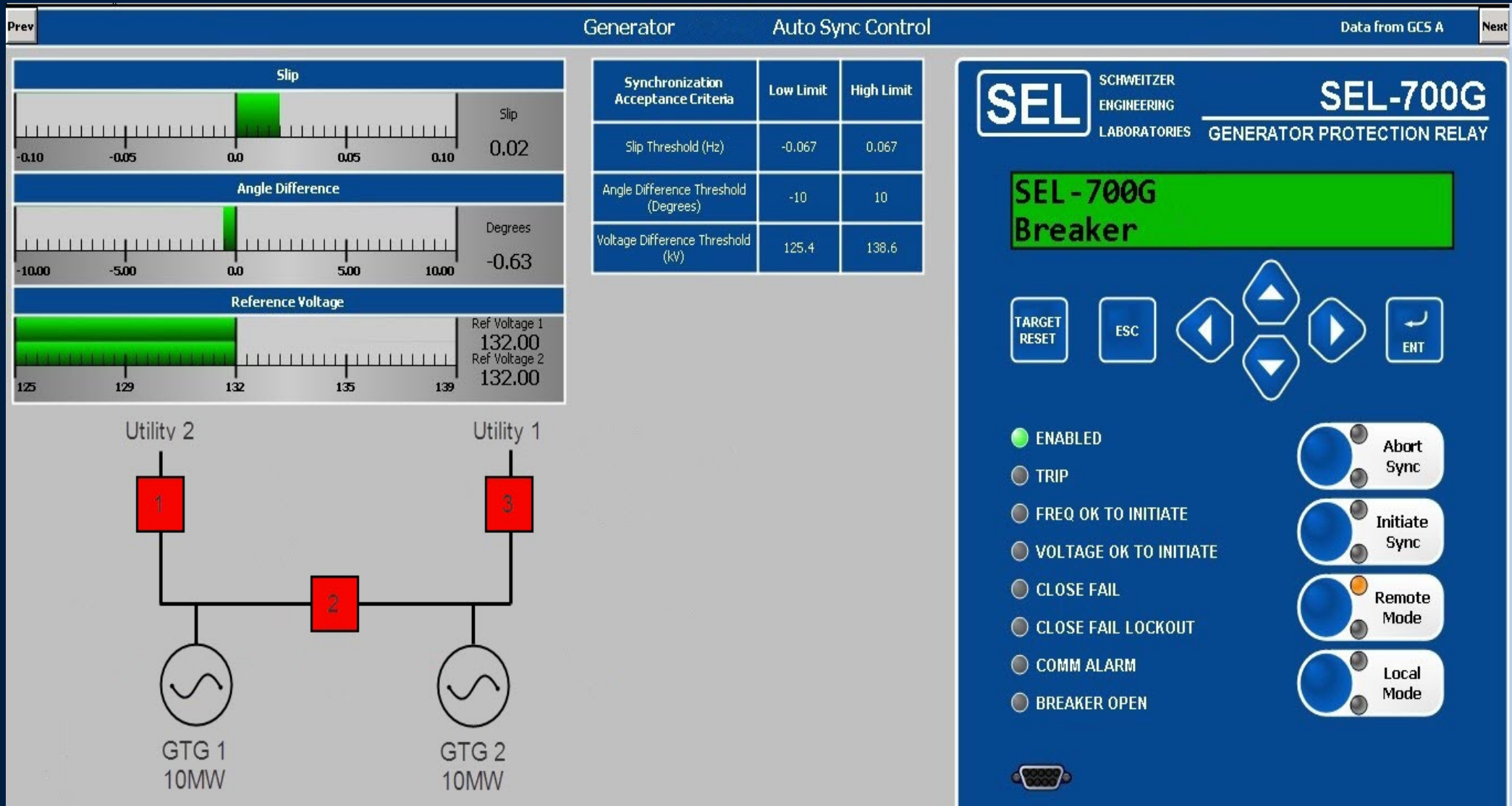
BSR-A

BUS 1B FREQUENCY	60 HZ
SEC-A FREQUENCY	60 HZ
SLIP FREQUENCY	0
ANGLE DIFFERENCE	197
BUS 1B VOLTAGE	113.5 KV
SEC-A VOLTAGE	114.5 KV

<input checked="" type="checkbox"/> ENABLED	<input type="checkbox"/> TRIP	<input type="checkbox"/> SYNCH SUCCESSFUL	<input type="checkbox"/> CLOSE FAILED
<input checked="" type="checkbox"/> FREQ. OK TO INITIATE	<input type="checkbox"/> dF/dT OK	<input type="checkbox"/> ANGLE OK	<input type="checkbox"/> MASTER
<input checked="" type="checkbox"/> SLIP OK	<input type="checkbox"/> REQUEST UNAVAILABLE	<input type="checkbox"/> GEN. FREQ. HI	<input type="checkbox"/> GEN. FREQ. LO
<input type="checkbox"/> dF/dT OK	<input type="checkbox"/> RAISE GEN. FREQUENCY	<input type="checkbox"/> LOWER GEN. FREQUENCY	<input type="checkbox"/> VOLT. OK TO INITIATE
<input type="checkbox"/> VOLT. DIFF. OK	<input type="checkbox"/> BREAKER STATUS ALARM	<input type="checkbox"/> CLOSE LOCKOUT	<input type="checkbox"/> SYNCH COMM. ALARM
<input type="checkbox"/> VOLT. HI	<input type="checkbox"/> VOLT. LO	<input type="checkbox"/> RAISE VOLT.	<input type="checkbox"/> LOWER VOLT.

<input type="checkbox"/> SELECT CB601	<input type="checkbox"/> ABORT SYNCH PROCESS
<input checked="" type="checkbox"/> SELECT CB602	<input checked="" type="checkbox"/> INITIATE SYNCH PROCESS
<input type="checkbox"/> SELECT CB603	<input type="checkbox"/> CLOSE SELECTED CB
<input type="checkbox"/> SELECT CB604	<input type="checkbox"/> AUTO LOCAL
<input type="checkbox"/> SELECT CB605	<input type="checkbox"/> AUTO REMOTE
<input type="checkbox"/> SELECT CB606	<input checked="" type="checkbox"/> LOCAL MANUAL

Automatic Synchronization



Utility 2 Utility 1

GTG 1 10MW GTG 2 10MW

Questions?

