
On-Site Power Systems

Developing the single line
Writing the sequence of operation

Presented by:

Mike Pincus, PE
Kohler Power System

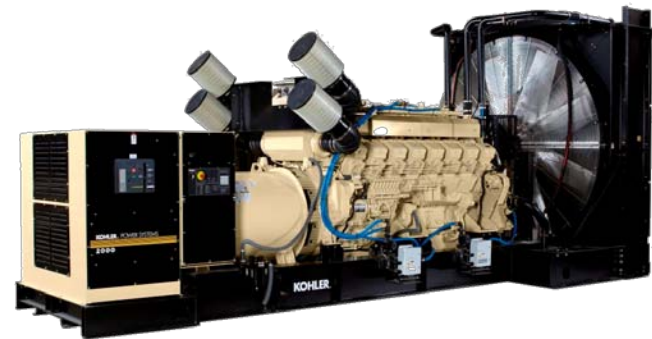
About Me

- Mike Pincus, PE
 - Manager – Systems, Kohler Power Systems
 - 20 years of experience in on site power systems
 - Manager - Switchgear Engineering, Kohler (13 Years)
 - Project Engineer - Switchgear Engineering, Kohler (2 Years)
 - Field Test Engineer - On Site Power Systems (3 Years)
 - Consulting Engineer - Power Systems (2 Years)
 - BSEE – UW Madison
 - MBA – UW Milwaukee

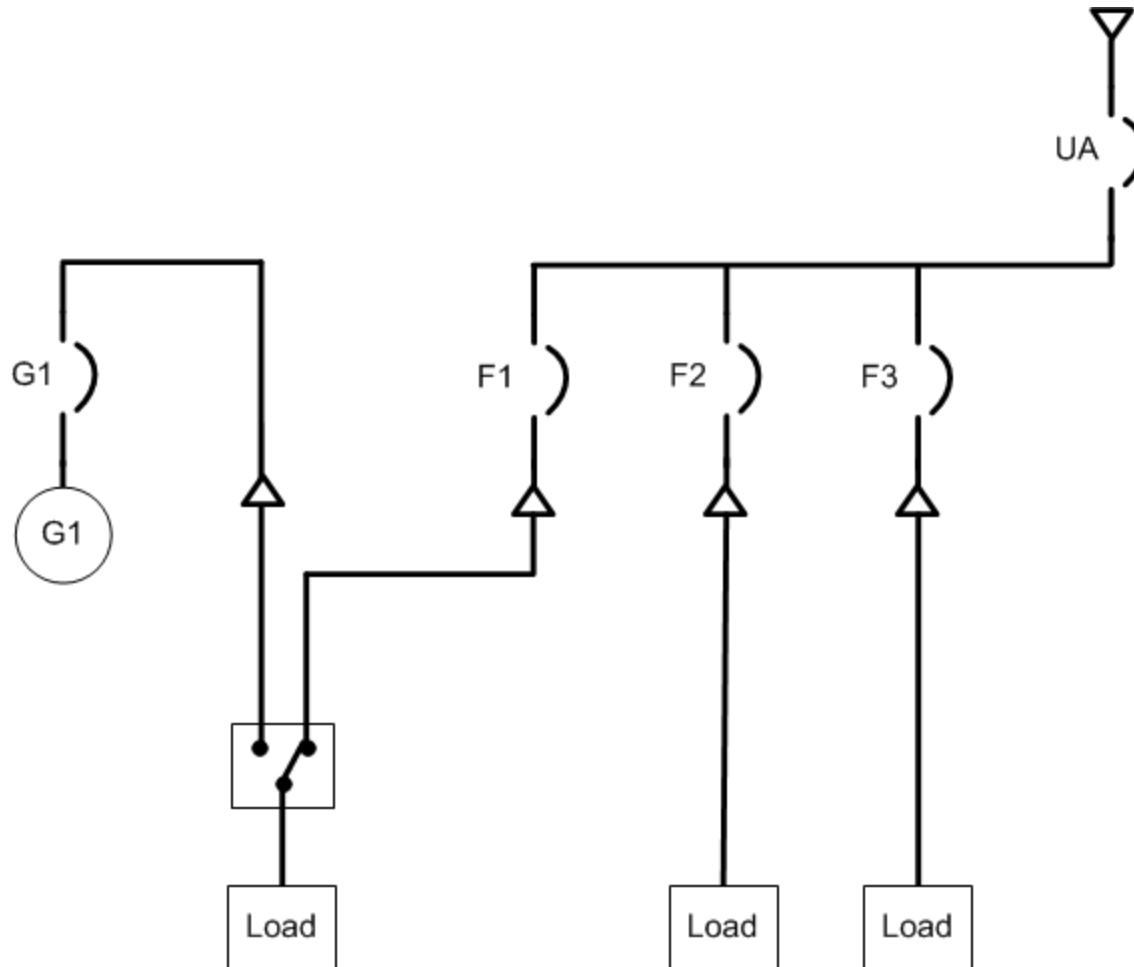


About Kohler Power Systems

- Generator sets from 4 to 3250kW
 - Most genset accessories:
 - Enclosures, Tanks, Genset Controllers, etc.
- Transfer Switches from 30 to 4000 Amps
 - Standard (open)Transition, Closed (100ms) or Programmed Transition
 - Available in Bypass Isolation and Service Entrance Configurations
- Low and Medium Voltage Paralleling Switchgear



The most common on-site power system



What are the components of an ATS

Contactor

Controller

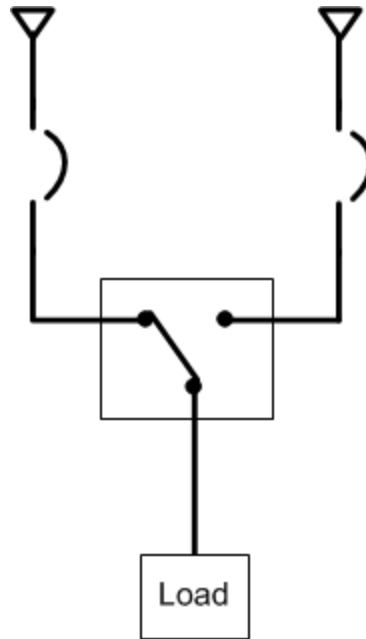


Selecting the correct ATS

- Frame size
- Transfer Type
- Withstand rating
- Frame Type
- Neutral Switching



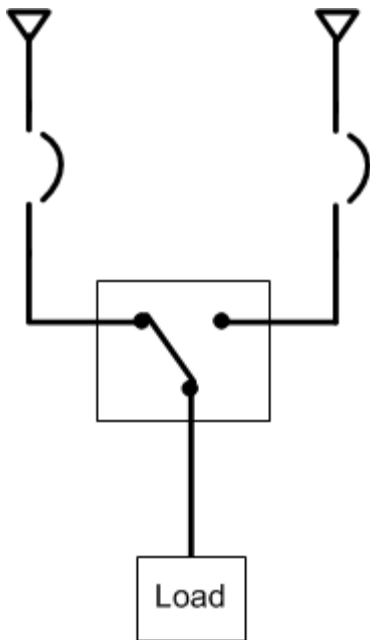
Frame Size



Transfer Type

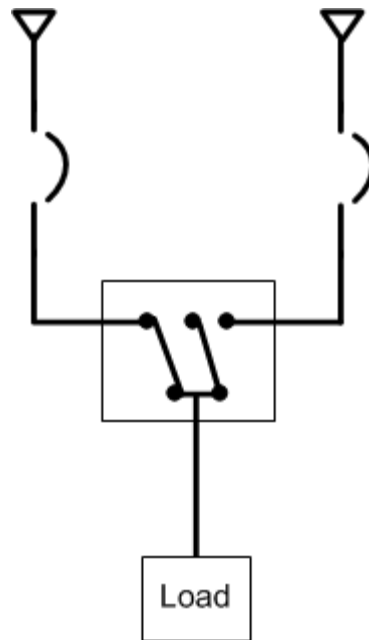
Open

Break before make



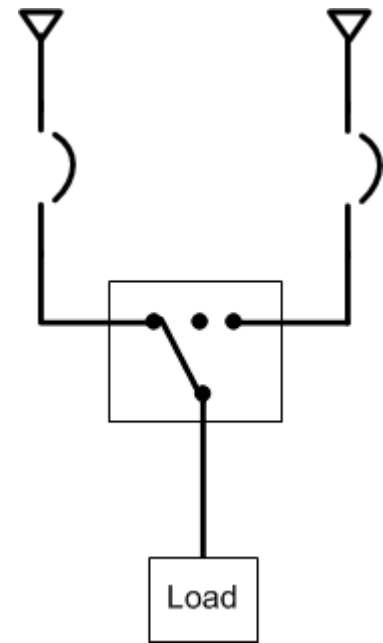
Closed

Make before break
(under 100mS)



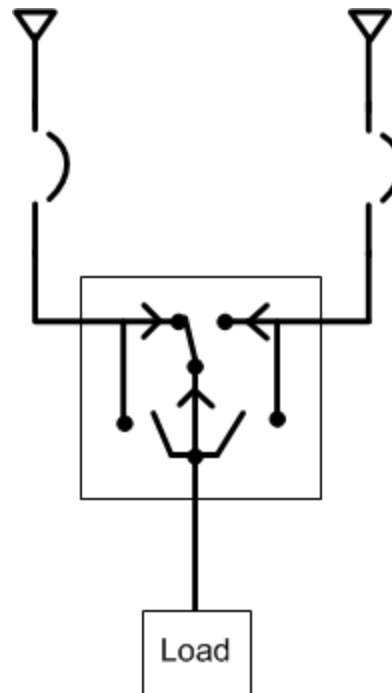
Programmed Transition

Break – OFF - Make

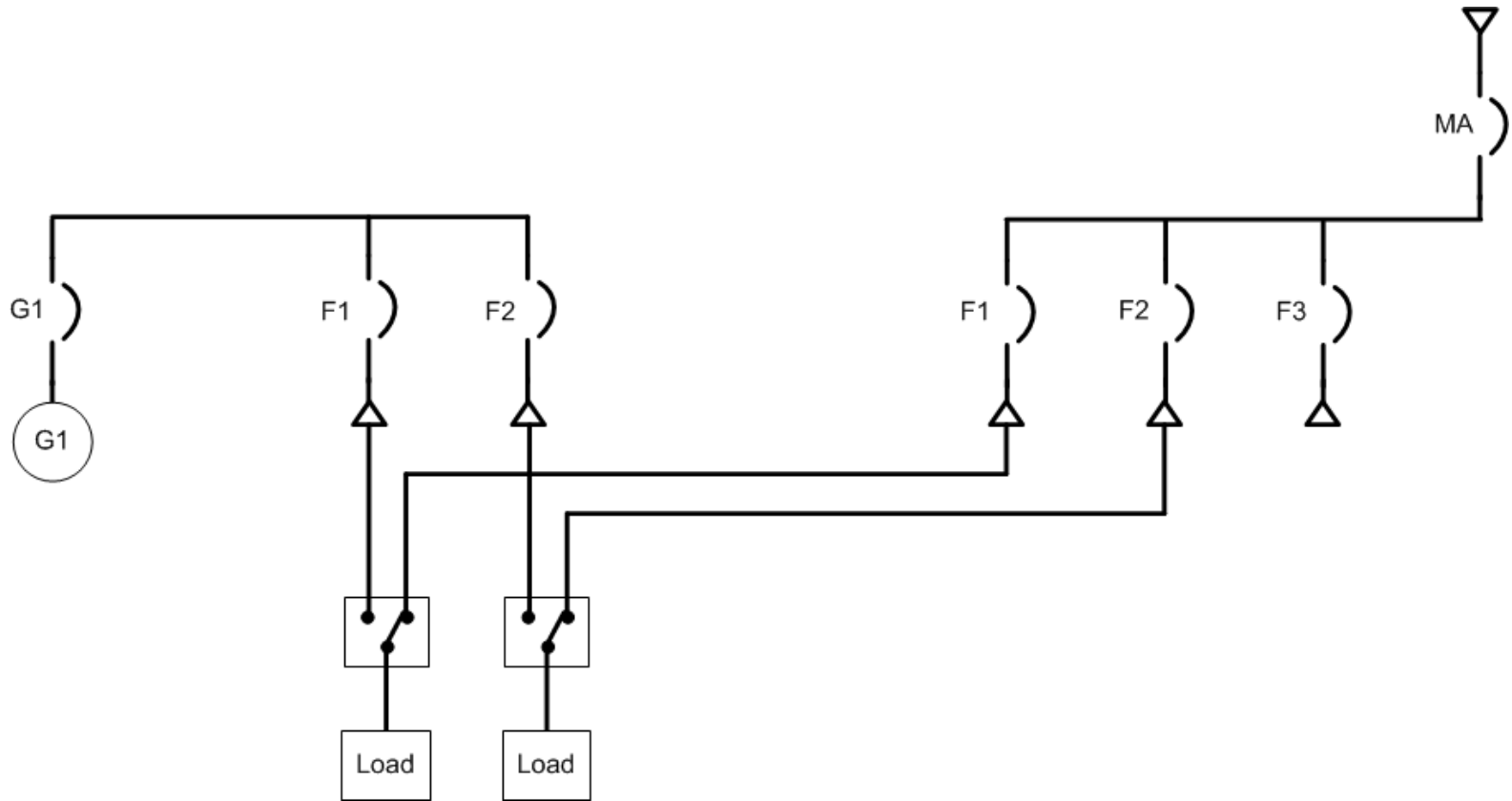


Frame Type

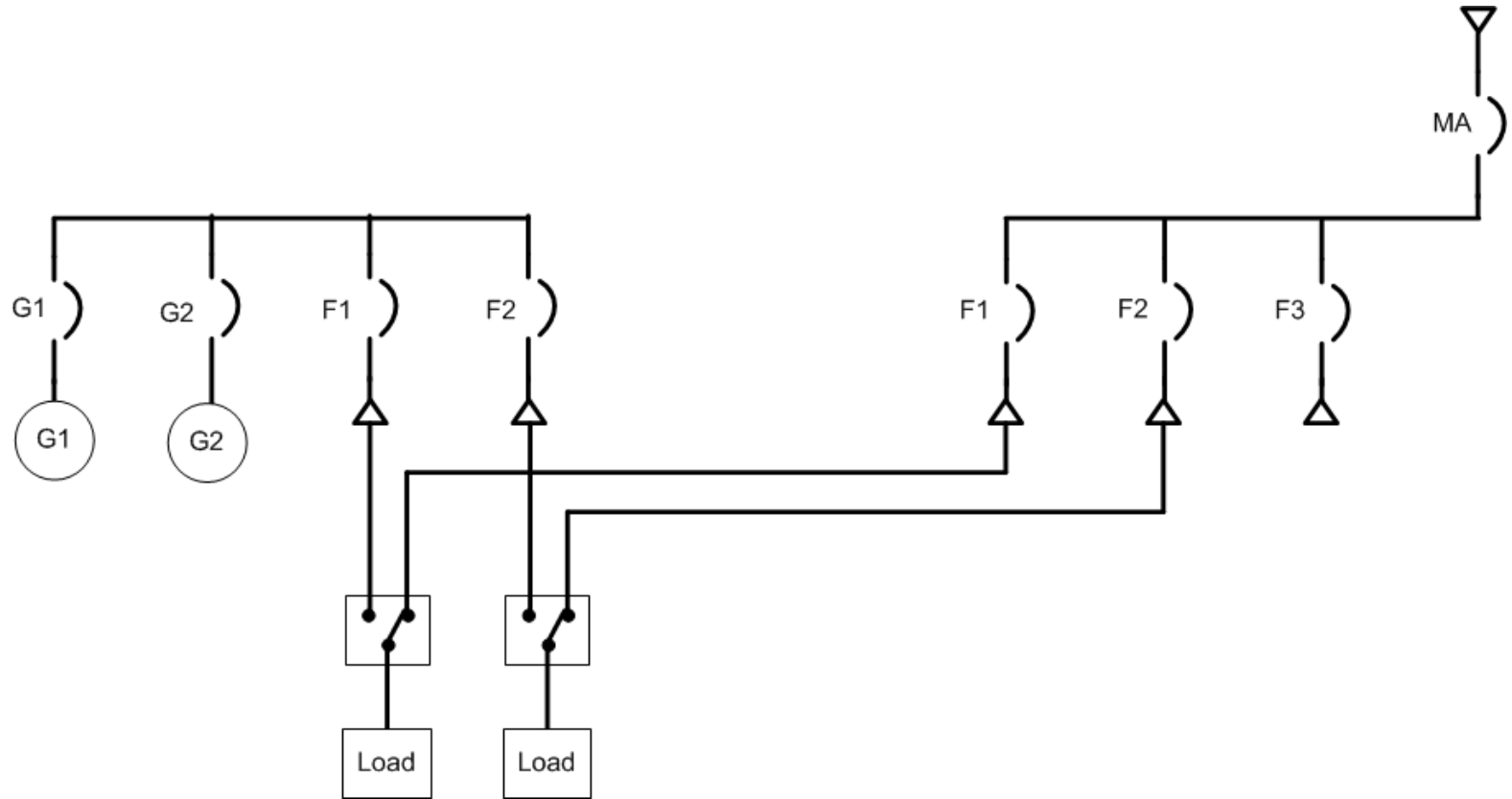
- Bypass / Isolation
 - Two TS mechanisms in parallel
 - Automatic
 - Drawout
 - Manual
 - Fixed



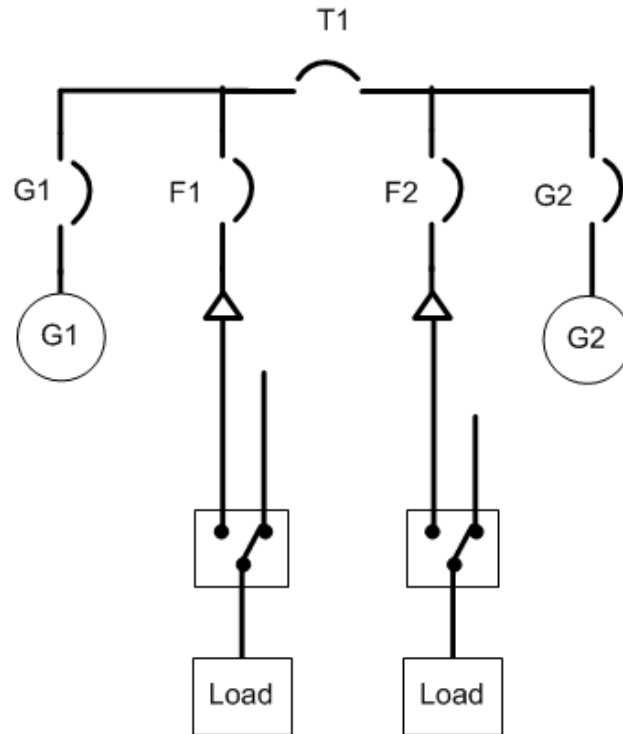
1 Gen + 2 (or more) ATS



2 (or more) Gen + 2 (or more) ATS

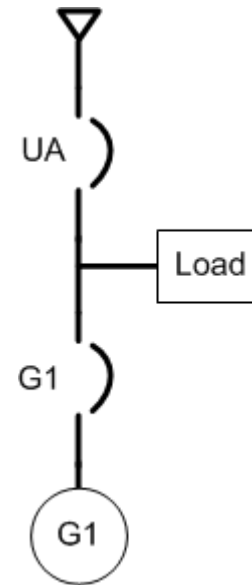


What if One Gen Cannot Support P1?

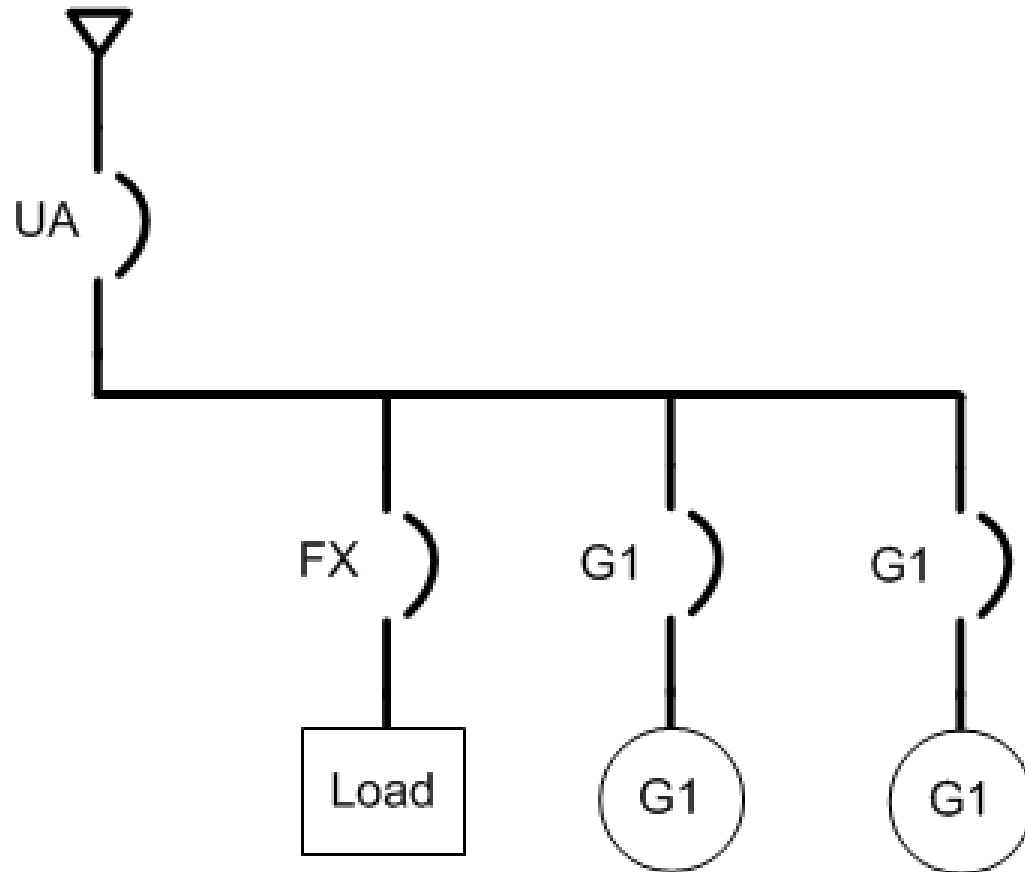


One Gen and One Utility

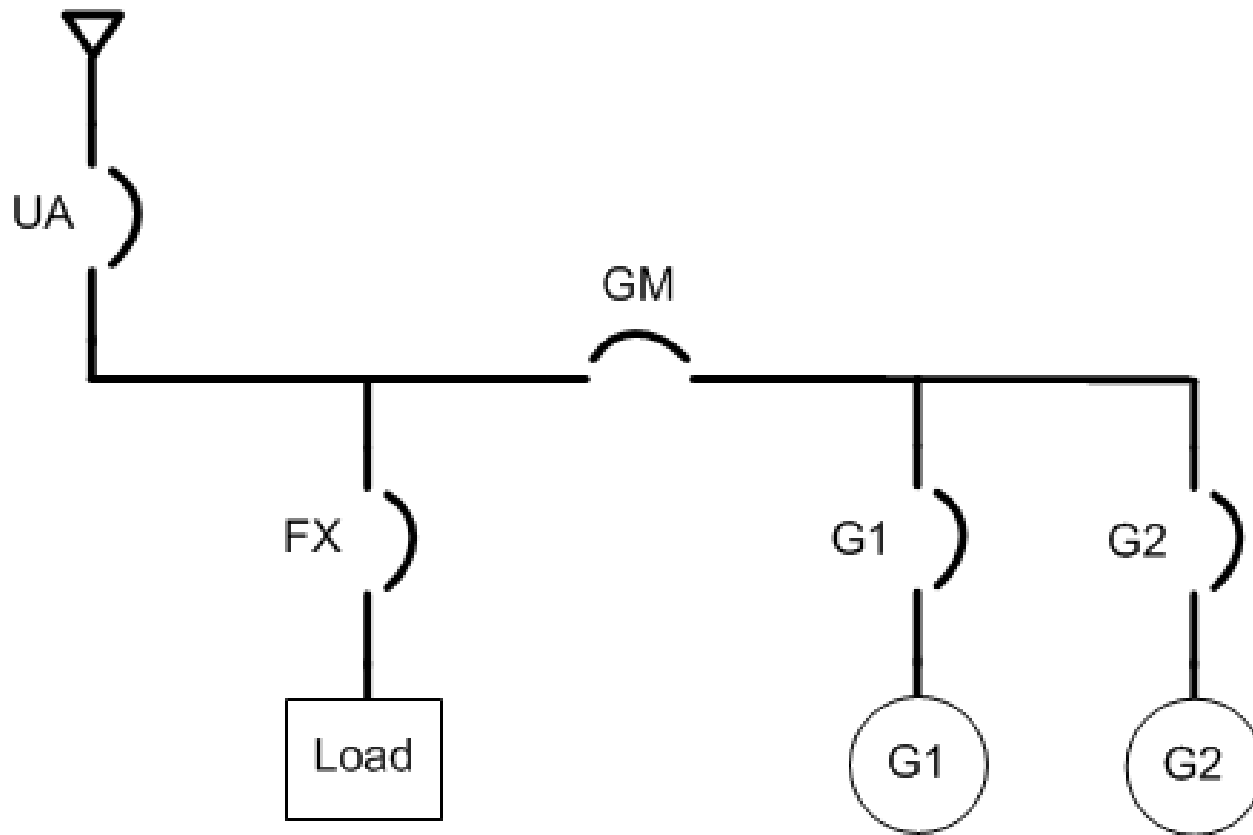
- Types of transfers
 - Open
 - Closed
 - Fast
 - Soft
- Maintain Parallel
 - Peak Shave
 - Utility as load bank
 - Base load
 - Import mode



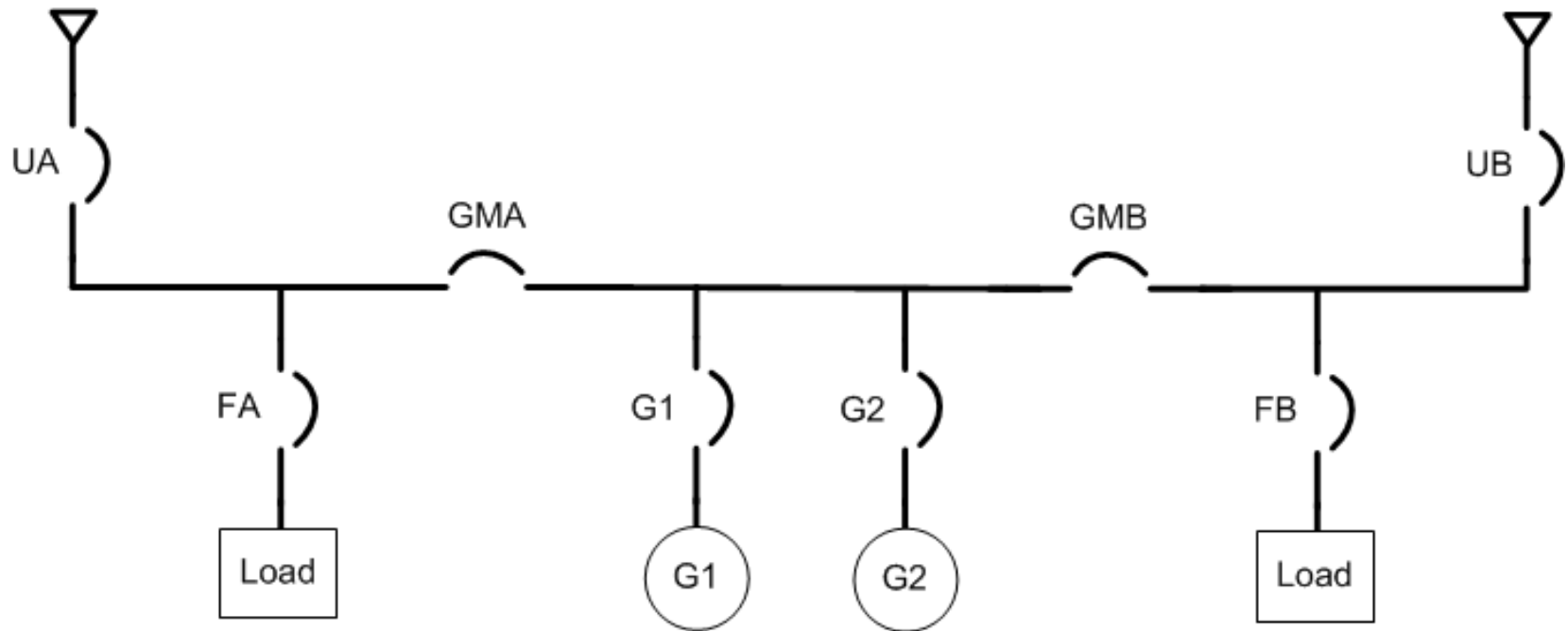
Two or More Gen and One Utility



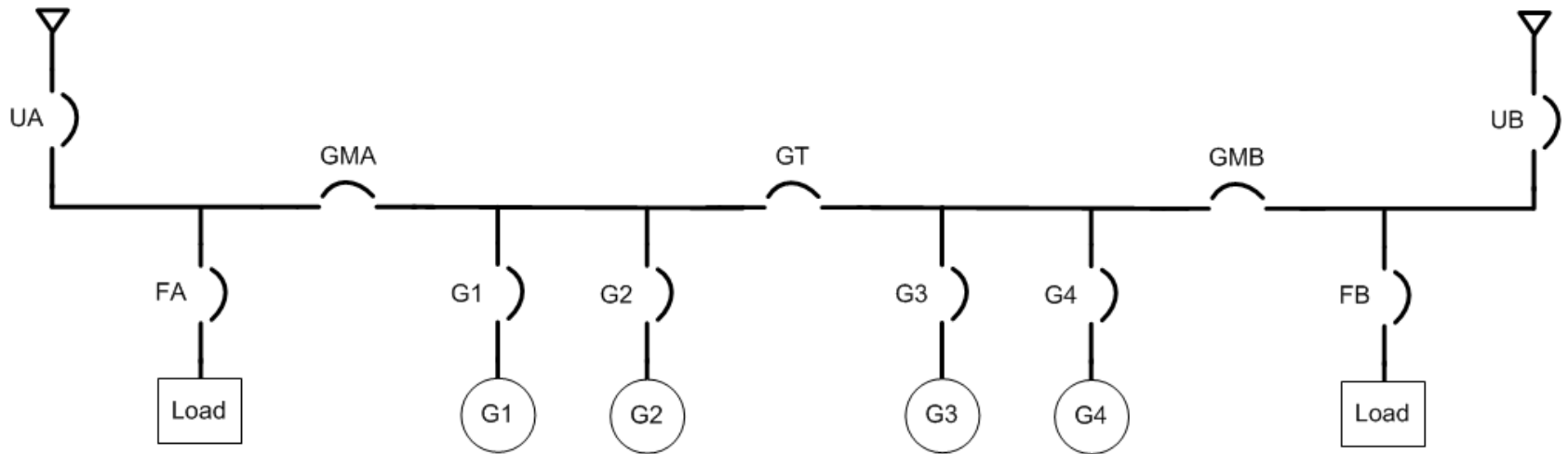
Two or More Gen and One Utility with Gen Main



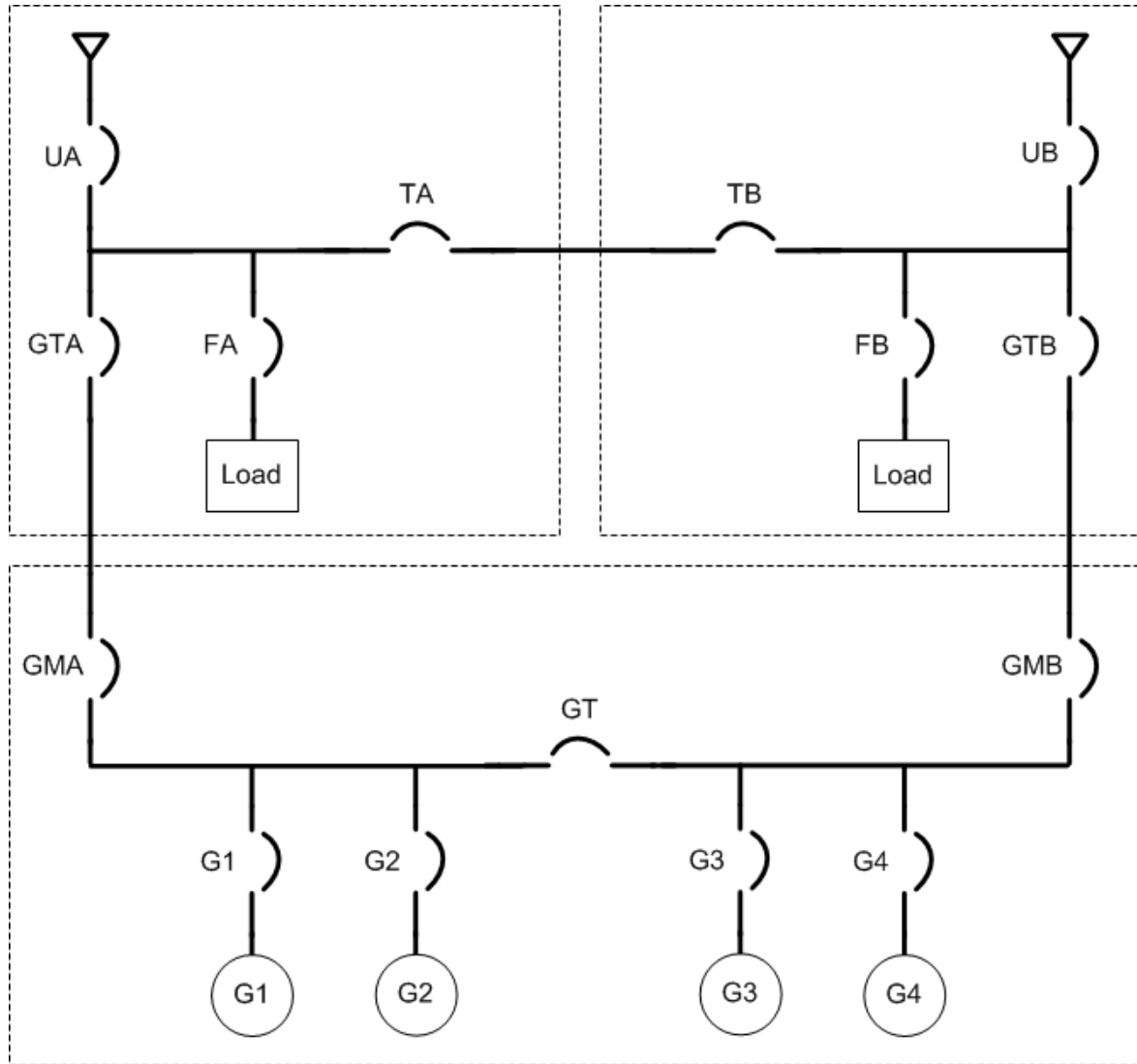
Two or More Gen and Two Utility



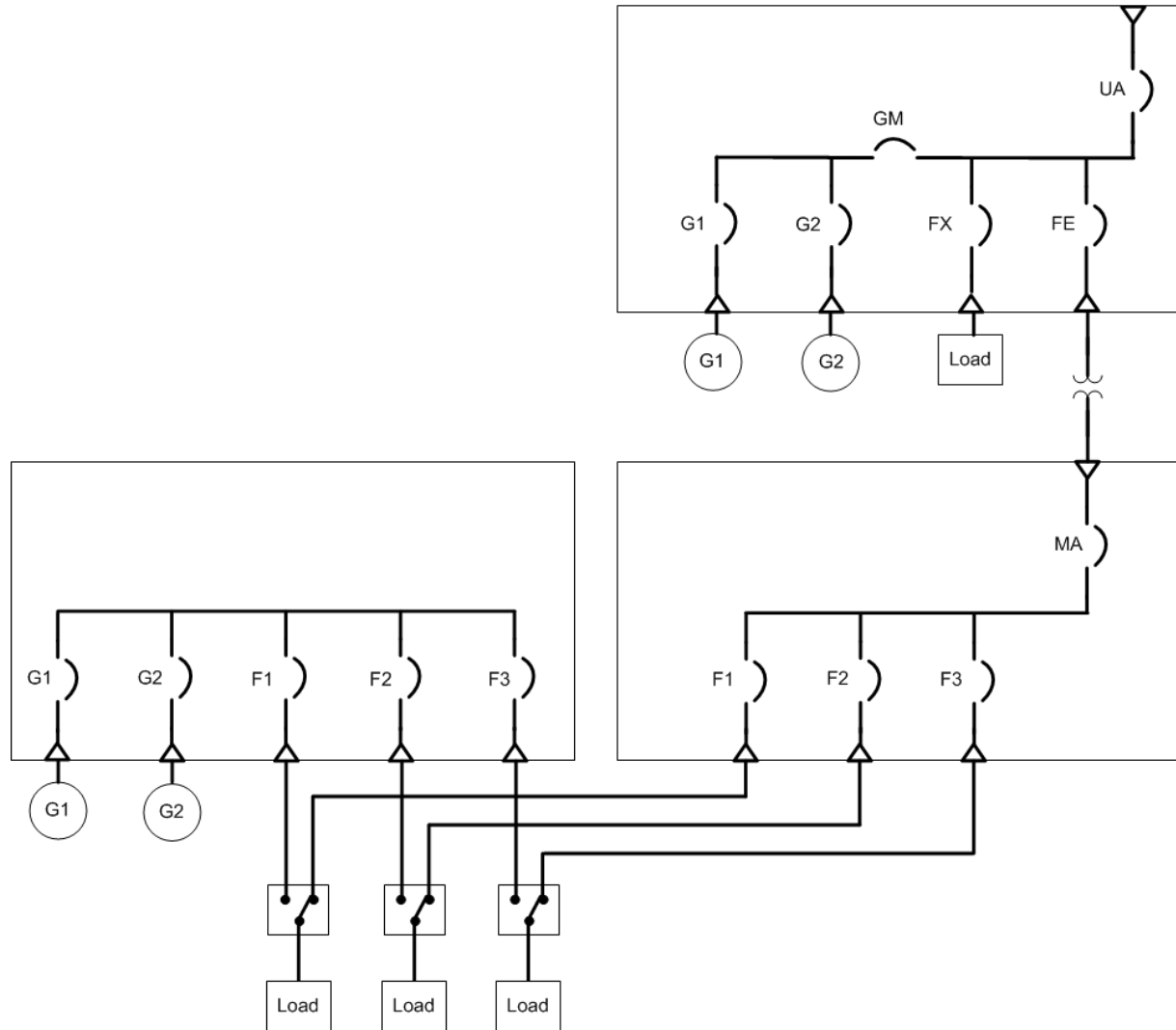
Two or More Gen and Two Utility with Tie



Two or More Gen and Two Utility With Ties



It is OK to Mix and Match



The secret

- Turning words into action
 - Tell you how it will work.....It will work like we tell you

Arvest Mortgage Submittal For Approval – Rev. New	SGP-1038 3/10/04
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Section 2 Modes of Operation

2.1 Emergency Mode

2.1.1 Response to Loss of Utility

The loss of utility causes the Engine Start Delay timer in the PLC to start. If this timer expires, then the following sequence will occur:

1. The Utility Breaker (52U) opens.
2. The priority 2 and 3 feeder breakers open.
3. The generators start.
4. The first generator that has stable voltage and frequency closes its breaker.
5. Tie Breaker (52T) closes.
6. The other generator synchronizes to the bus. When synchronized, its circuit breaker closes.
7. The priority 2 and 3 feeder breakers close.

2.1.2 Response when Utility Returns

When the utility returns, the Utility Stable timer in the PLC starts.

When this timer expires, the following sequence occurs:

3. The generators soft (ramp) unload.
4. When the generators reach their unloaded setpoint, 52T and the generator breakers open.
5. The generators shut down after completing a cool down cycle.

2.2 Isolate Mode

Isolate mode is used to manually initiate a transfer to generator power. This can be used to test the system or in anticipation of a potential power failure.

2.2.1 Start-Transfer to Generator

Momentarily touching the isolate mode start push-button on the touch-screen starts the following sequence:

If open transfer mode is selected

1. The generators start.
2. The first generator that has stable voltage and frequency closes its breaker.
3. The other generator synchronizes to the bus. When synchronized, its circuit breaker closes.

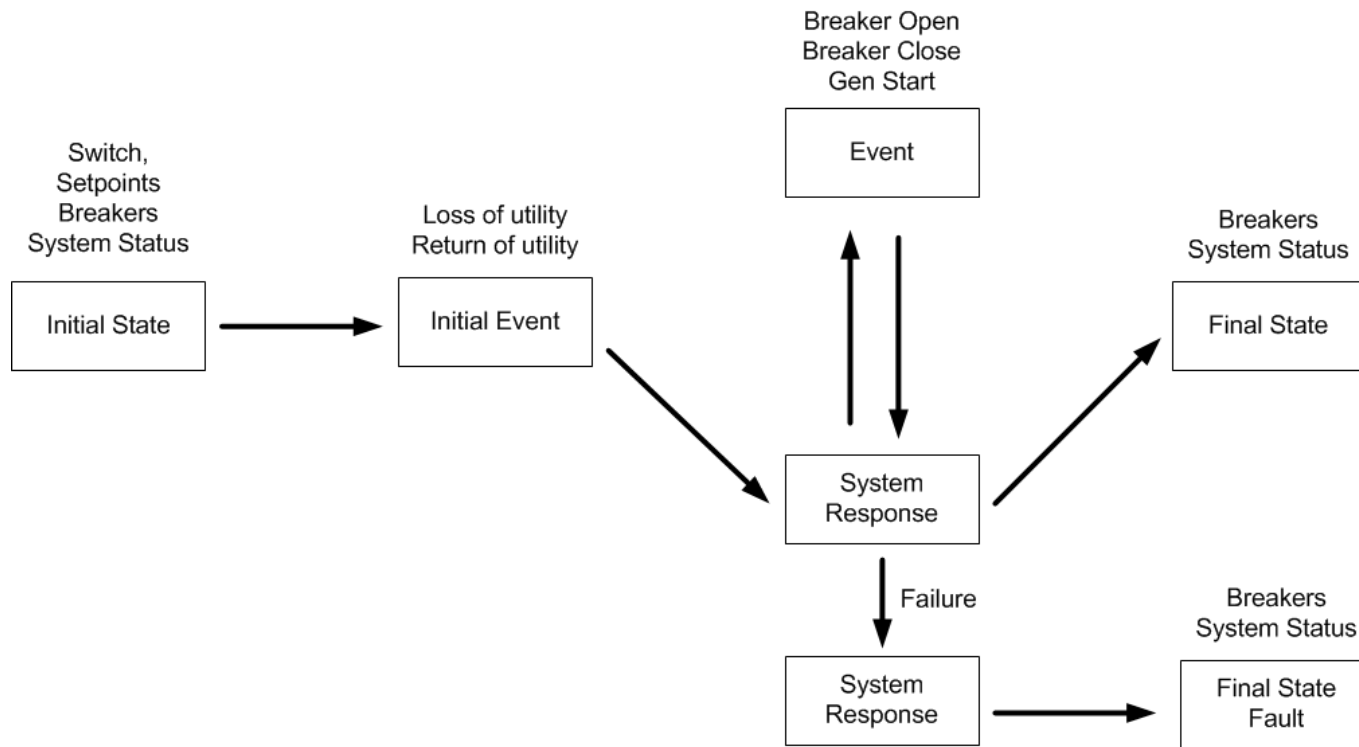
NOTE: If the second generator fails to start or go on-line, the operator can depress the Isolate GOL Bypass push-button and the sequence will continue with one generator.

There had to be a better way



Sequence of Operation

- How every on-site power system works (AKA Operate)
 - Automatic Operation
 - Manual Operation (Operated initiated operation)



Sequence of Operation – Normal Operation

1.1.1 Overview

When utility A voltage or frequency falls out of tolerance, the Utility A Failure timer in the PLC starts. When utility B voltage or frequency falls out of tolerance, the Utility B Failure timer in the PLC starts. When both timers expire, or when one of the timers expires while the other is timing, the bus A and B loads transfer to generator power.

1.1.2 Sequence

Initial State	UA	Bus A	GMA	Gen Bus	GMB	Bus B	UB
	X	E	O	D	O	E	X

Step	Event	Response	If Fail
1	Utility A and utility B out of tolerance.	Utility A Failure timer starts.	A
		Utility B Failure timer starts.	B
2	Both utility failure timers expire or one timer expired while the other is still timing.	All generators start.	
		Utility breaker UA opens.	C
		Utility breaker UB opens.	D
3	Utility breaker UA is open.	Required GOL Bypass timer starts.	
		Bus A Dead/Live Open Transfer timer starts.	
		Startup Shed Option: Selected loads on bus A are shed.	

		Generator Stabilization timer starts.	
9	Generator Stabilization timer expires and Bus B Dead/Live Open Transfer timer expired.	Generator main breaker GMB closes.	H
10	Generator main breaker GMB is closed.	Bus B is on generator power.	
11	Bus A and B on generator power.	Startup Shed Option: Shed loads add back on bus A and B according to the Load Management settings.	I
		Generator Management Option: Becomes active if in Auto and all loads added.	

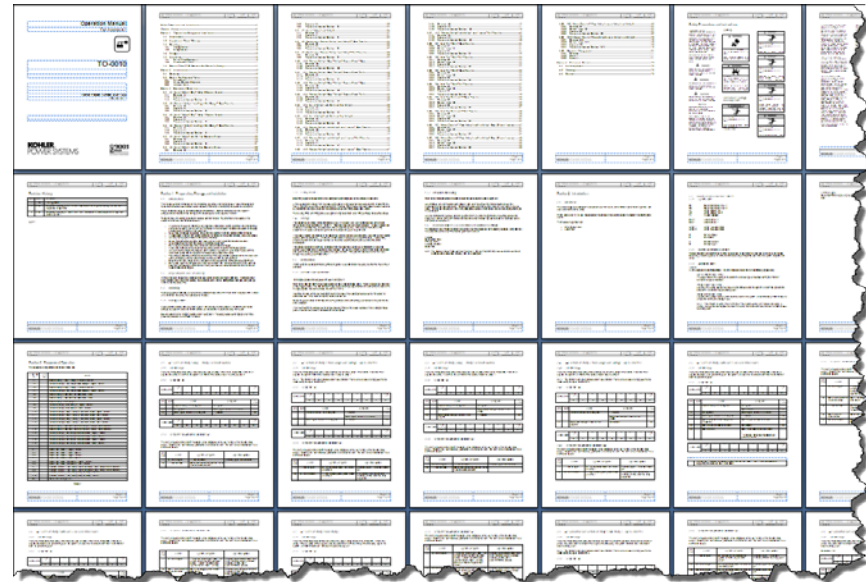
Final State	UA	Bus A	GMA	Gen Bus	GMB	Bus B	UB
	O	E	X	E	X	E	O

Sequence of Operation – Response to Failures

Step Fail	Event	System Response	Operator Action
A	Utility A power returns before Utility A Failure and Utility B Failure timers expire.	Bus A remains on utility A.	No operator action required.
		<u>Utility B Failure Timer Expires:</u> Bus B loads transfer to generator power (Seq. 605) or utility A power (Seq. 606).	No operator action required.
B	Utility B power returns before Utility A Failure and Utility B Failure timers expire.	Bus B remains on utility B.	No operator action required.
		<u>Utility A Failure Timer Expires:</u> Bus A loads transfer to generator power (Seq. 601) or utility B power (Seq. 602).	No operator action required.
C	Utility breaker UA fails to open.	<u>Utility A Remains Failed. Utility B Remains Failed:</u> Bus A is without power. Generator main breaker GMA does not close. After the required generators are online, generator main breaker GMB closes.	<u>Option #1:</u> Reset the Fail To Open alarm. System retries to open utility breaker UA. When breaker opens, transfer automatically continues. <u>Option #2:</u> Manually open utility breaker UA. Transfer automatically continues if system is in Auto. <u>Option #3:</u> 1. Place system in Manual. 2. Manually open utility breaker UA. 3. If required, shed load. 4. Manually close generator main breaker GMA.
		<u>Utility A Remains Failed. Utility B Returns:</u> Bus A is without power. The system transfers bus B from generator power to utility B power following the expiration of the Utility B Stable timer.	No operator action required.
		<u>Utility A Returns. Utility B Remains Failed:</u> Bus A remains on utility A. Bus B remains on generator power.	Operator may manually transfer bus B from generator power to utility A power.
		<u>Utility A and Utility B Return:</u> Bus A and Utility B Return.	No operator action required.

One Document does it All

- One document used for many purposes
 - Submittal approval (Draft O&M)
 - PLC Programming instructions
 - FAT (factory acceptance test) document
 - SAT (site acceptance test)
 - Final O&M manual



Screen shot

5:08:56 PM 2/7/2011 UB PTX Comm Loss - Reset

5:06:16 PM 2/7/2011 UA PTX Comm Loss - Reset

4:34:09 PM 2/7/2011 Remote IO MB+30 Comm Loss - Reset

4:34:09 PM 2/7/2011 Remote IO MB+40 Comm Loss - Reset

4:34:09 PM 2/7/2011 Remote IO MB+50 Comm Loss - Reset

Transfer Active

Timer Active

Mode Active

FACTORY

07-Feb-11

5:51:01 PM

Overview

Status

Control

Add/Shed

Gen Mgmt

Setup

Alarms

Reports

Trend

Help

Current Screen

Control Gen to Split

Reset

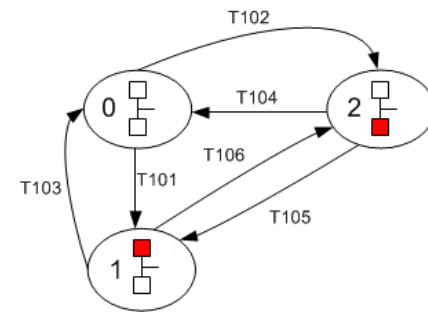
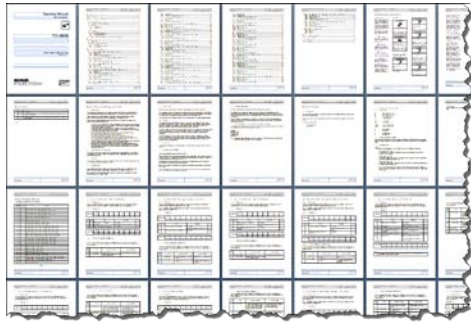
Util Mtr	Util	Volts	Amps	kW	Status
	Util B	0 V	0 A	0 kW	Fail
	Util A	0 V	0 A	0 kW	Fail

Gen Meter	Gen	Volts	Amps	kW	Status
	G1	0 V	0 A	0 kW	Not in Auto
	G2	0 V	0 A	0 kW	Not in Auto

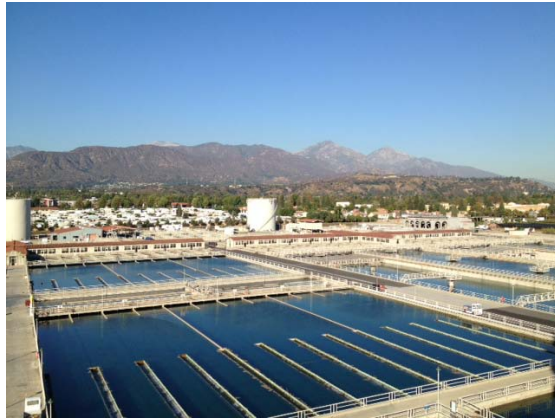
Transfer System from Generator to Split Bus

Sequence Requirements	1: Bus A Xfer	2: Bus B Xfer	3: On Split Bus
<input checked="" type="checkbox"/> Sys Control Switch In Auto	<input checked="" type="checkbox"/> GMA CB Open	<input checked="" type="checkbox"/> GMB CB Open	<input type="checkbox"/> G1 In Cooldown
<input type="checkbox"/> GMA CB Control is Available	Open Xfer A 0 : 05	Open Xfer B 0 : 05	<input type="checkbox"/> G2 In Cooldown
<input type="checkbox"/> GMB CB Control is Available	<input checked="" type="checkbox"/> UMA CB Closed	<input checked="" type="checkbox"/> UMB CB Closed	
<input type="checkbox"/> UA Stable and CB Control is Available			
<input type="checkbox"/> UB Stable and CB Control is Available			
Control	Control	Control	Control
Start			

How we Program the PLC



Weymouth Water Treatment Plant



Paralleling Switchgear Projects

- Prime Power
 - 3 Gens



Paralleling Switchgear Projects

- Medical Center
 - 3 Utilities
 - 5 Gens



Thank you and Questions?

- Thank you
- Questions?