Georgia Power Company Distributed Generation Application DB18-23

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Distributed Generation

- Distributed Resources (DR)
- Non-Utility Generator (NUG)
- Standby Generator
- Emergency Generator
- Dispersed Generation
- Renewable Energy Generator (RE)
- PV systems
- Solar Farms
- Peak Shaving Generator
- On-site Generator
- Base Load Generation

IEEE 1547 Standard for Interconnecting Distributed Resources with Electric Power Systems

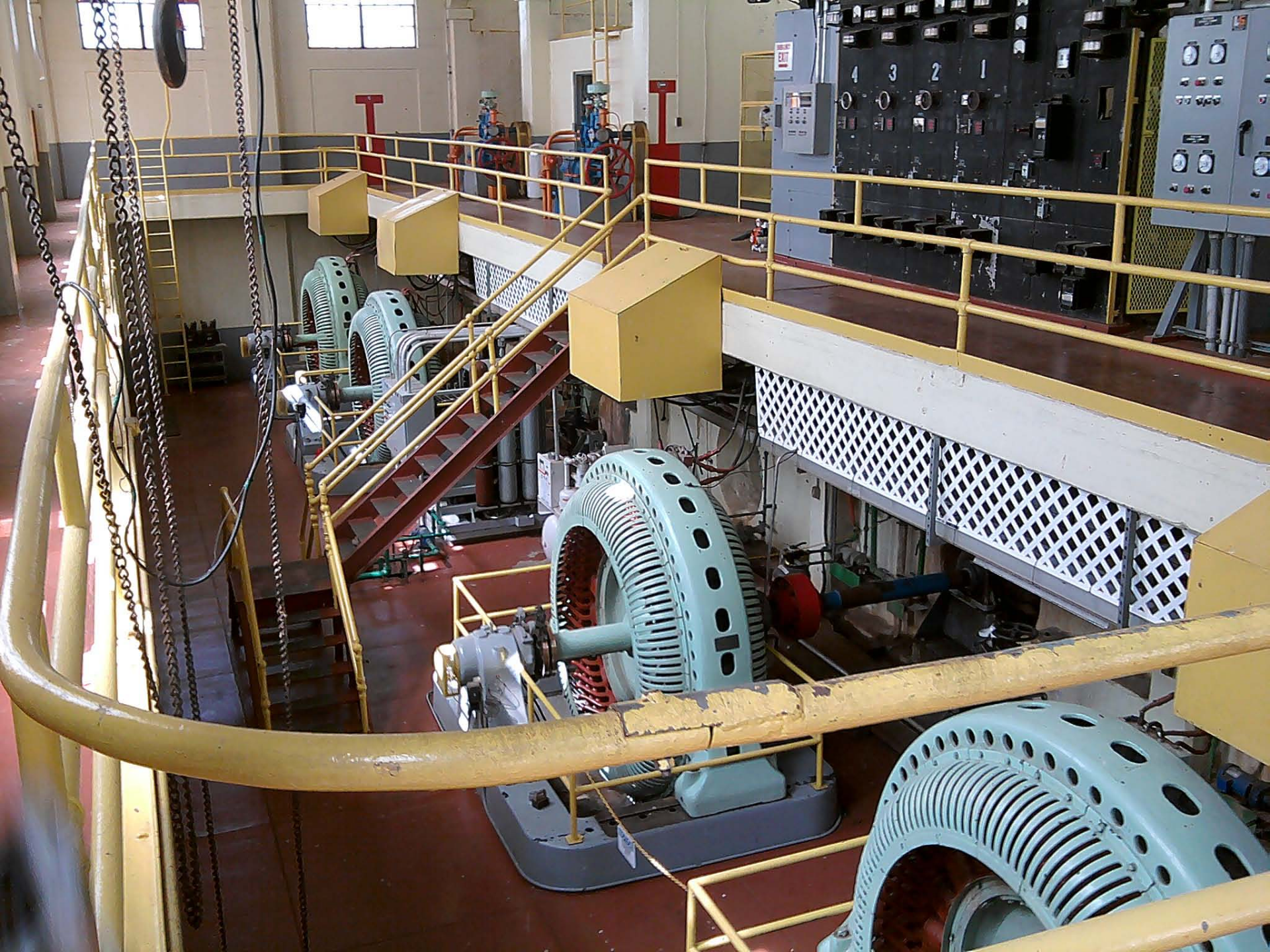
- IEEE 1547 Standard for Interconnecting Distributed Resources with Electric Power Systems was approved by the IEEE Standards Board in June 2003. It was approved as an American National Standard in October 2003. The published standard is available here: **https://standards.ieee.org/findstds/standard/1547-2003.html**

- The USA Federal Energy Policy Act of 2005 calls for state commissions to consider certain standards for electric utilities. Under Section 1254 of the act: "Interconnection services shall be offered based upon the standards developed by the Institute of Electrical and Electronics Engineers: IEEE Standard 1547 for Interconnecting Distributed Resources With Electric Power Systems, as they may be amended from time to time."

Generation Types

- Inverter based Generators
  - PV arrays
  - Wind generation
- Induction generators
  - Some generators also start as Induction then switch to synchronous
- Synchronous Generators

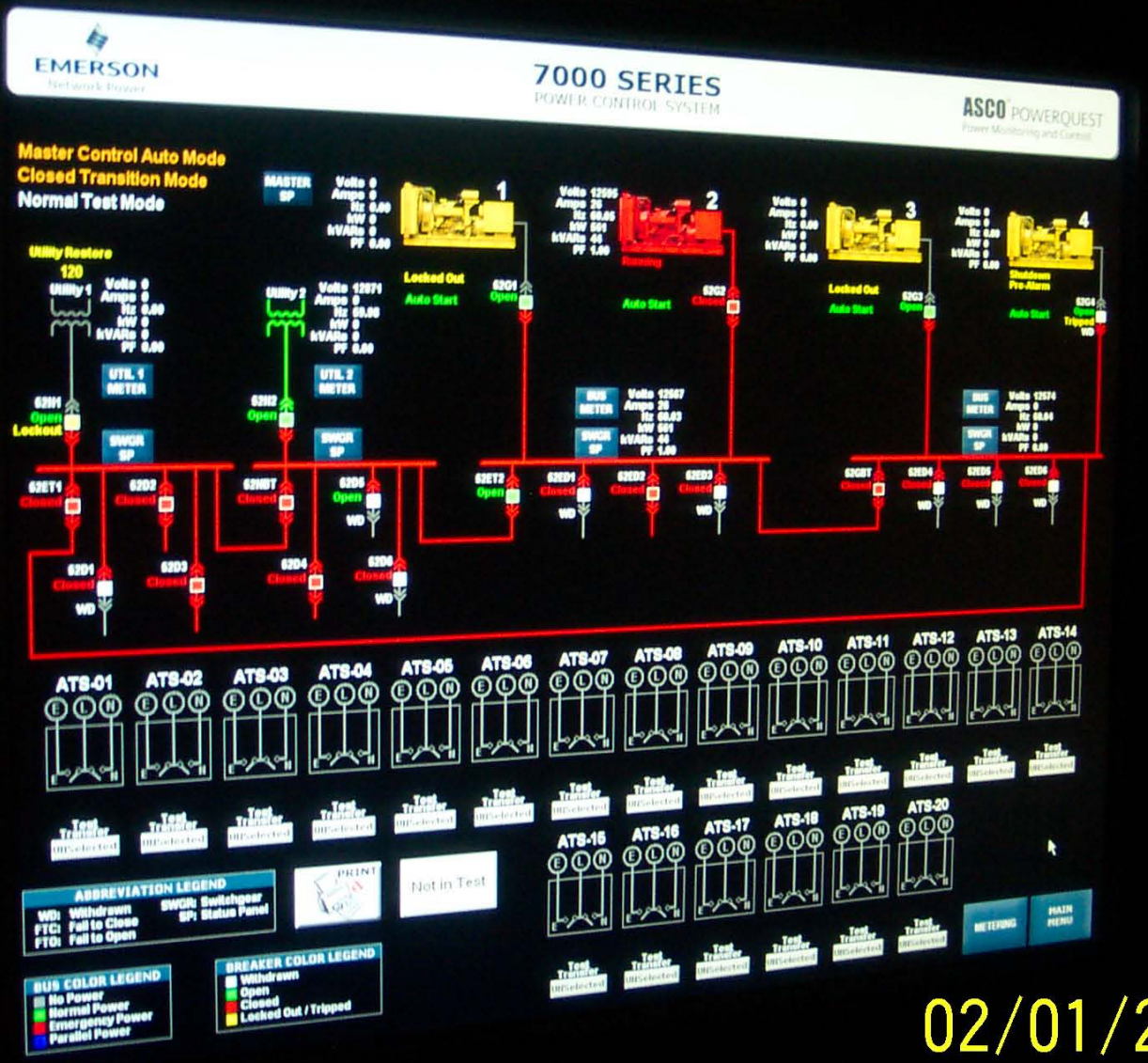
We work with the extremely old…


4 3 2 1


PLANT BREAKER
22MΩ
12 kV
PLANT CONTROL
22 VDC SUPPLY
CLOSED
OPEN
CLOSED
OPEN


140 160 175
GENERAL ELECTRIC COMPANY
Watts


ASCO
UTILITY RELAY TRIP
CONTACT GEORGIA POWER COMPANY
BEFORE RESETTING
PRIMARY
ALTERNATE
ASCO
SERVICES, INC.
1-800-800-ASCO
ASCO
POWER MANAGER
WARNING
Arc Flash Hazard
Appropriate PPE Required


EMERSON
Network Power
7000 SERIES
POWER CONTROL SYSTEM
ASCO POWERQUEST
Power Monitoring and Control
Master Control Auto Mode
Closed Transition Mode
Normal Test Mode
Utility Restore
Locked Out
Auto Start
Shutdown
Pre-Alarm
Open
Closed
Tripped
WD
ATS-01
ATS-02
ATS-03
ATS-04
ATS-05
ATS-06
ATS-07
ATS-08
ATS-09
ATS-10
ATS-11
ATS-12
ATS-13
ATS-14
ATS-15
ATS-16
ATS-17
ATS-18
ATS-19
ATS-20
Test
Transfer
UnSelected
ABBREVIATION LEGEND
WD: Withdrawn
FTC: Fail to Close
FTO: Fail to Open
SWGR: Switchgear
SP: Status Panel
PRINT
Not in Test
METERING
MAIN MENU
BUS COLOR LEGEND
No Power
Normal Power
Emergency Power
Parallel Power
BREAKER COLOR LEGEND
Withdrawn
Open
Closed
Locked Out / Tripped
02/01/2011

To the most modern technology.


KEEP OUT

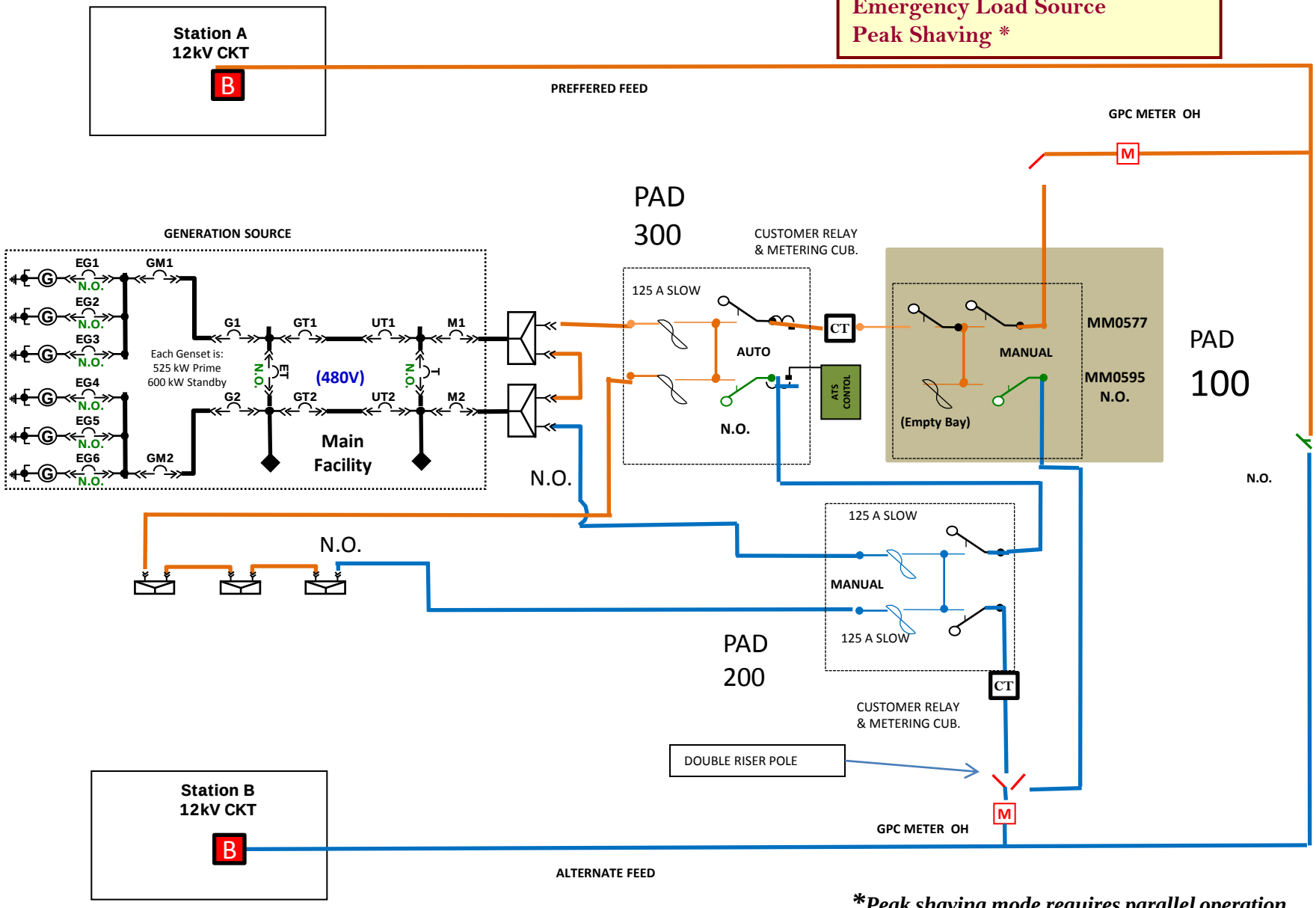

06.14.2012 14:48

From the easy …

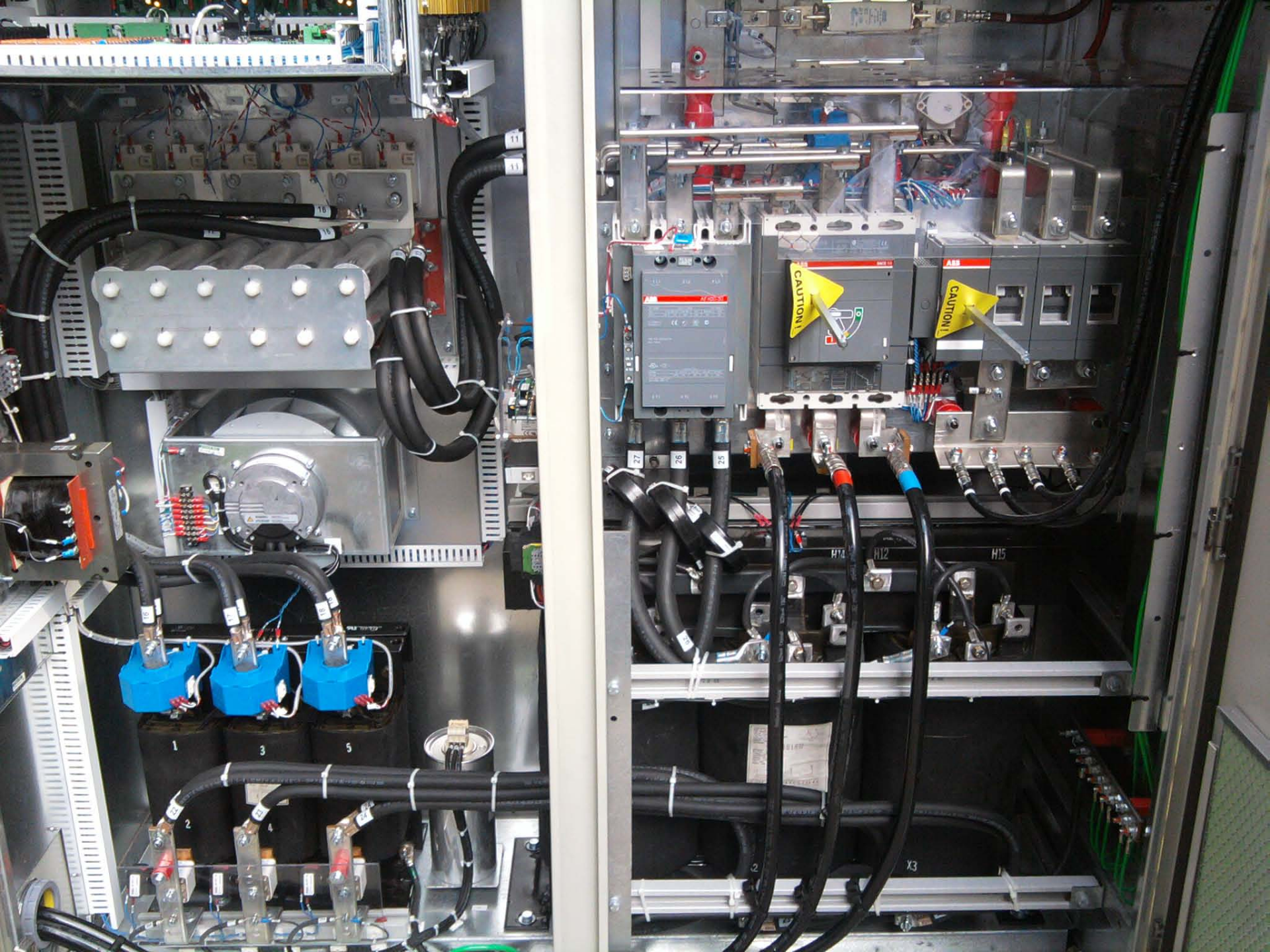
To very complicated systems…

Rev. 12/13/2011

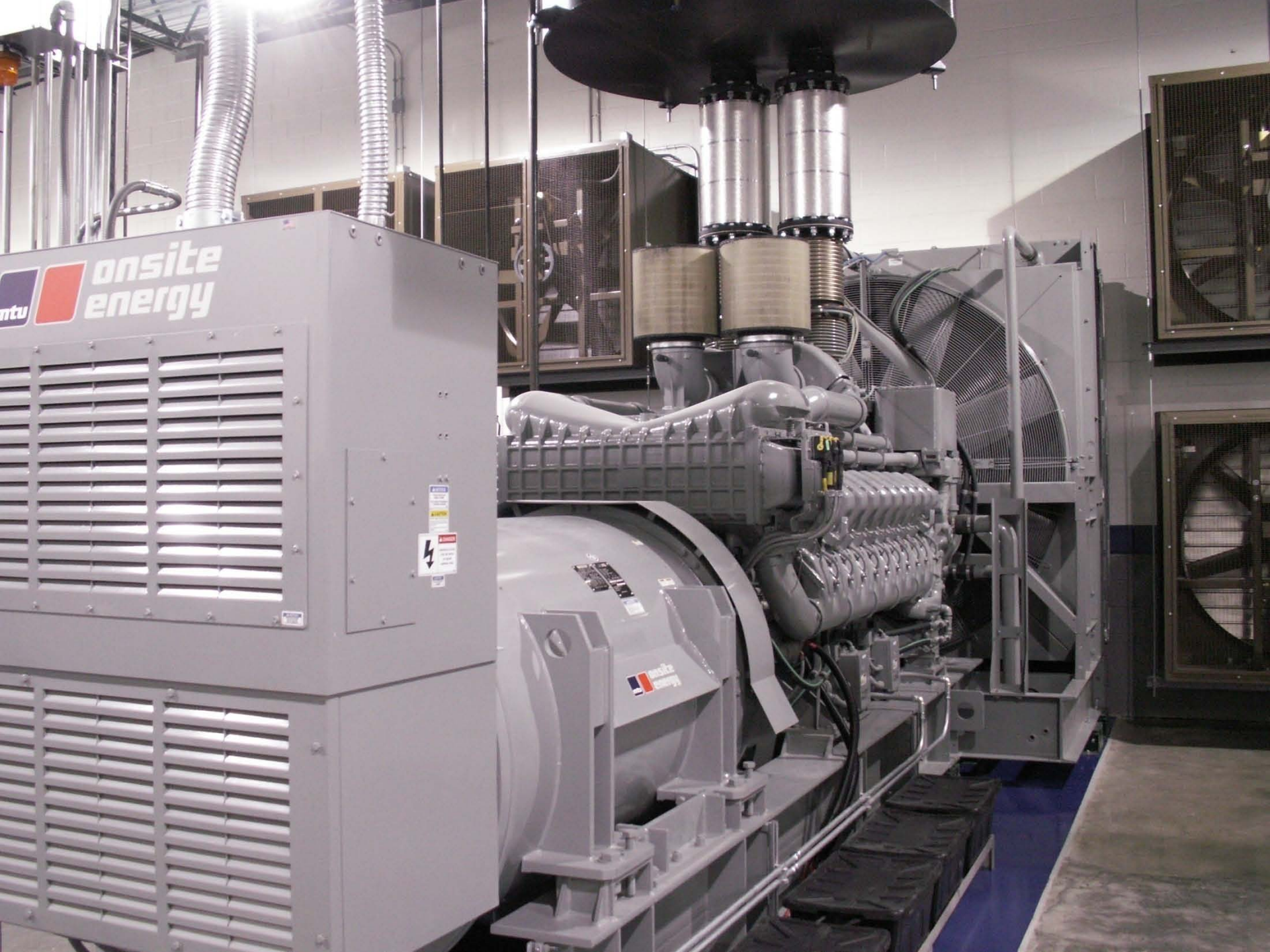
Facility OPERATION
Generation Provides:
Standby Generation
Emergency Load Source
Peak Shaving *



Peak shaving mode requires parallel operation.


CAUTION!
CAUTION!
H14
H12
H15
X3


SOLAR INVERTER
#4
Brilliance PVb-5000
Grid Tie Solar Inverter
online
ground fault
Wiring Box with Disconnect
OFF
ON


onsite energy


WARNING
02/01/2011


4
mtu
onsite energy
02/01/2011

Four basic types of interconnections

- Standby generation Open Transition
- Standby generation Closed Transition
- Peak shaving (parallel operating)
- Exporting

Utility concerns

- Back energizing of circuits from customer generation
- Quality of supply to our other customers
- Islanding conditions that can occur
- Miscoordination of protection
- False sense of load ability of feeder
- Restoration issues
- Addition of AF energy
- Compliance with IEEE 1547

Open Transition Transfers

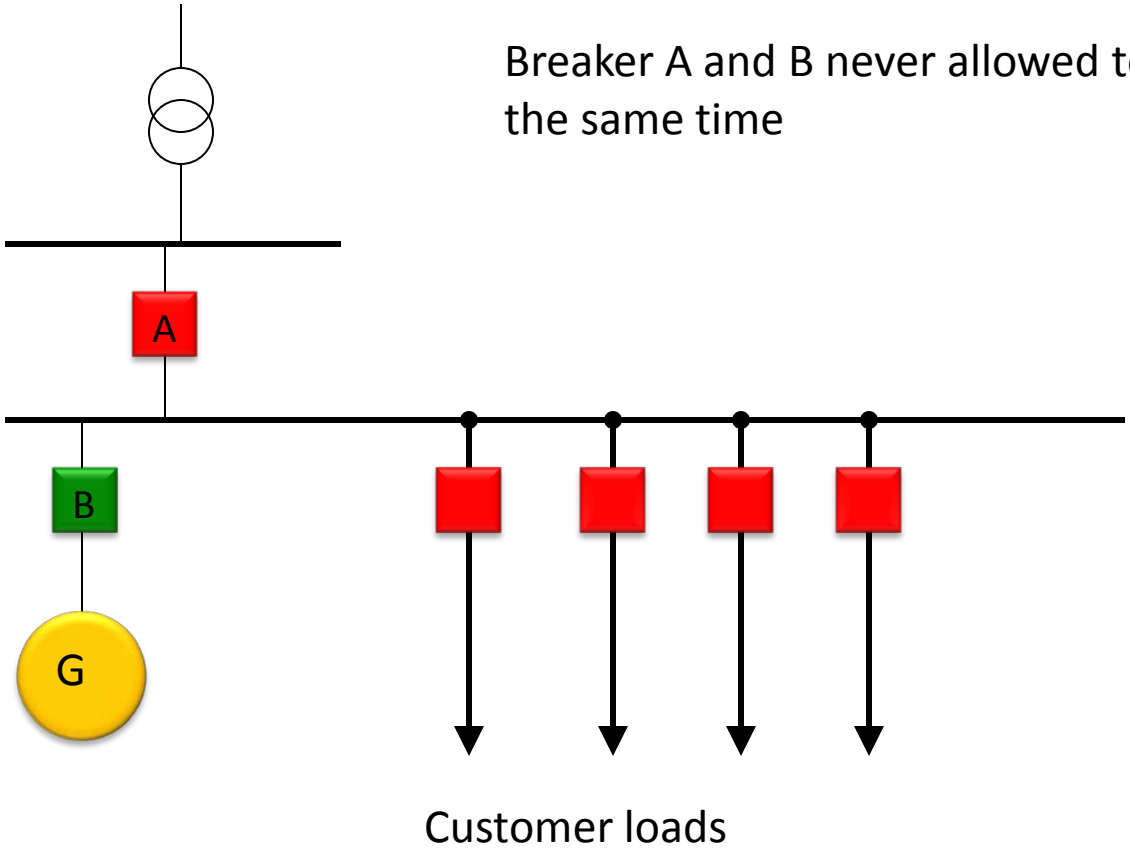
- At no time do the two sources parallel
- A mechanical way to inhibit both sources closing at the same time
- Being UL1008 listed does not imply open transition transfer; UL1008 deals with transfer switches, both open and closed transition

Most frequently asked question about DB18-23

- Do separate breakers that are electrically or electronically controlled to prevent CTT count as OTT?
  - For OTT scheme that meets the definition of Section 2.0, the ESG Owner is not required to provide intertie protection. **To be accepted by GPC, this transfer scheme must use mechanical interlocking of the switching devices to prevent inadvertent paralleling of the two sources due to failure of the switching device(s).**

OPEN TRANSITION TRANSFER (OTT)

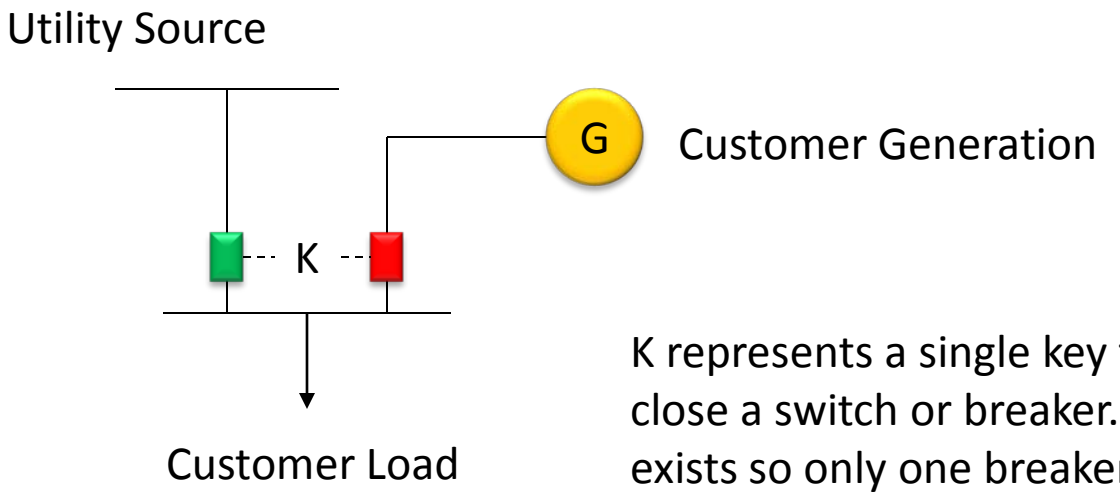
Utility Source



Breaker A and B never allowed to be closed at the same time

Customer loads

Kirk Key Interlocking System

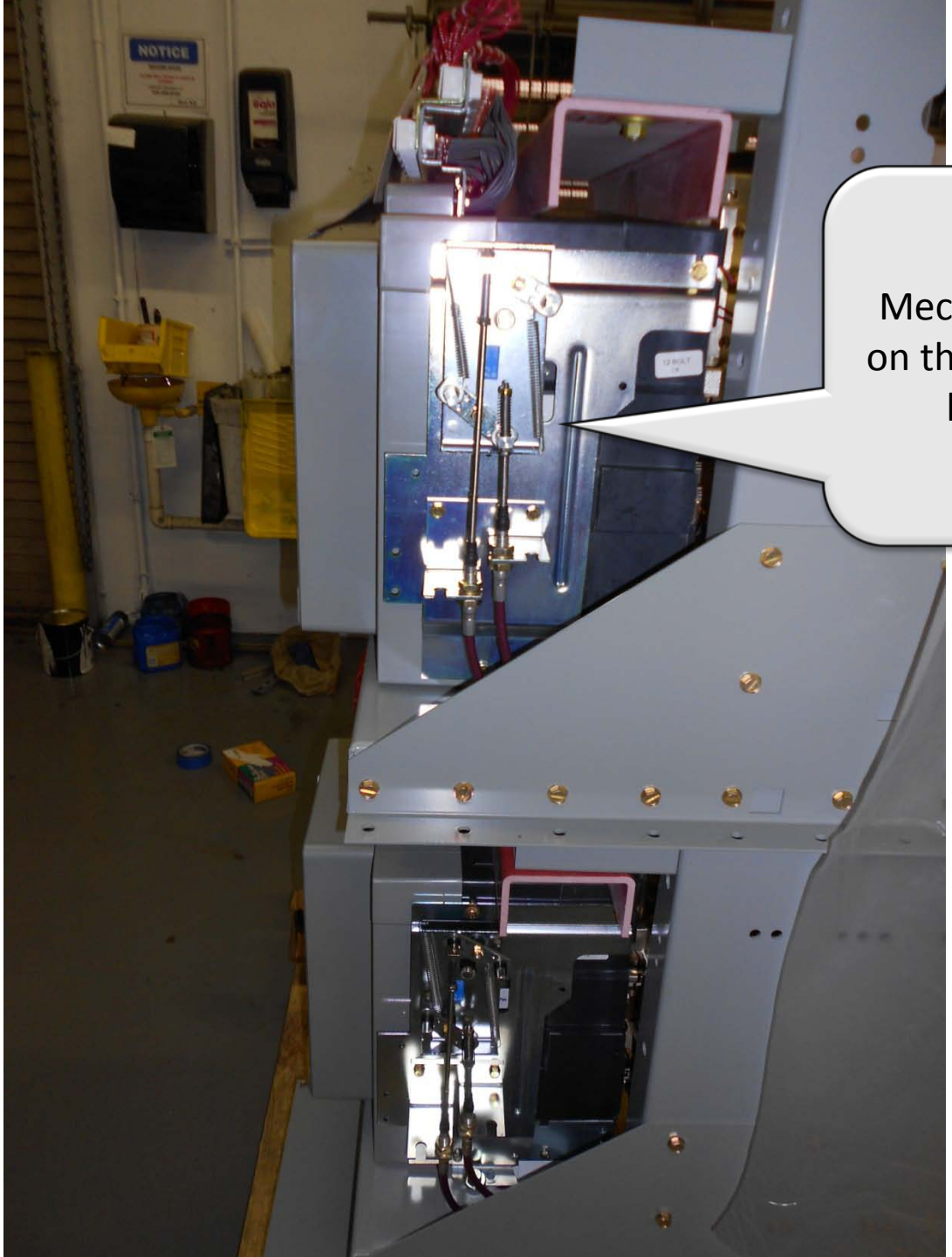


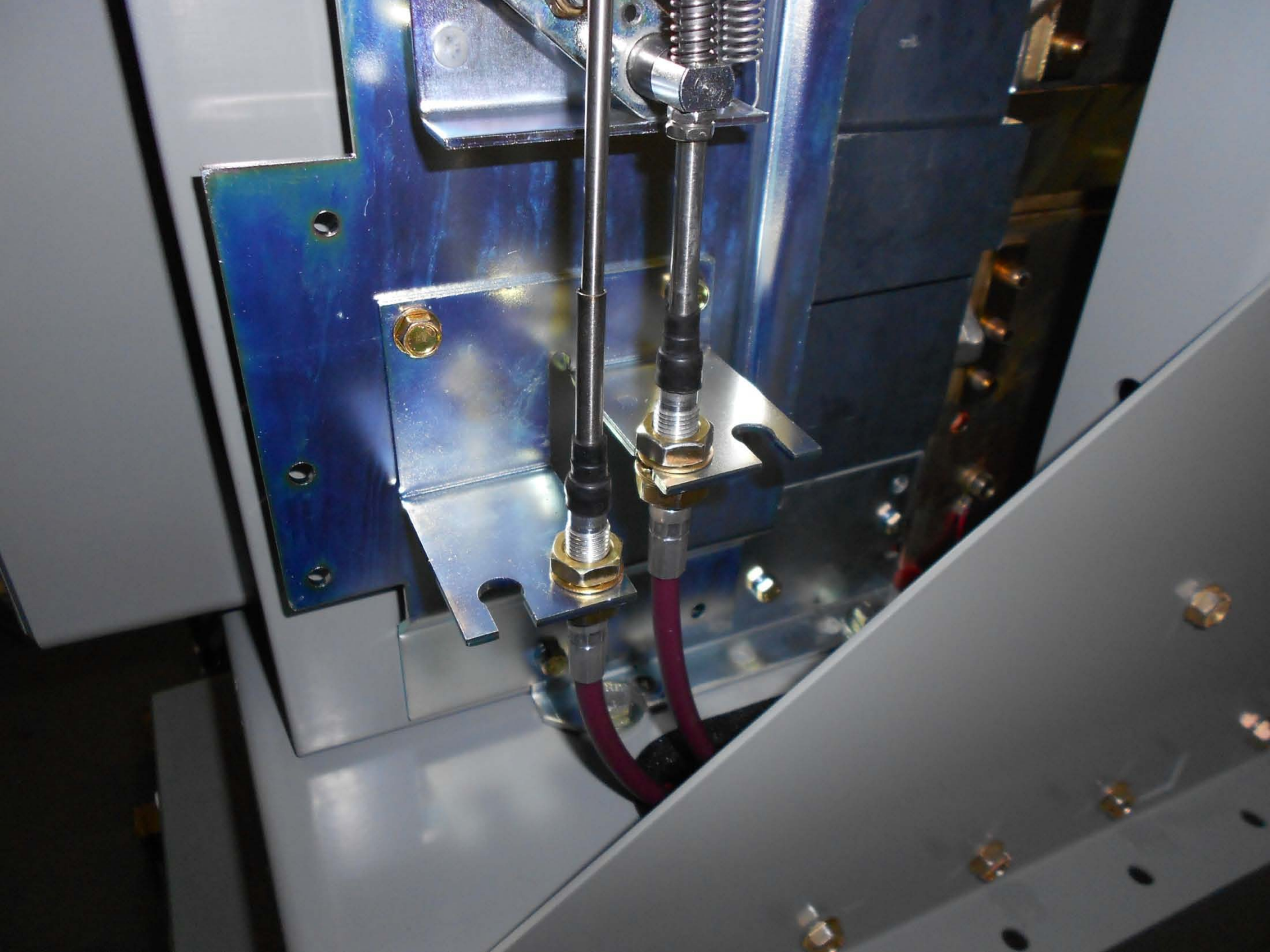
K represents a single key that is required to close a switch or breaker. Only one such key exists so only one breaker or switch can be closed at a time.

For more information about this product used by many of GPC customers, please see:
http://kirkkey.com/default.aspx?Page=Products


POSITION LOCK

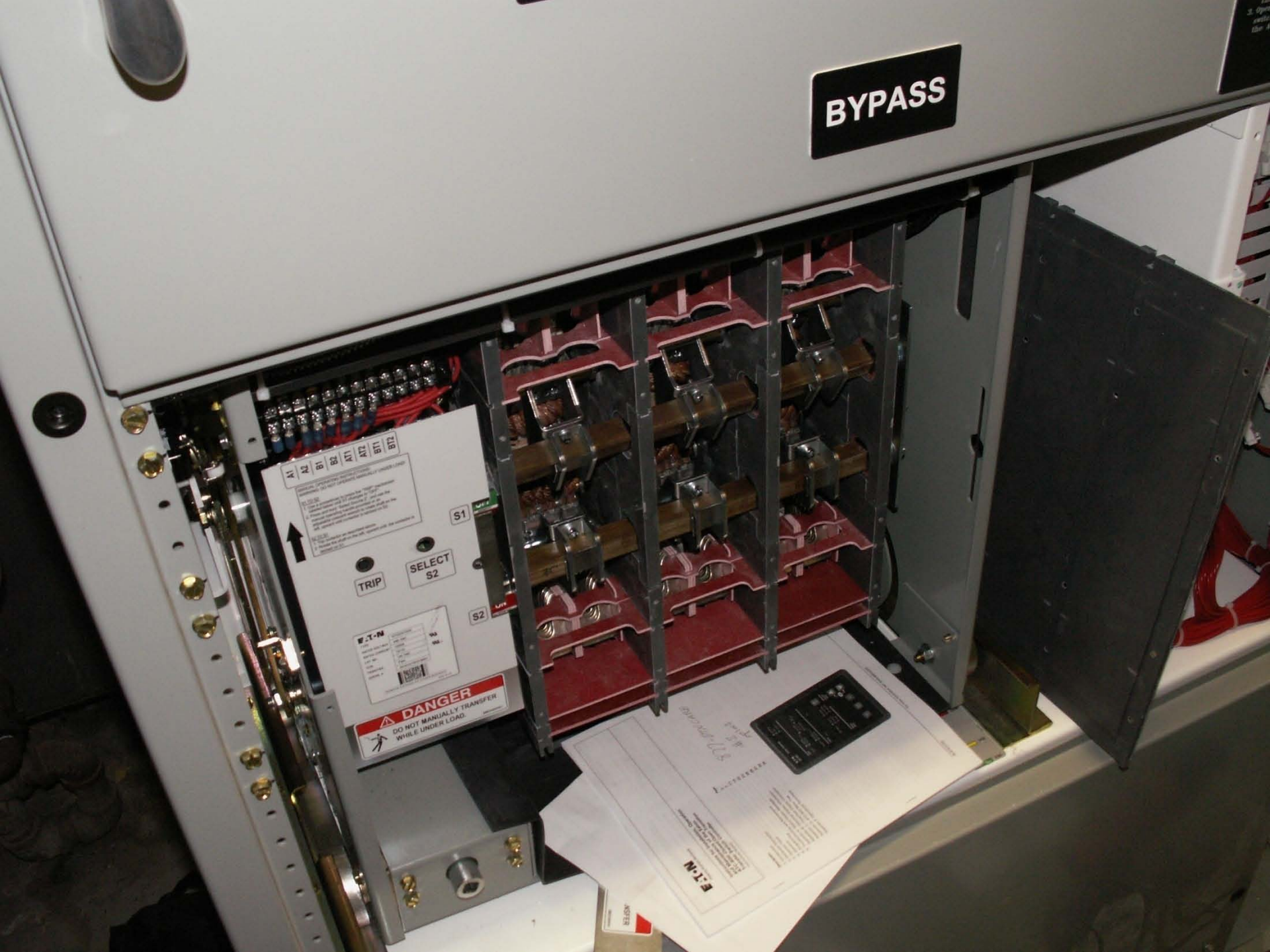

E·T·N
Magnum DS
OPEN
PUSH OFF
PUSH ON
E·T·N
NO OVERCURRENT PROTECTION PROVIDED


NOTICE
Mechanical links on this side of the breakers

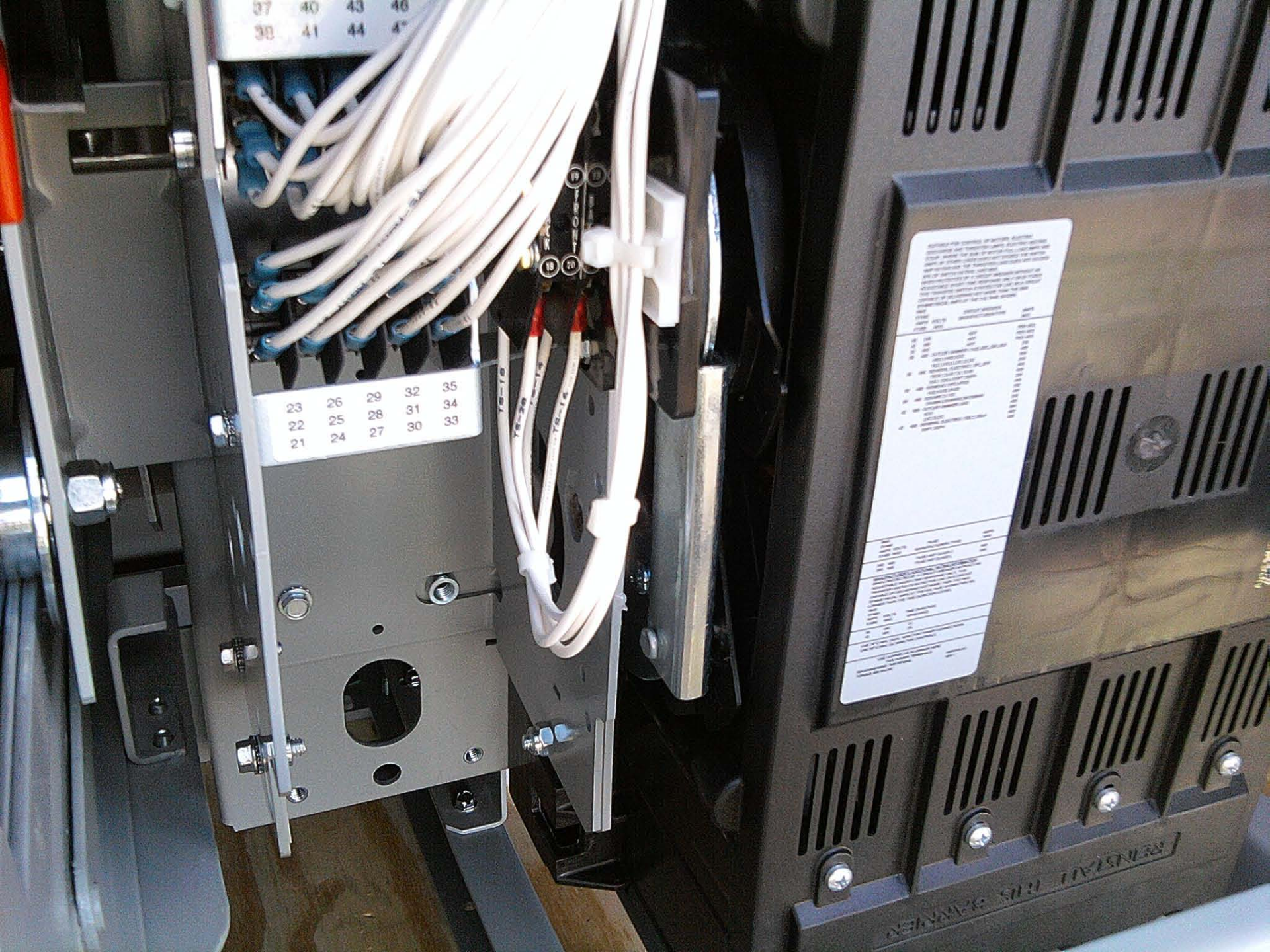


ON

ON


BYPASS
A1
A2
B1
B2
AT1
AT2
BT1
BT2
S1
TRIP
SELECT
S2
S2
E·T·N
DANGER
DO NOT MANUALLY TRANSFER
WHILE UNDER LOAD.

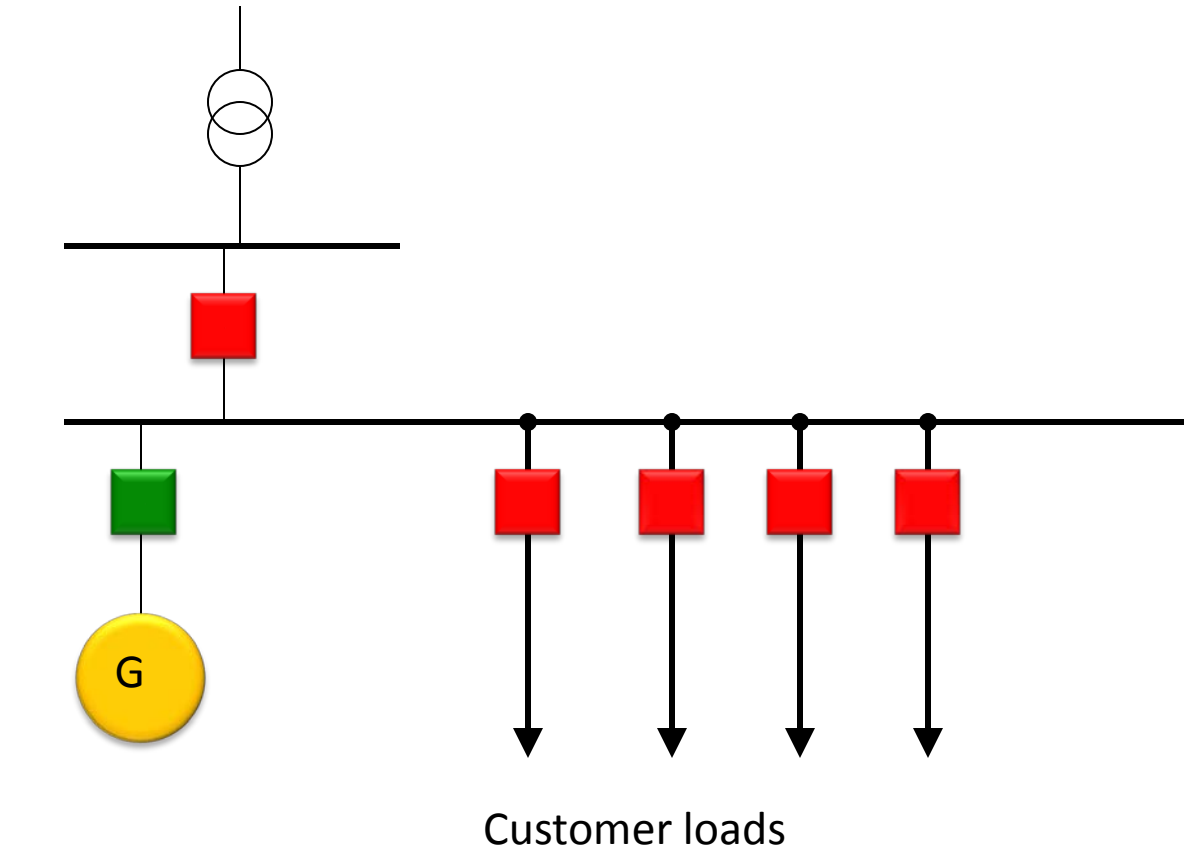

NORMAL
LOCK
LOCK
EMERGENCY


23 26 29 32 35
22 25 28 31 34
21 24 27 30 33

Closed Transition Transfer

- The two sources parallel for just long enough to allow soft loading or unloading of generation
- Care must be taken to ensure that if the transfer scheme fails, it does not allow the two sources to be connected indefinitely

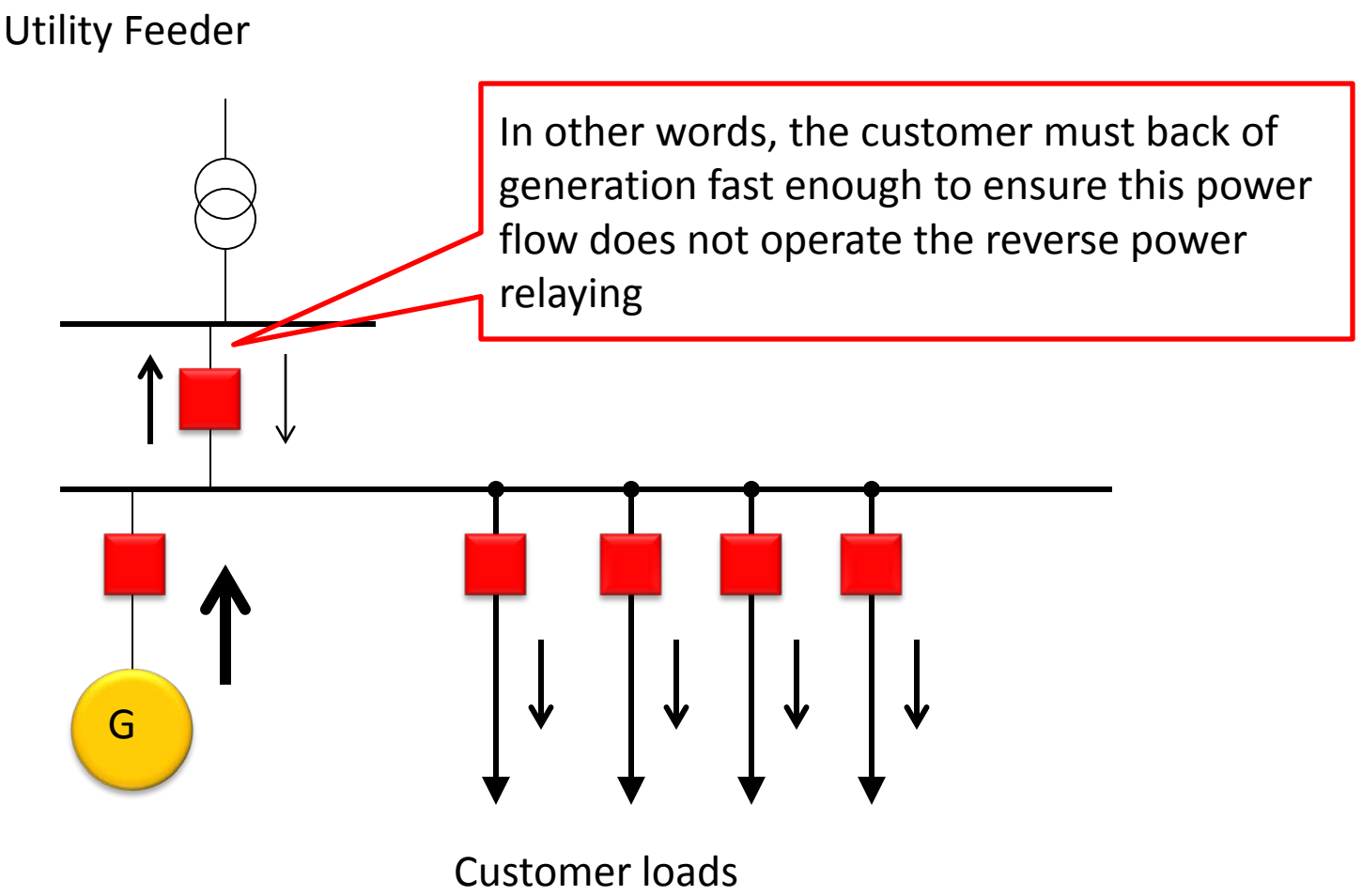
A Close Transition Transfer allows temporary paralleling with the utility. This allows for transferring without dropping load. It does NOT mean the customer will not see an outage under fault conditions.

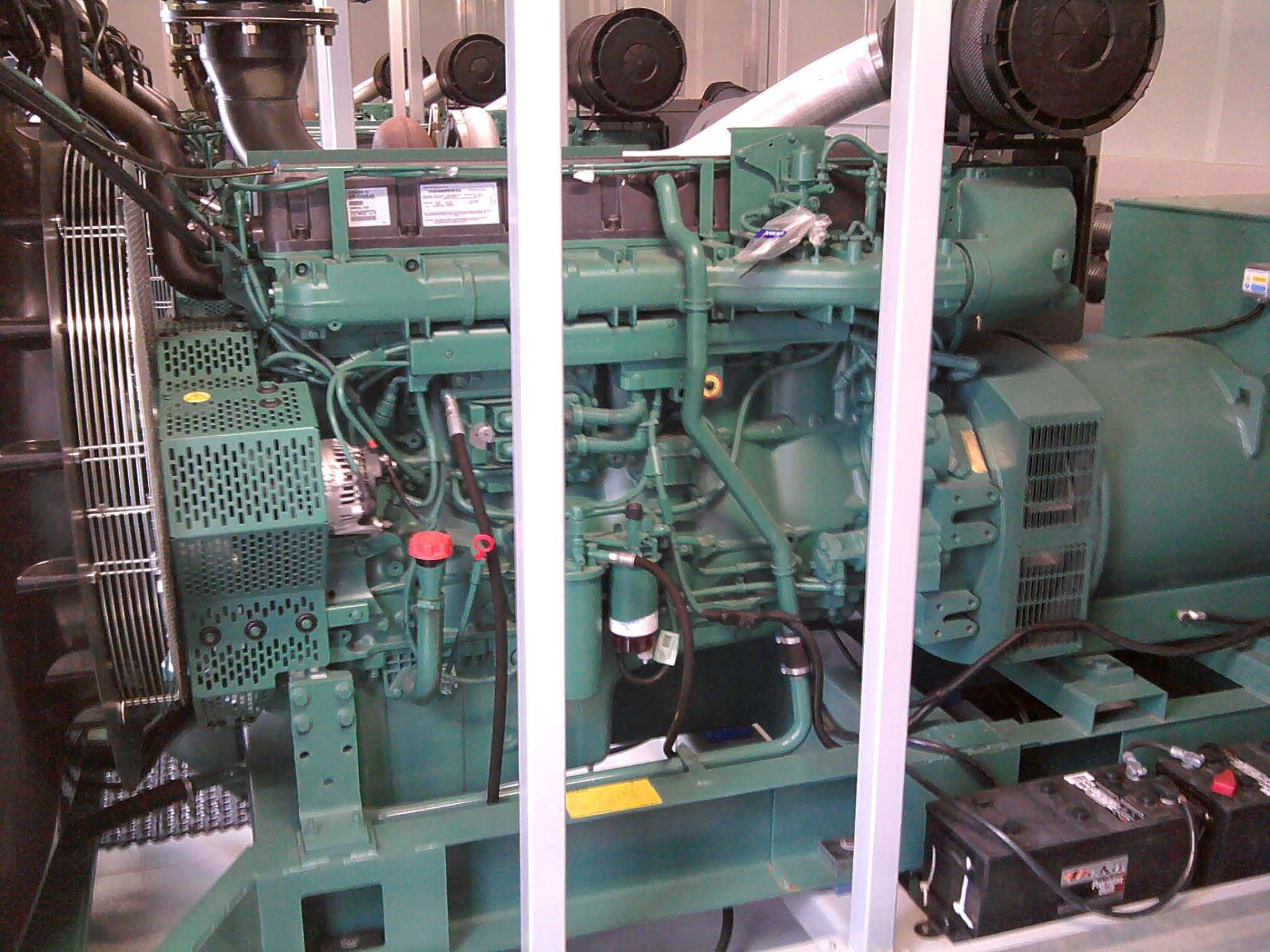


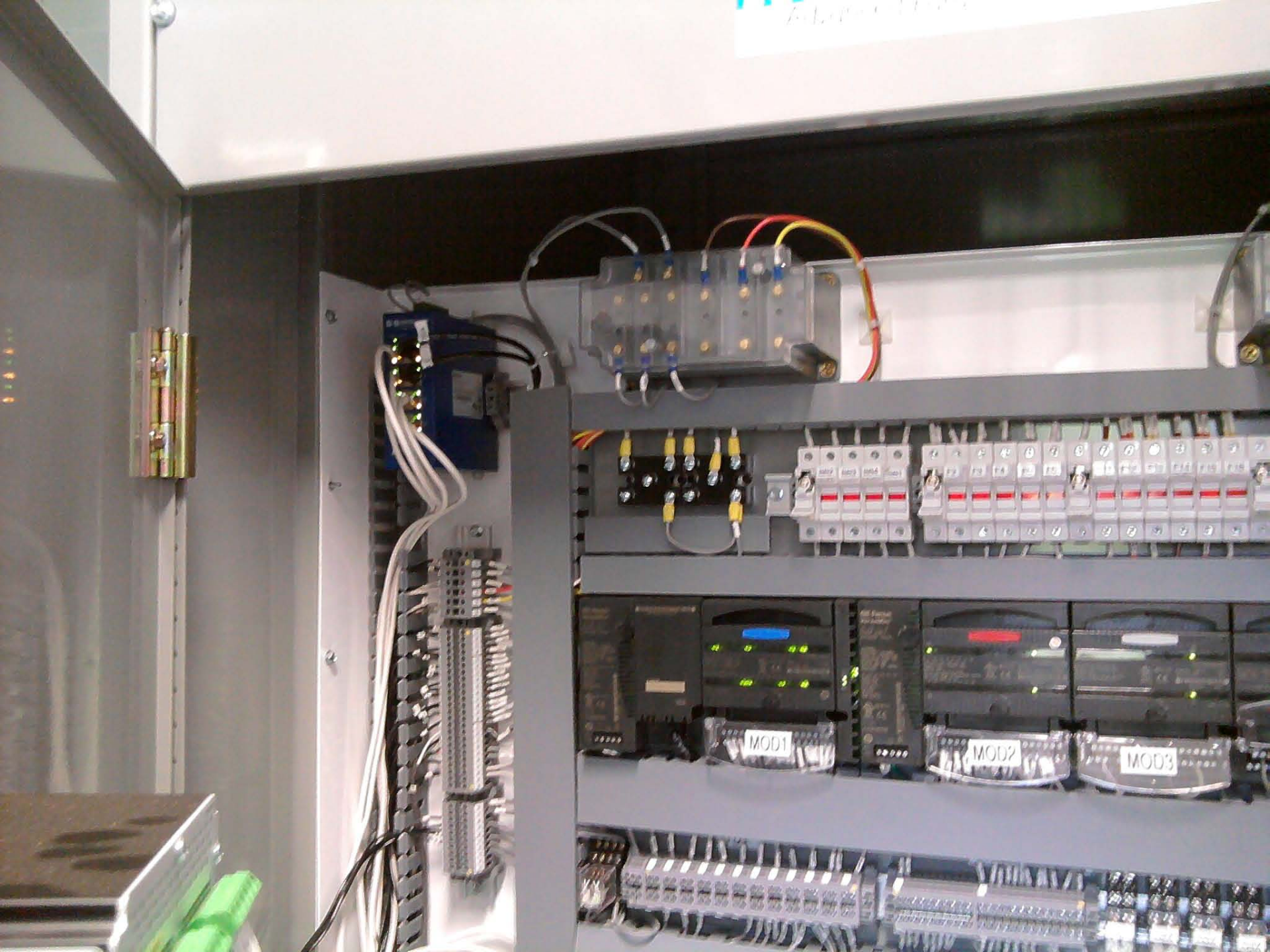
Peak Shavers

- Generation runs parallel with utility
- No exporting of power is allowed
- Care must be taken that generation acts fast enough to large load reduction
- Generation may contribute to Utility Fault current
- Protection coordination with Utility required
- Method of Generator control must be considered
- AF analysis may be required

While peak shaving the customer must control the generator such that loss of the largest load would not cause reverse power to flow for longer than the pre-determined time.






MOD1
MOD2
MOD3

DB18-23

- The Bulletin:
  - Last Revision dated July 15, 2008
  - Provides definitions of OTT, CTT and others
  - Gives Minimum intertie requirements
  - Currently a single Application Bulletin for all non-exporting Generation
  - Addresses non-exporting Generation only
  - Provides minimum responsibilities of DG Owner
- The Bulletin does not:
  - Give guidance for customer equipment protection
  - Guarantee correct and safe operation of customer installation
  - Cover all scenarios
  - Allow for the customer to decide IF an application should be completed; All must apply

It’s all about safety!

1.3 SAFETY

The requirements of this bulletin are intended to achieve the following:

- Insure the safety of the general public and GPC personnel
- Minimize possible damage to the property of the general public, GPC, and GPC customers
- Minimize adverse operating conditions on the GPC Distribution System
- Permit safe operation of customer-owned ESG.

In order to achieve these goals, intertie protection devices (relays, power circuit breakers, etc) may be required to ensure prompt disconnection of the ESG from the GPC Distribution System. The protective devices required depend primarily on the power source transfer scheme selected by the ESG owner. These schemes include:

- Closed Transition Transfer (CTT)
- Open Transition Transfer (OTT)

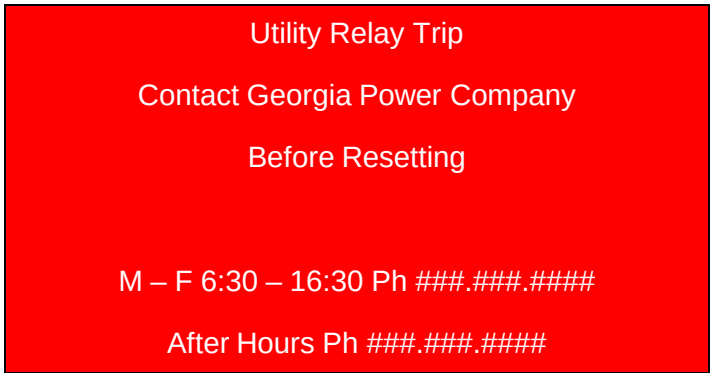
4.3.1 INTERTIE PROTECTION

Minimum protection requirement to prevent undesired export of power to GPC shall include:

- •Sensitive directional power (32) relay with trip direction towards GPC that can be set to detect 2% of the power rating of the GPC service transformer
- •Timing (62) relay which supervises the 32 relay
- •Manual reset, lockout (86) relay

These must be utility-grade and are required for each intertie breaker. Each lockout relay must be wired to trip the circuit breaker directly (with no indication lights, etc, in the trip path) and block its closing. When the lockout relay trips the breaker, the Customer shall not reset the lockout relay until instructed to do so by the GPC Distribution Control Center or their appointed representative. Each

lockout relay must be clearly marked with the following illustration:



How to apply:

6.0 APPLICATION

A GPC Customer who wishes to own, install and operate an ESG is required to complete the Application attached to this document. Completed application must be sent to the GPC Account Manager assigned to the Customer including the following documents:

- Required Technical Data Form that is attached to this document.
- A detailed one–line electrical diagram of the proposed facility.
- All applicable elementary diagrams.
- Specifications and Details of All Generators, Generator Transformers, Intertie & Generator Circuit Breakers, Intertie Protective Relays, Current Transformers and Voltage Transformers and any other major equipment.

GPC Distribution Reliability Engineering and Distribution Planning will review all documents submitted and provide recommended intertie protection requirements to the GPC Account Manager for transmittal to the Customer. The Customer is advised to not purchase any equipment until after the review has been completed. The review may identify modifications to the GPC facilities serving the Customer. The Customer shall be responsible to pay the total cost for the modifications.

How does GPC verify it all works correctly?

7.0 ESG FACILITY INSPECTION AND TEST

ESG Facilities that choose to employ CTT scheme with the electric utility source shall not be permitted to operate until operational testing of the CTT scheme has been inspected and witnessed by GPC. Prior to doing this activity, GPC requires that the ESG Owner completes the attached Checklist and submits to his GPC Account Manager for review by GPC Distribution Reliability Engineering. Upon completion of the review, GPC Distribution Reliability Engineering will schedule an inspection date with the Customer. The inspection shall include, but not be limited to, verification of the proper operation of the intertie protection scheme, including trip testing of the breakers by the intertie protective relays under real system conditions.

Once all requirements are met, the ESG owner shall be granted approval for operation of the generating equipment in parallel with the GPC system. Neither the inspection nor the granting of approval to operate shall serve to relieve the ESG owner of any liability for injury, death or damage attributable to the negligence of the

owner.

Why test Inverter based generation?

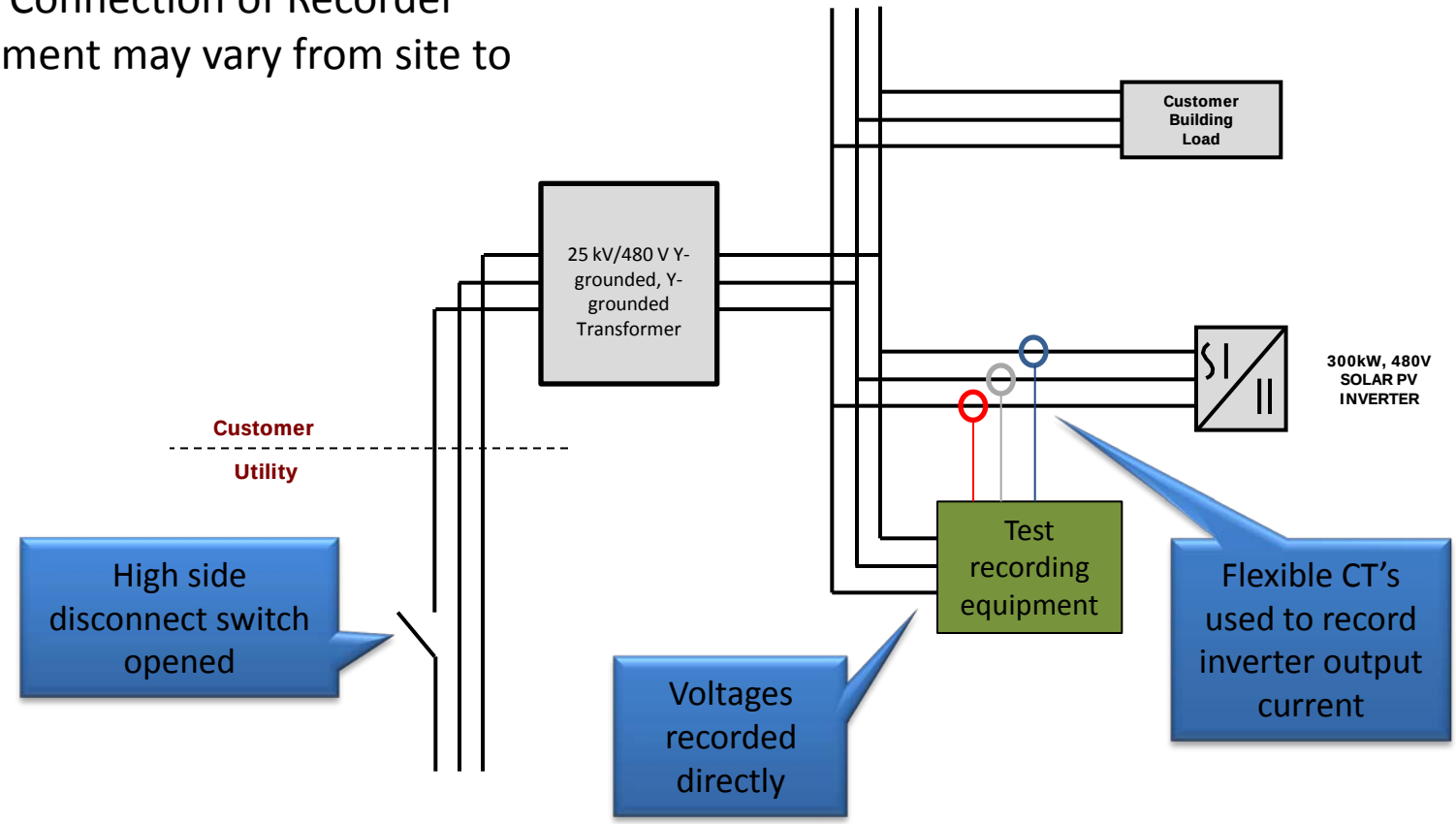
- All customer owned inverters used for power generation must be UL1741 listed.
- Listing of UL 1741 is the MINIMUM requirement. The customer must also adhere to IEEE 1547
- As shown in this presentation, not all inverters are set up to be IEEE 1547 compliant and may require modification

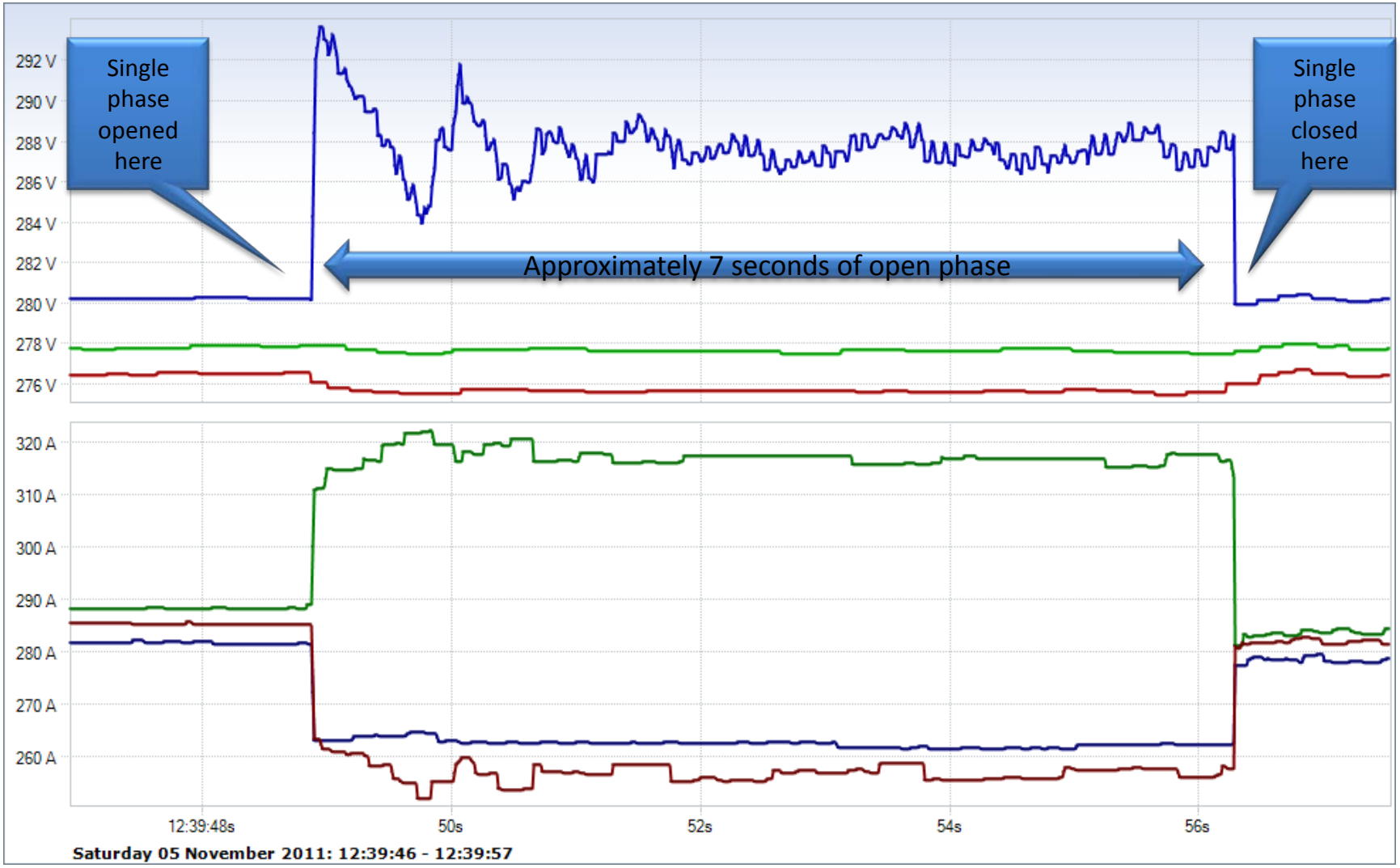
Testing Single Phasing disconnect of Generators

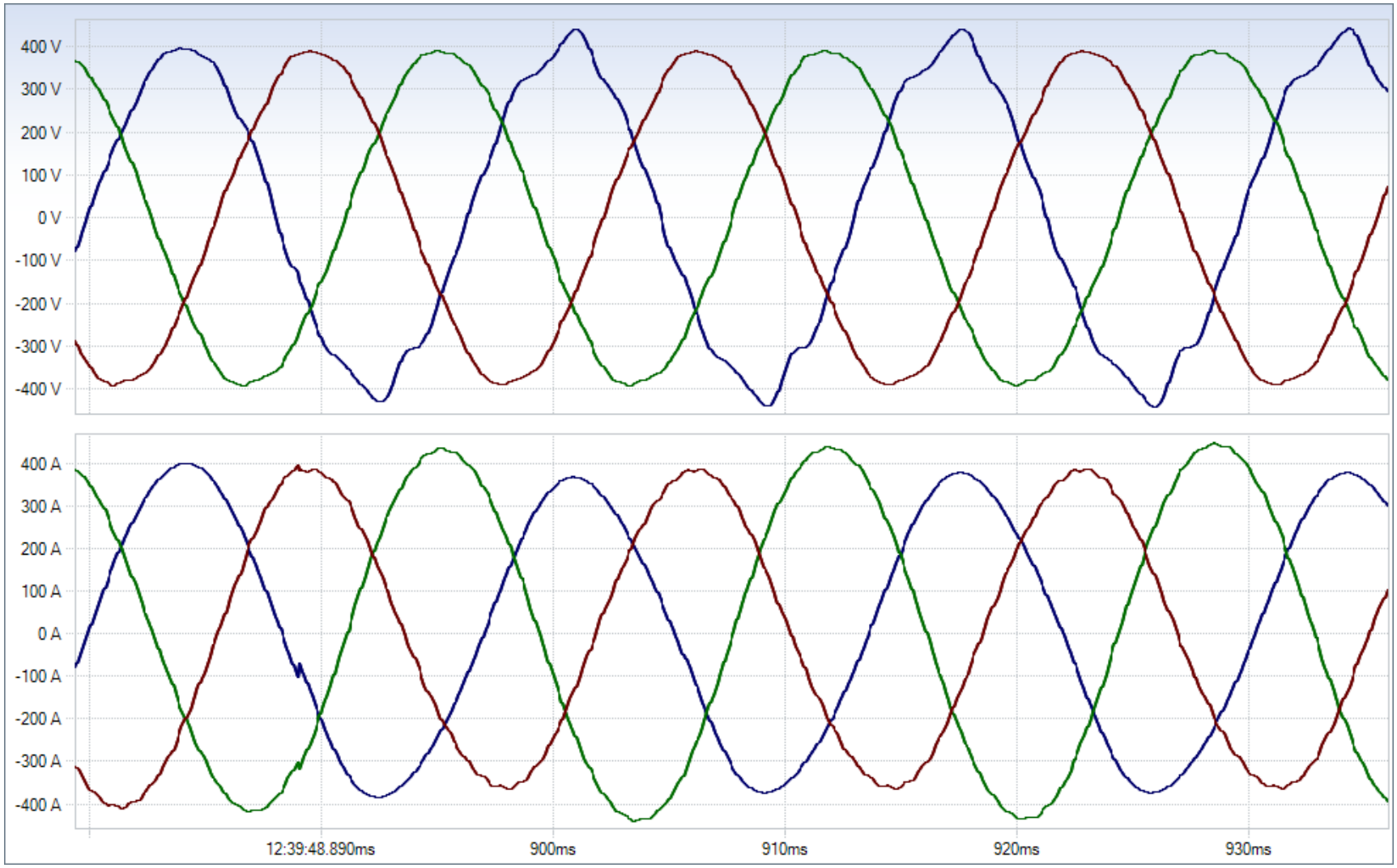
- IEEE 1547 specifies that the Cease to Energize test shall be performed on each phase individually.
- IEEE 1547.1 specifies “With the DR operating, disconnect one phase conductor from the area EPS using a device other than the interconnection component that provides the cease-to-energize function.”

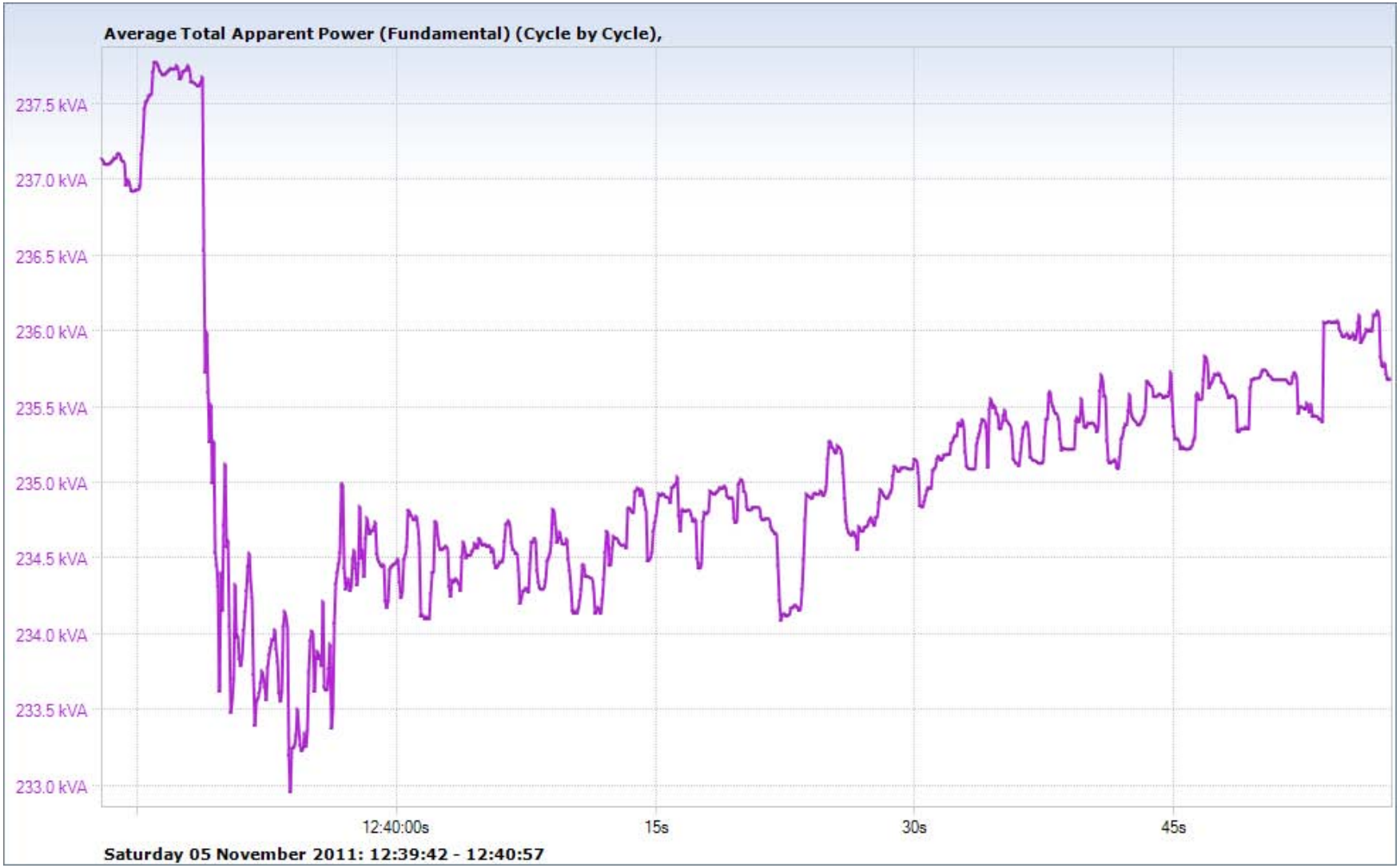
The test setup

Note: Connection of Recorder equipment may vary from site to site.

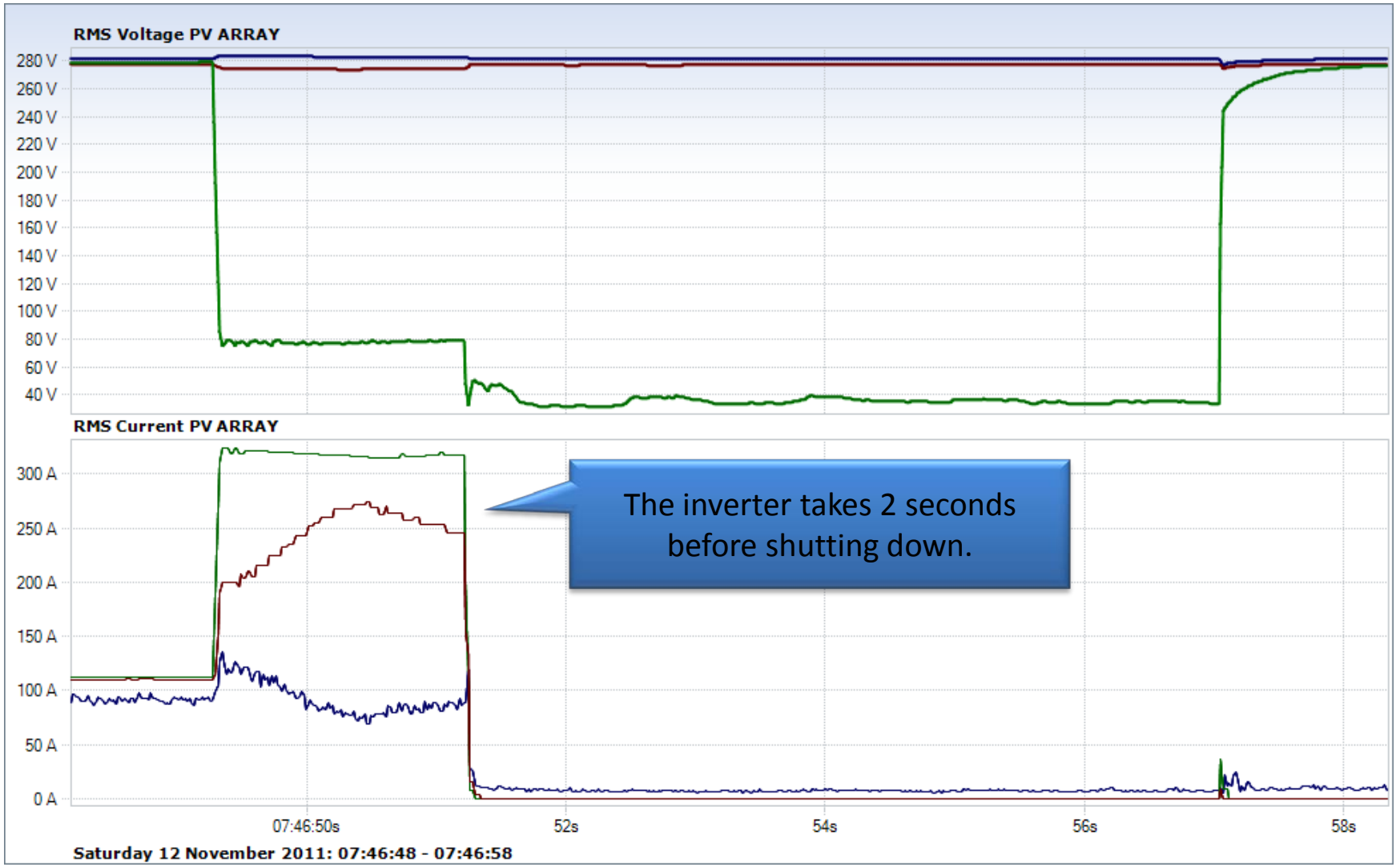



Single phase opened here
Single phase closed here
Approximately 7 seconds of open phase
292 V
290 V
288 V
286 V
284 V
282 V
280 V
278 V
276 V
320 A
310 A
300 A
290 A
280 A
270 A
260 A
12:39:48s
50s
52s
54s
56s
Saturday 05 November 2011: 12:39:46 - 12:39:57


400 V
300 V
200 V
100 V
0 V
-100 V
-200 V
-300 V
-400 V
400 A
300 A
200 A
100 A
0 A
-100 A
-200 A
-300 A
-400 A
12:39:48.890ms
900ms
910ms
920ms
930ms


Average Total Apparent Power (Fundamental) (Cycle by Cycle),
237.5 kVA
237.0 kVA
236.5 kVA
236.0 kVA
235.5 kVA
235.0 kVA
234.5 kVA
234.0 kVA
233.5 kVA
233.0 kVA
12:40:00s
15s
30s
45s
Saturday 05 November 2011: 12:39:42 - 12:40:57

After settings on the inverter were changed



8.0 OPERATING GUIDELINES

The ESG owner shall operate the generating equipment within the guidelines of this document. GPC reserves the right to disconnect service to the ESG Facility for any of the following reasons:

- A GPC system emergency.
- Departure of ESG Owner from the technical specifications and requirements of this bulletin, including resetting the intertie protection lockout relay without explicit instruction to do so by GPC.
- Personal safety is threatened.

Failure of GPC to disconnect service to ESG Facility shall not serve to relieve the ESG owner of any liability for injury, death or damage attributable to the negligence of the ESG owner.

DB18-23