ONBOARD VS TRADITIONAL

IEEE Central Tennessee

PARALLELING SWITCHGEAR

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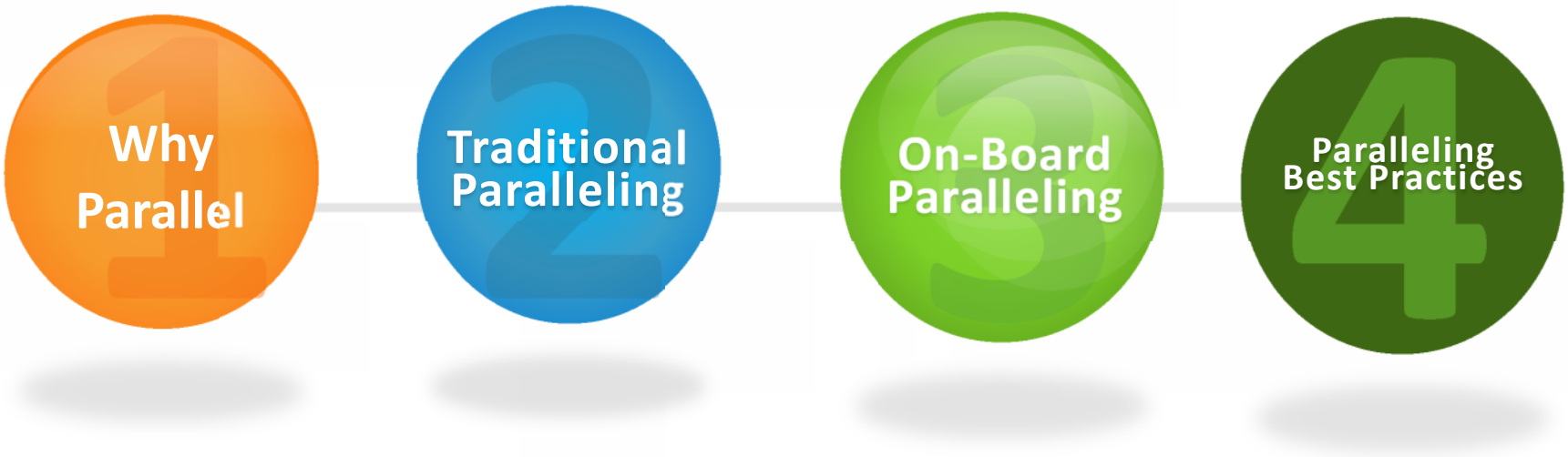
Objective for todays meeting:

To examine the latest technology in paralleling controls and discuss the pros and cons of each.

Overview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Why Parallel
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Traditional Paralleling
3
On-Board Paralleling
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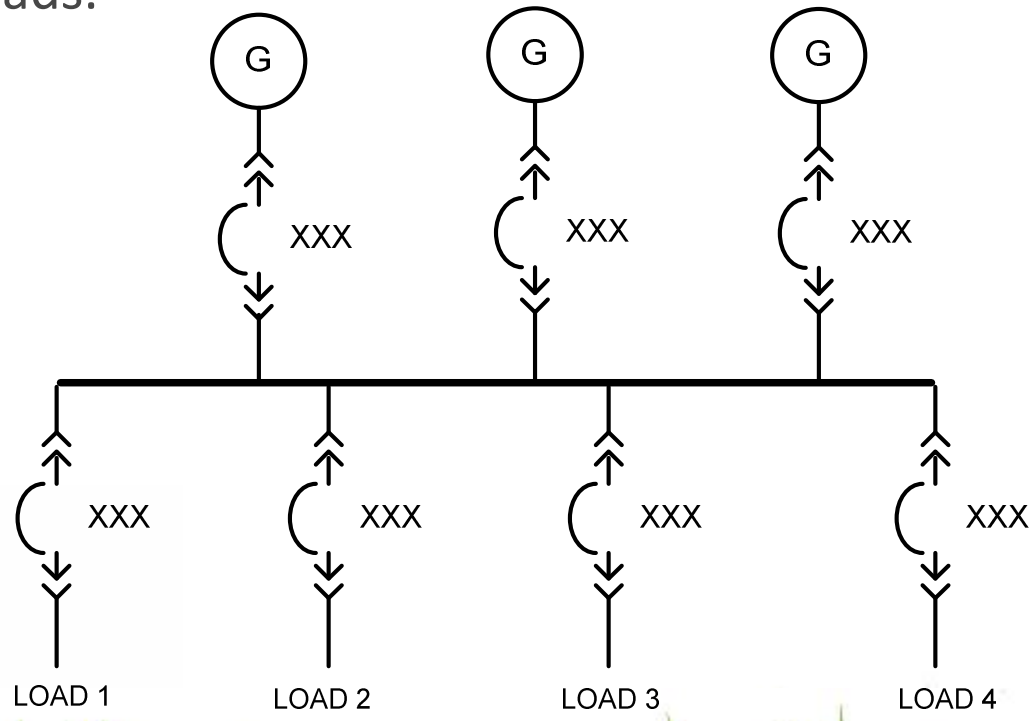
Paralleling Best Practices

Why Parallel

Why Parallel

Paralleling

- Synchronous operation of two or more generator sets connected together on a common bus in order to provide power to common loads.



Why Parallel?

RELIABILITY:

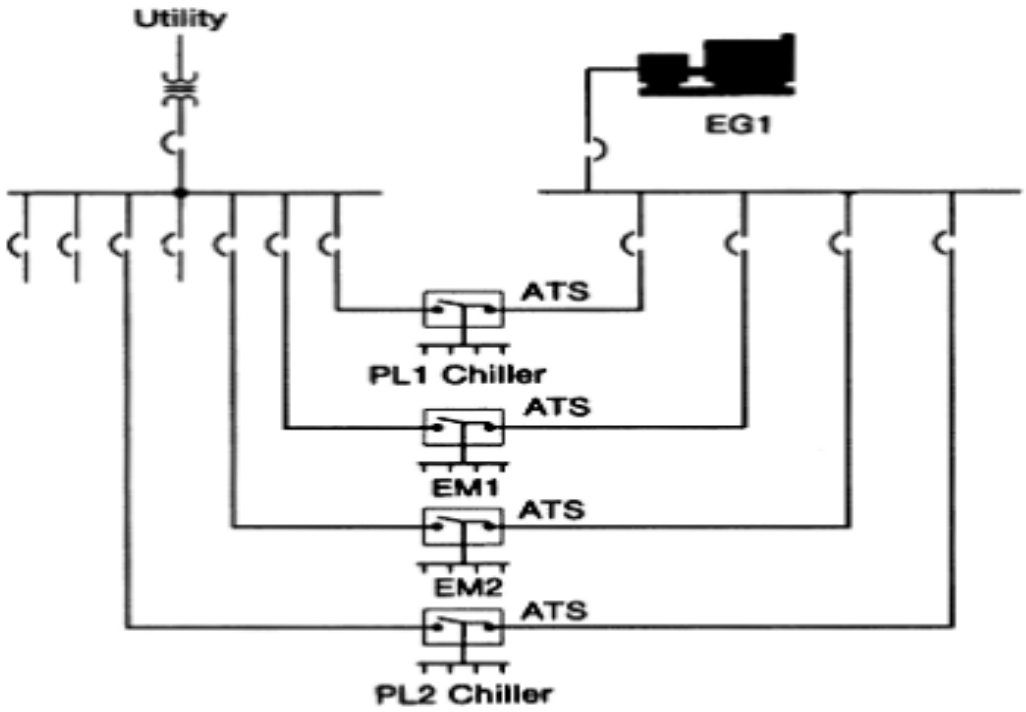
- Continue operation if one Genset fails.
  - One large Genset failure/being serviced - entire facility is at risk.

- Utilize all available sources.
  - Many facilities have Gensets scattered from building to building without being paralleled .
  - If the Genset for life safety/Critical loads fails, cannot utilize other Gensets on campus.

REDUNDANCY:

- Redundancy required for most mission critical facilities.
  - Remove/Reduce single sources of failure.
  - Required for Tier 2+ data centers.

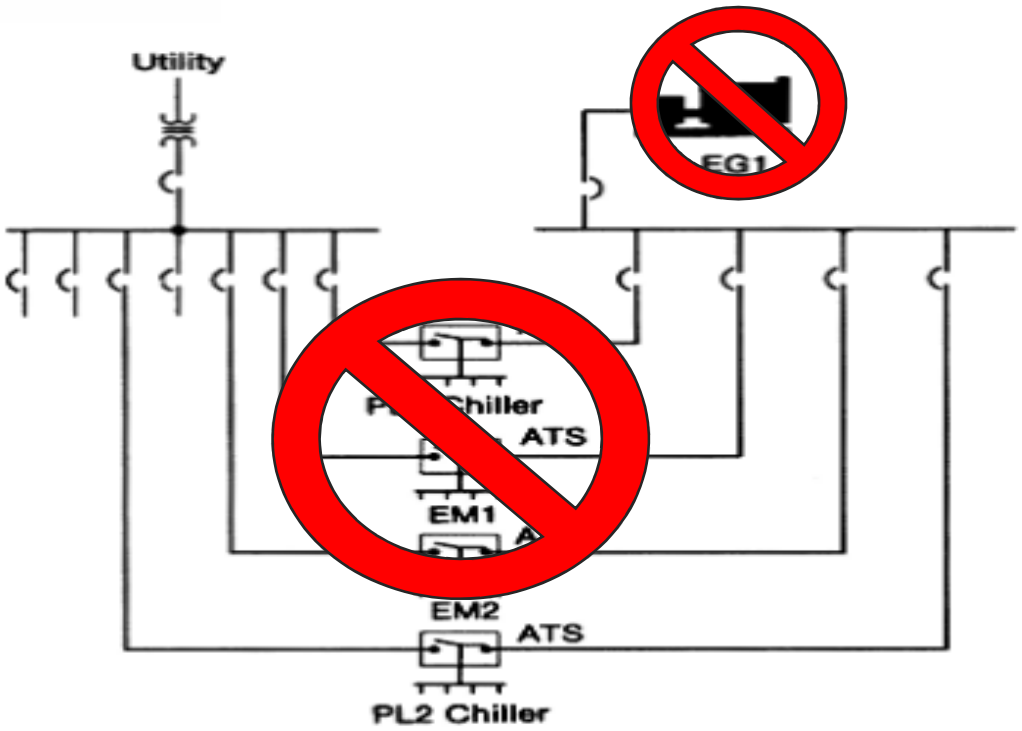
Why Parallel?



Legend

ATS – Automatic Transfer Switch
EM – Emergency Load
EG – Emergency or Standby Engine Generator Set
PL – Peak Shaving Loads

Why Parallel?



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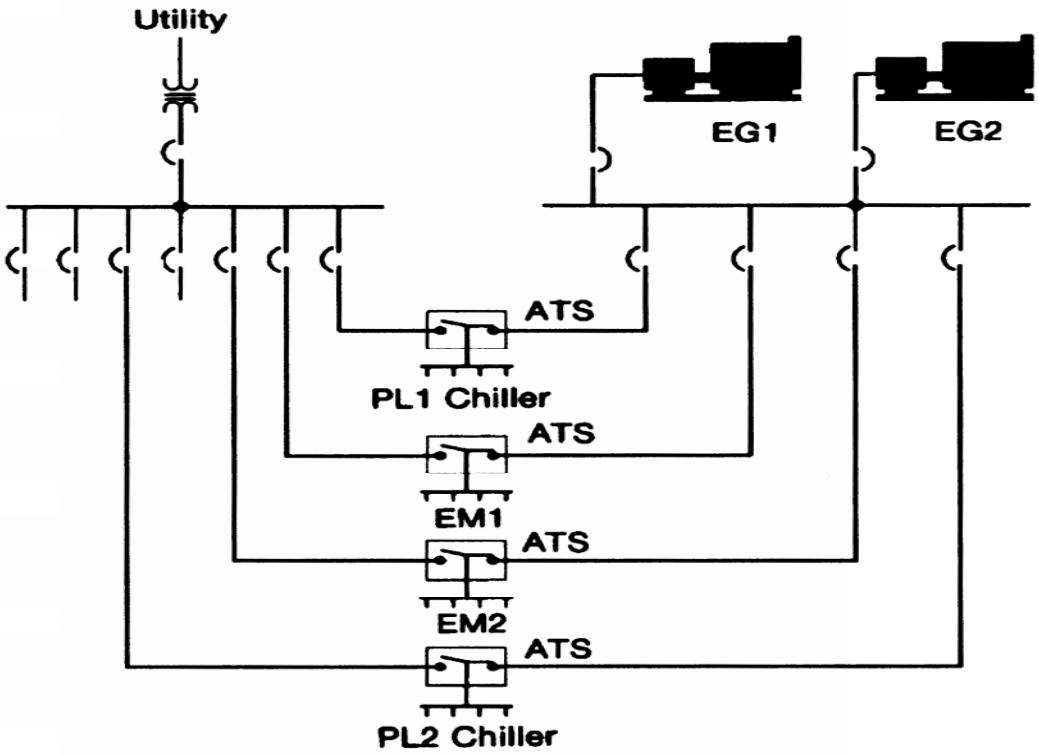

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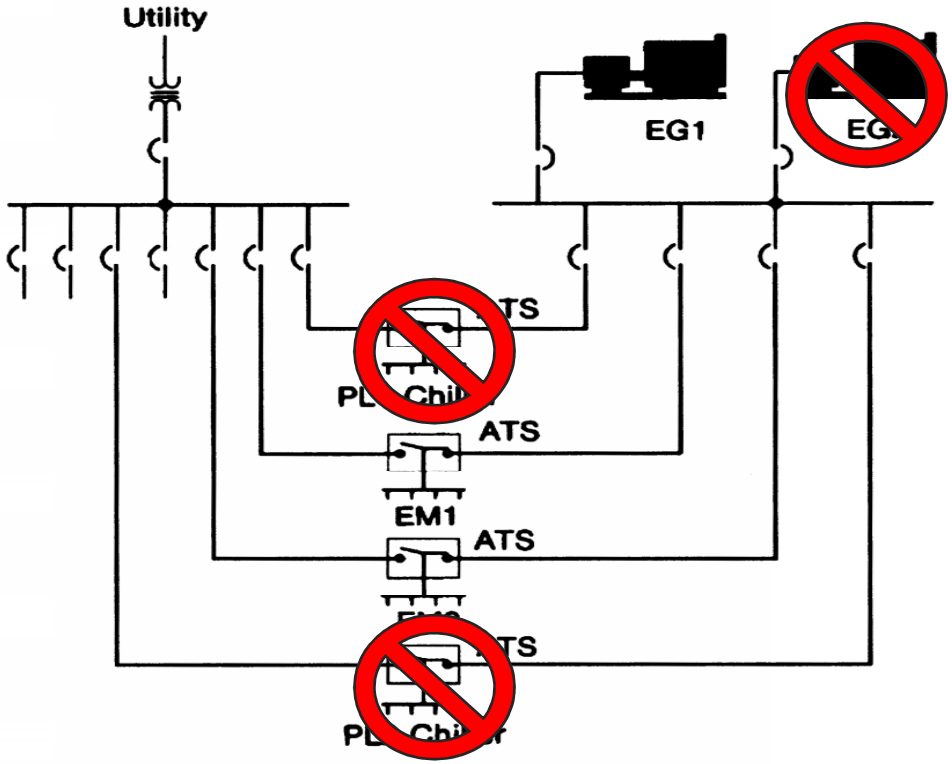

Legend

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Why Parallel?

FLEXIBILITY:

- Using multiple units in parallel offers greater flexibility than a single unit (smaller units on a roof).
- Can share load or run on intervals.

  (which prolongs engine life and reduces maintenance costs)

EXPANDABILITY:

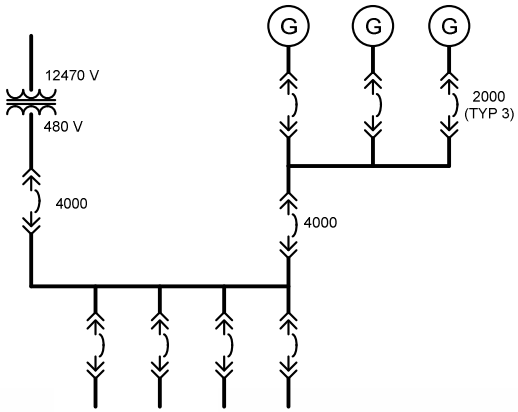
- Consider future needs and leave room for expansion.

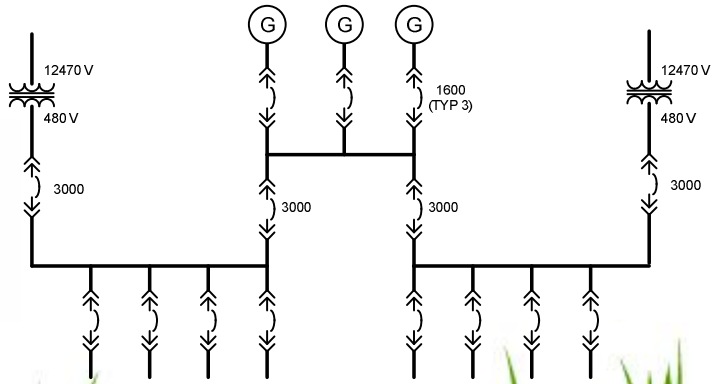
EASE OF MAINTENANCE AND SERVICIBILITY:

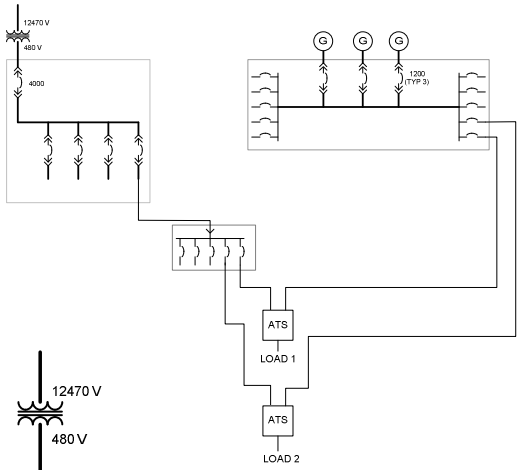
- Can service/maintain one Genset while second Genset remains in standby.

Paralleling Switchgear Types

- Low Voltage (600V class)/Medium Voltage (5kV-15kV class) switchgear.
- Indoor (NEMA1) / Outdoor (NEMA 3R).
- Other (DO/FM Breakers, Closed Transition, Differential Protection).







Nine (9) Common Configurations

FIGURE 100

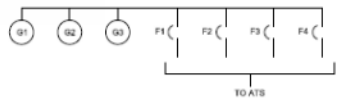


FIGURE 200

FIGURE 300

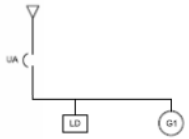


FIGURE 400

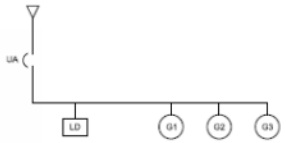


FIGURE 500

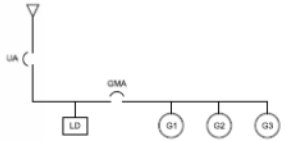


FIGURE 600

FIGURE 700

FIGURE 800

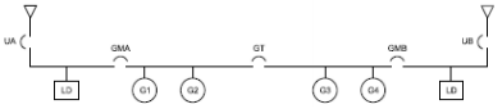
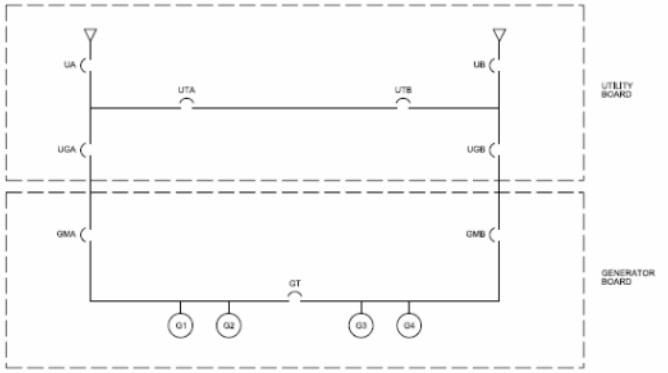


FIGURE 900



CAE GENERATED DRAWING

REV	DATE	REVISION	BY
A	09/21/2011	UPDATED 700, 800 CONFIG.	

PROJECT NO.: SSC-0001

PROJECT NAME:

APPROVALS	DATE
PJL	11×11×2009
MEP	11×11×2009
MEP	11×11×2009

KOHLER CO.

POWER SYSTEMS KOHLER, WI 53044 U.S.A.

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TITLE: STANDARD SYSTEM CONFIGURATIONS

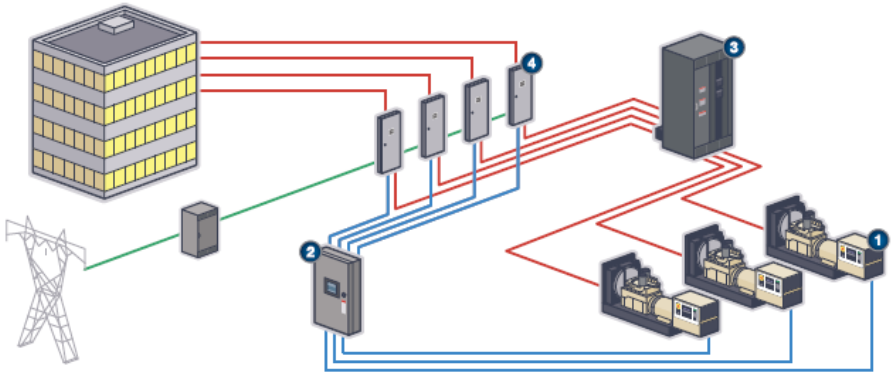
SCALE: NONE | SHEET 1 OF 1

CAD NO.: SSC-0001 | SIZE: D

DWG. NO.

On-board vs Traditional Paralleling Switchgear

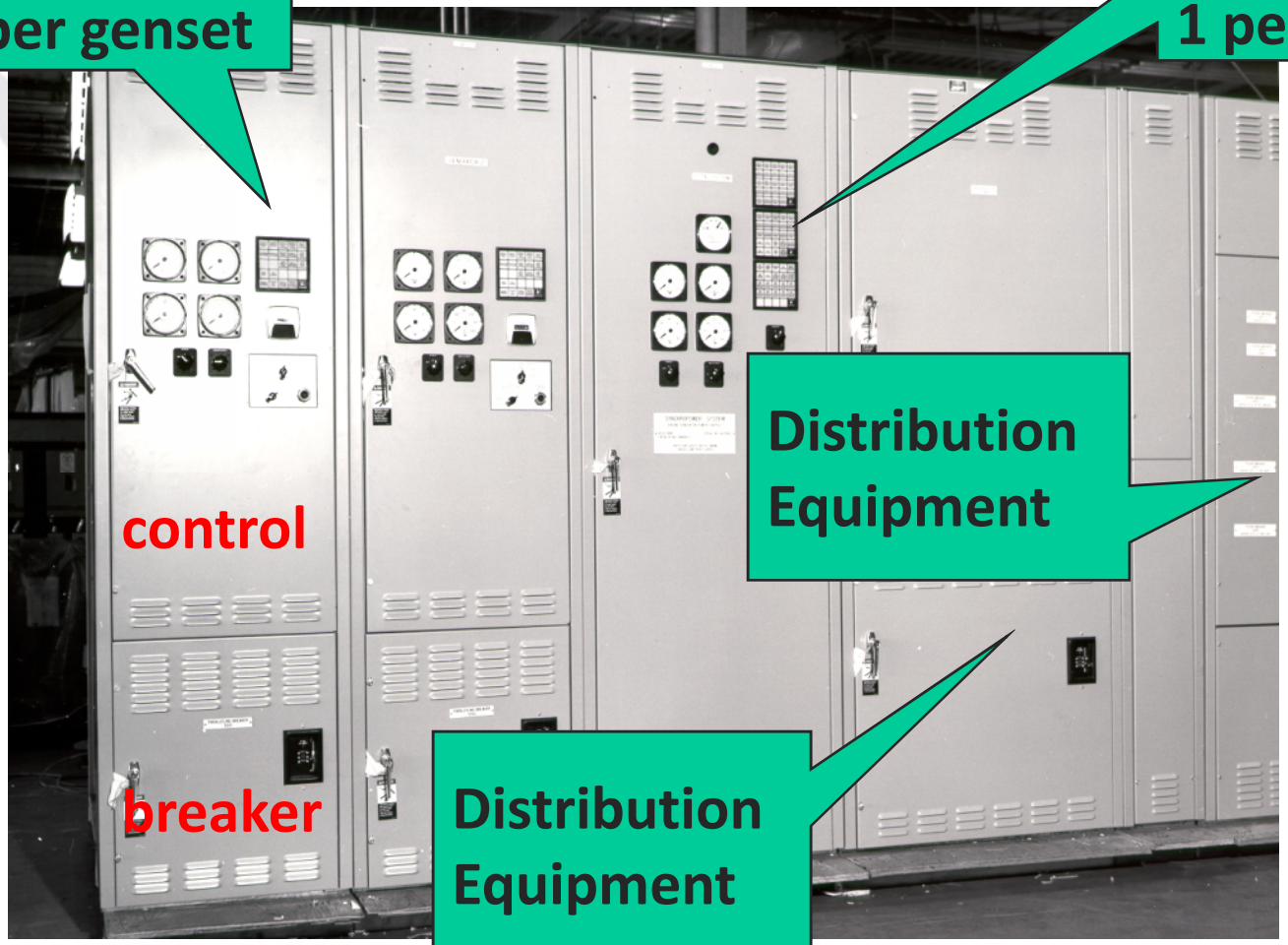
On-board Paralleling



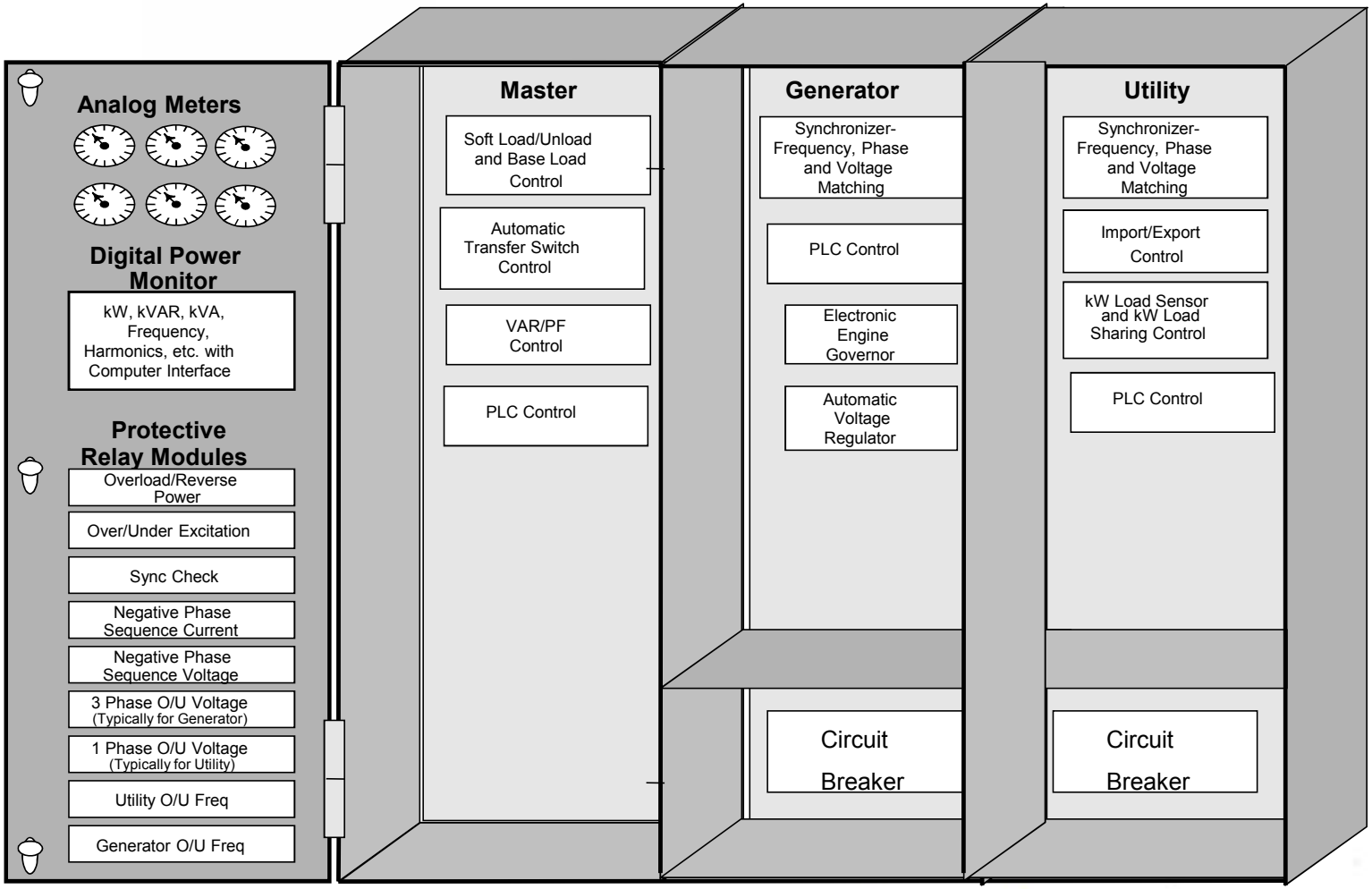
Traditional Paralleling

Traditional Switchgear

Traditional Paralleling


Paralleling
Control
1 per genset
Master
Control
1 per system
control
breaker
Distribution
Equipment
Distribution
Equipment

Traditional paralleling



Traditional paralleling

Engineered to Order

UL891 Switchboard

- Up to 600V
- Up to 8000 Amp Bus

UL1558 Switchgear

- Up to 600V
- Up to 10000 Amp Bus

UL Listed Medium Voltage

- Up to 27 kV
- 1200 to 4000 Amp Bus

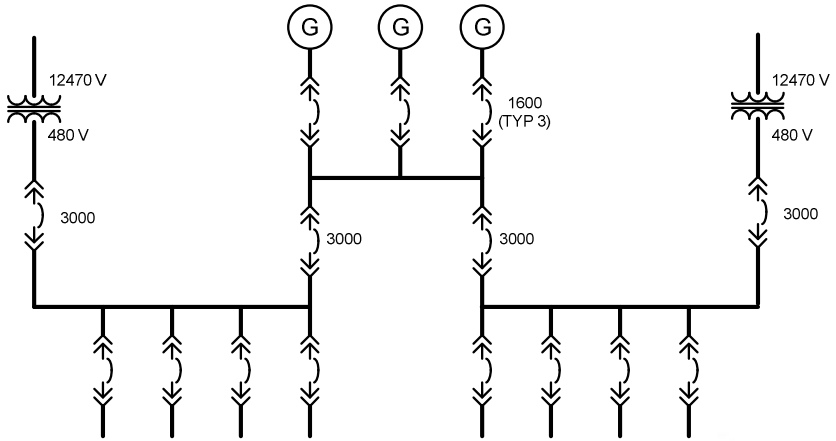
Traditional paralleling

BENEFITS

- All controls for Gensets, breakers, utilities, protections in one place.
- When sequence of operations is more complex.
- Can accommodate custom configurations or solutions.
- More than a one utility paralleling.

DRAWBACKS

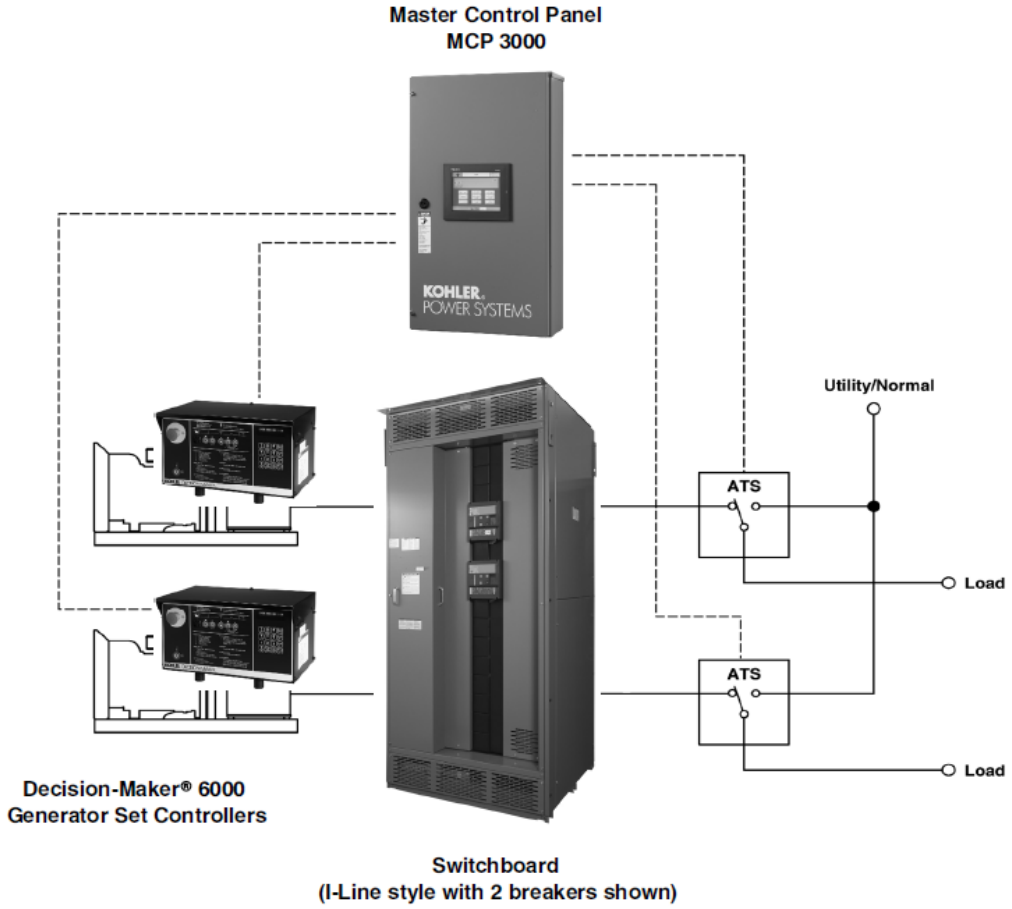
- Maybe single source of failure due to control wiring.
- Larger footprint.
- More $.



On-Board Paralleling

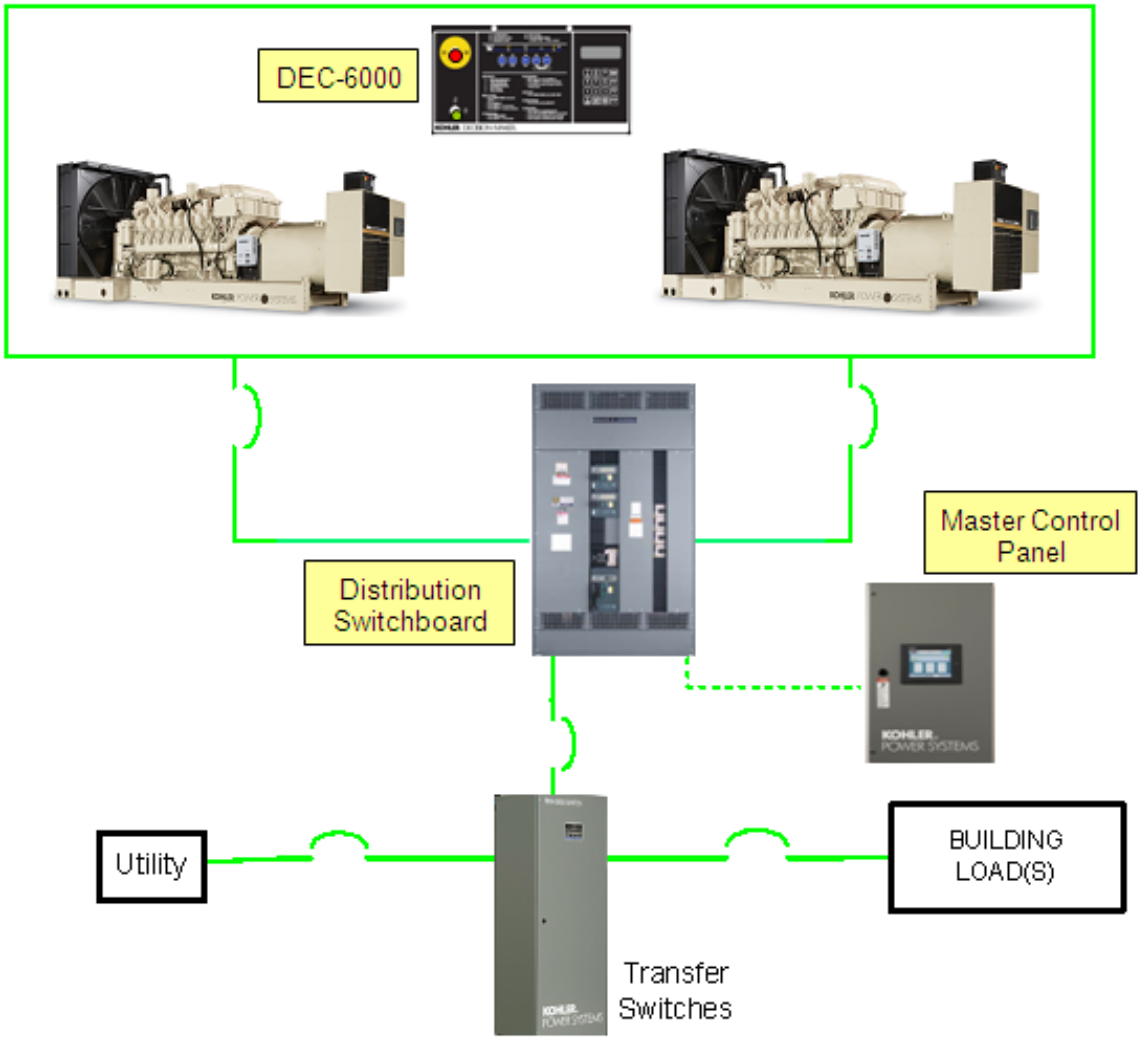
On-Board Paralleling

- Move the Genset paralleling from switchboard/switchgear to on-board the Genset
- Electrically operated breakers can be mounted on the Gensets or in the switchgear/ switchboard.
- Master control panel enables user to monitor system. Master also allows for load add/shed and Genset management



On-Board Paralleling Components

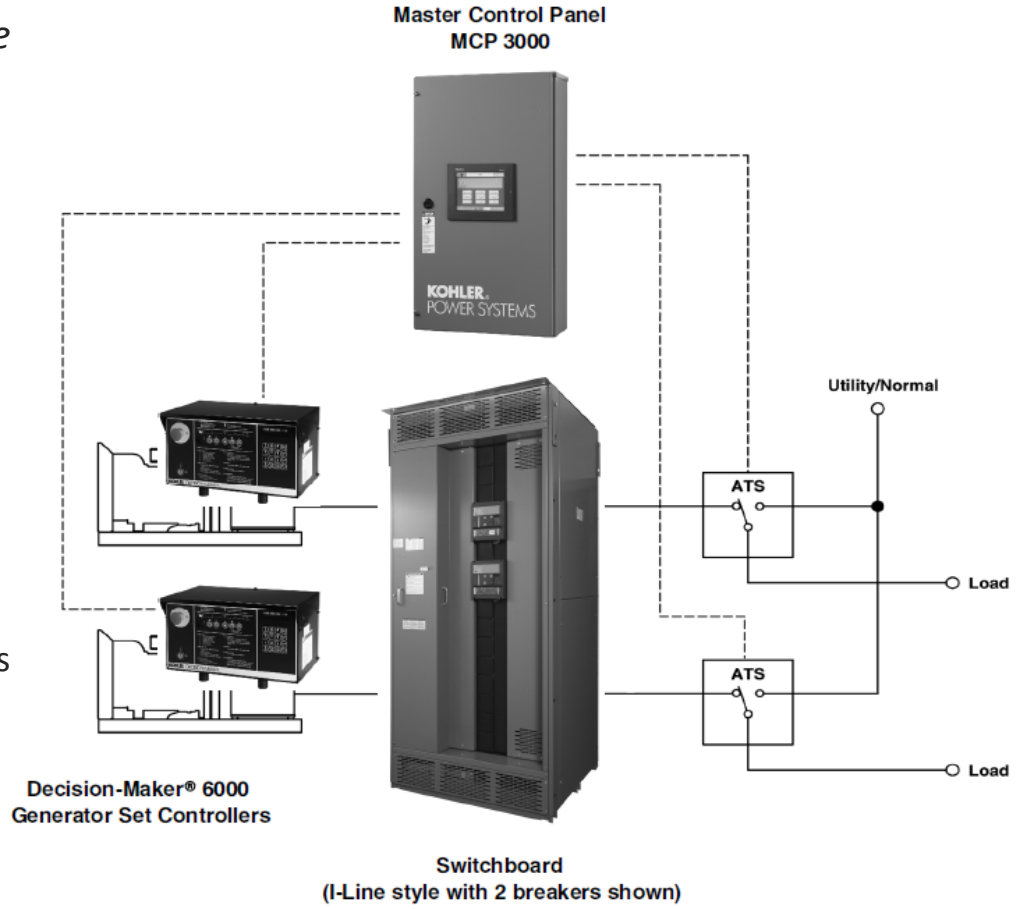
- On-Board Paralleling Control
  - First on logic
  - Synchronizer
  - Load / unload
  - Protective relays
- Distribution Switchboards
  - Common Bus
  - Breakers
- Master Control Panel
  - Generator management
  - Load management
  - Metering
  - History



On-Board Paralleling

Let's explore a Sequence of Operation to see how the integrated pieces work together:

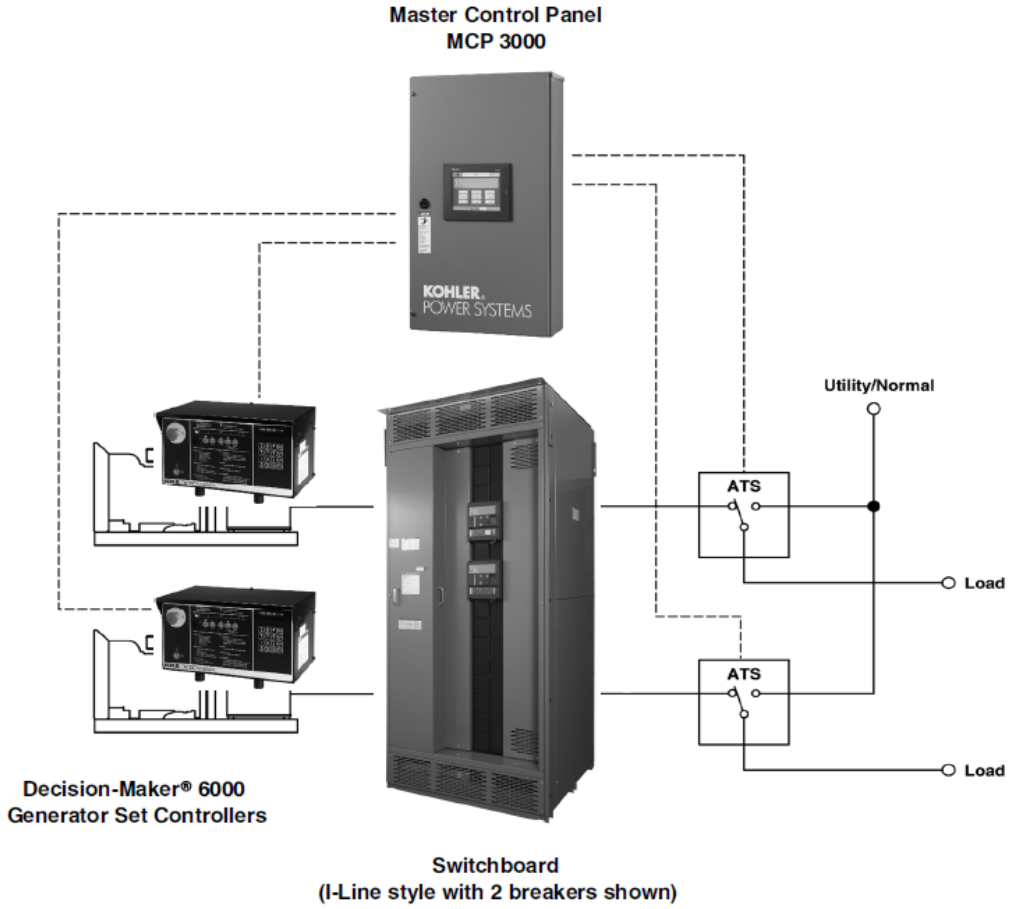
- When the Utility fails, the transfer switches signal the master of the outage. The master immediately communicates to each on-board genset controller to start up.
- The Genset on-board Paralleling Controllers communicate to each other and proceed with their first on logic to get the first unit online as quick as possible.
- First on logic and Random Access paralleling continues as the On-board control synchronizes and parallels all available gensets to the paralleling switchboard.



On-Board Paralleling

Sequence of Operation (*Continued…)*

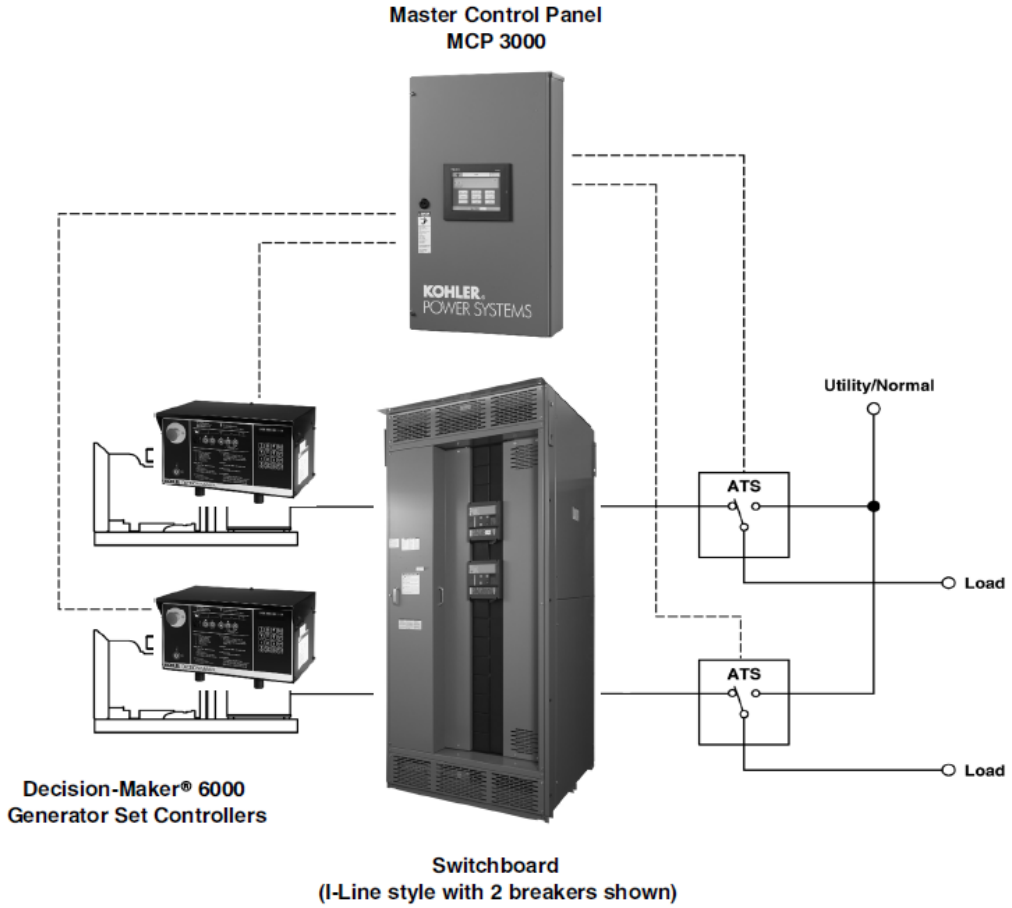
- When the first generator set comes online, the Priority one ATS immediately transfers position to emergency
- As more generators come online, the (MCP)master control panel sees them and Add Loads per the pre-programmed priority for each ATS.
- After all generators are online and the system has stabilized, the MCP will monitor the total capacity using Generator Management to determine if the system can be optimized.
- Generator management is based on KW demand of the load. The set points are adjustable.



On-Board Paralleling

Sequence of Operation (*Continued…)*

- The MCP is constantly monitoring to ensure the system is stable. In the event of an overload, the system will Load Shed per the pre-programmed settings in Load Management.
- Upon return of Utility, the transfer switches signal the MCP which then removes the remote start contacts.
- The load is transferred back to Utility and the generators go into cool down, waiting vigilantly for the next outage.
- This can also all be done manually from either the MCP or Genset mounted Controllers



On-Board Paralleling

Benefits of on-board paralleling

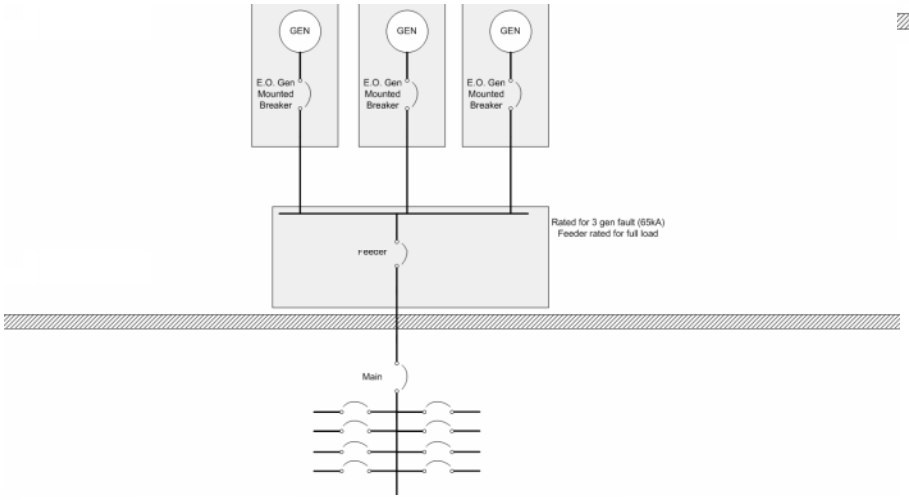
- Smaller footprint(No Genset control sections)
- Lower cost
- Smaller impact if interconnect wiring fails
- User interface safer. When master control is separated from switchgear.
- Simpler design – fewer points of failure
- Shorter lead time to manufacture

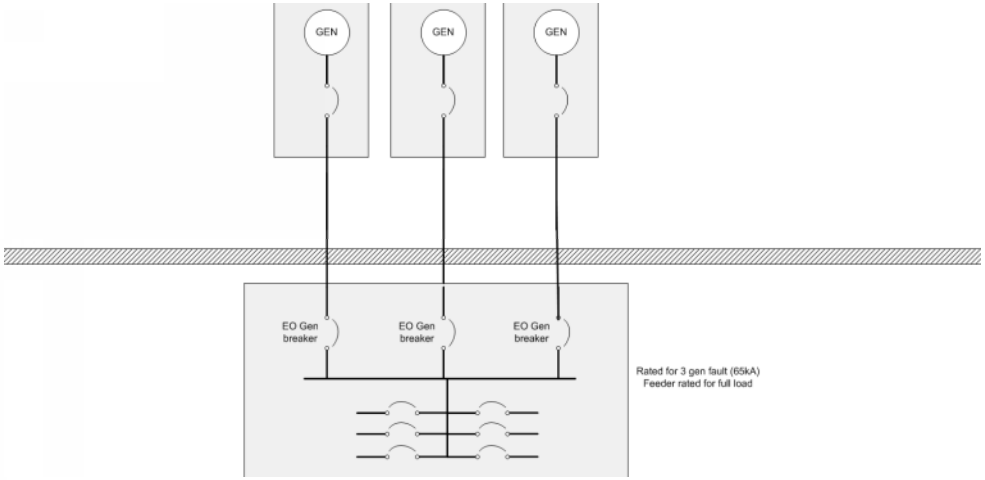
Drawbacks of On-Board

- Difficult to customize
- Could be difficult to integrate components

Paralleling Best Practices

Best Practices

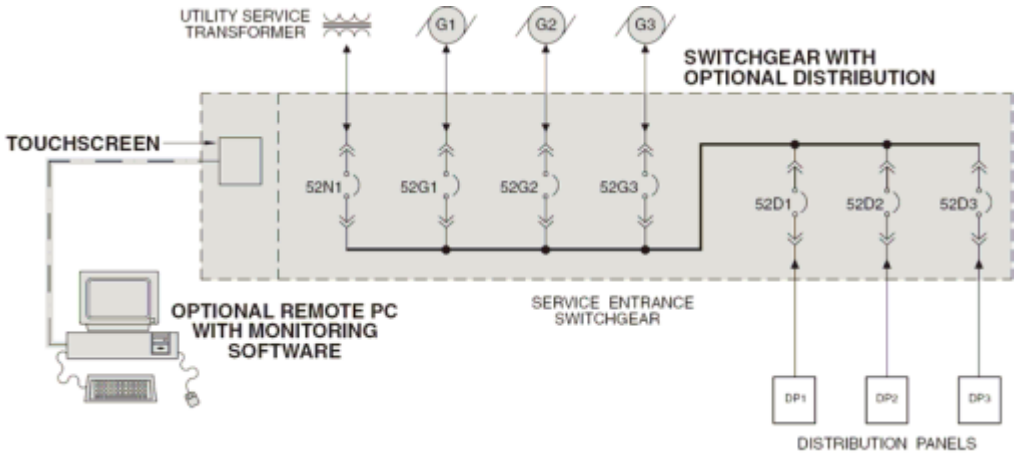


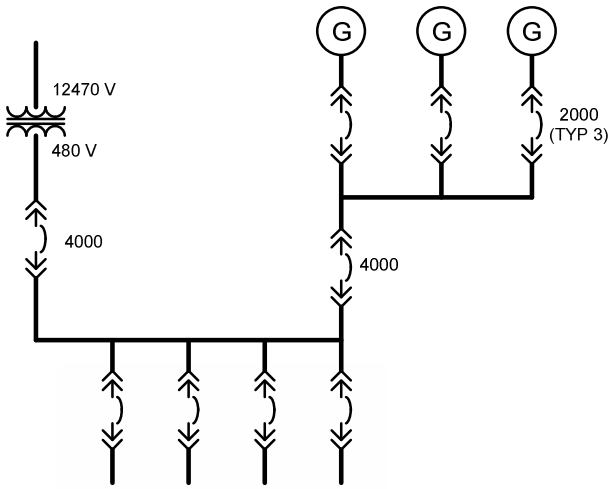


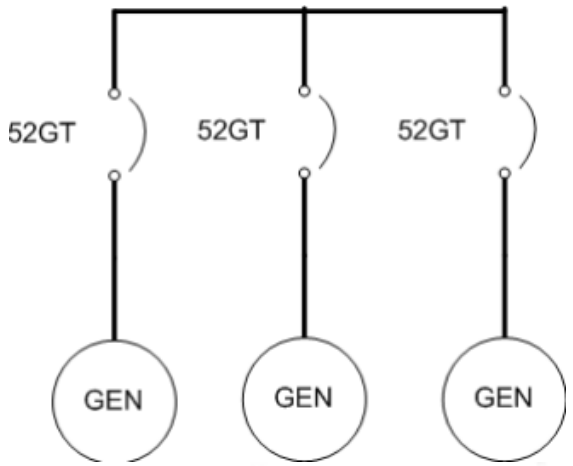
- With onboard paralleling the EO Genset breakers can be mounted on the Genset or in the switchgear.
- Both examples are NEC okay. But both are not equally safe!

Best Practices

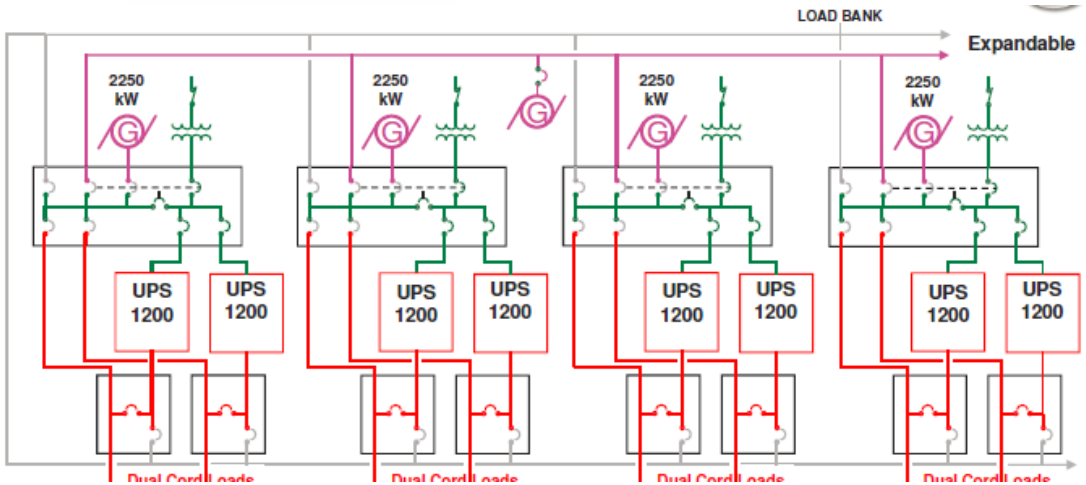
- Draw-out vs fixed mounted breakers
- Why isolate the Gensets from Utility





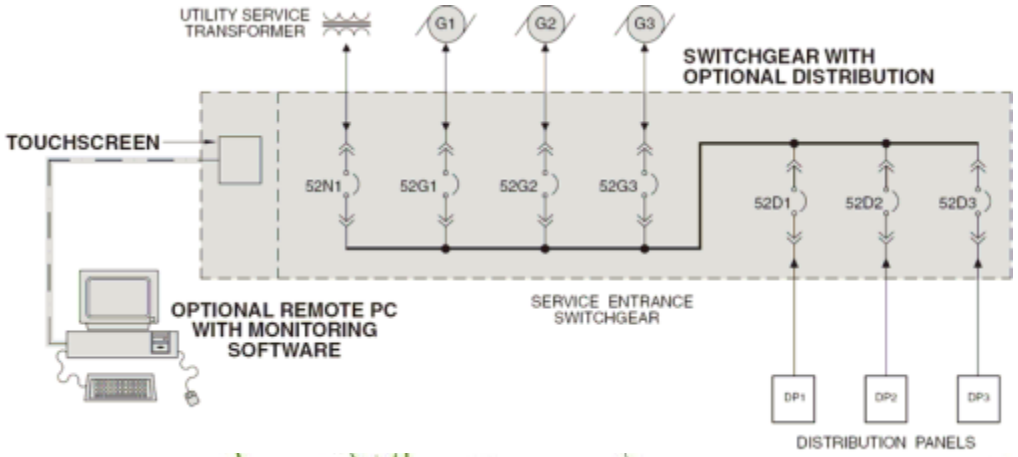


Best Practices



Avoiding single points of failure

- Single bus vs multiple bus.
- Battery failure/ best battery –
  Gensets batt. or paralleling station batt.
- Fuel supply with one pump.



Best Practices

SIZING PARALLELD GENSETS FOR LIFE SAFETY AND CRITICAL LOADS

- Smallest Genset must be large enough to start all priority one(1) life safety and critical loads.
- To meet NFPA110 type 10 for life safety, must be able to start in 10 seconds.
- Make sure the smallest Genset paralleled can start all priority 1 loads.

PARALLELING NATURAL GAS GENSETS:

- Most jurisdictions require an on site fuel source. i.e. diesel or LP.
- Natural gas Gensets do not react to single step loads and don’t start as fast as diesel.
- One option is to use diesel for priority one(1) loads.

Thank You!

Questions?

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