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# **DOE Distributed Power Program**

## **Pilot Interconnection Test at the Nevada Test Site**

**Ben Kroposki**  
**National Renewable Energy Laboratory**



**Distributed Power Program/Industrial DG Program Annual Review**

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**Arlington, VA**



## **Purpose:**

Conduct Field Validation of Interconnection Tests in IEEE P1547 Standard and Determine Issues with Conducting Testing at the Nevada Test Site

## **Participants:**

National Renewable Energy Laboratory – *Project Lead*

Department of Energy – *HQ and NV office*

Idaho National Engineering and Environmental Laboratory –  
*Engineering and Testing Support*

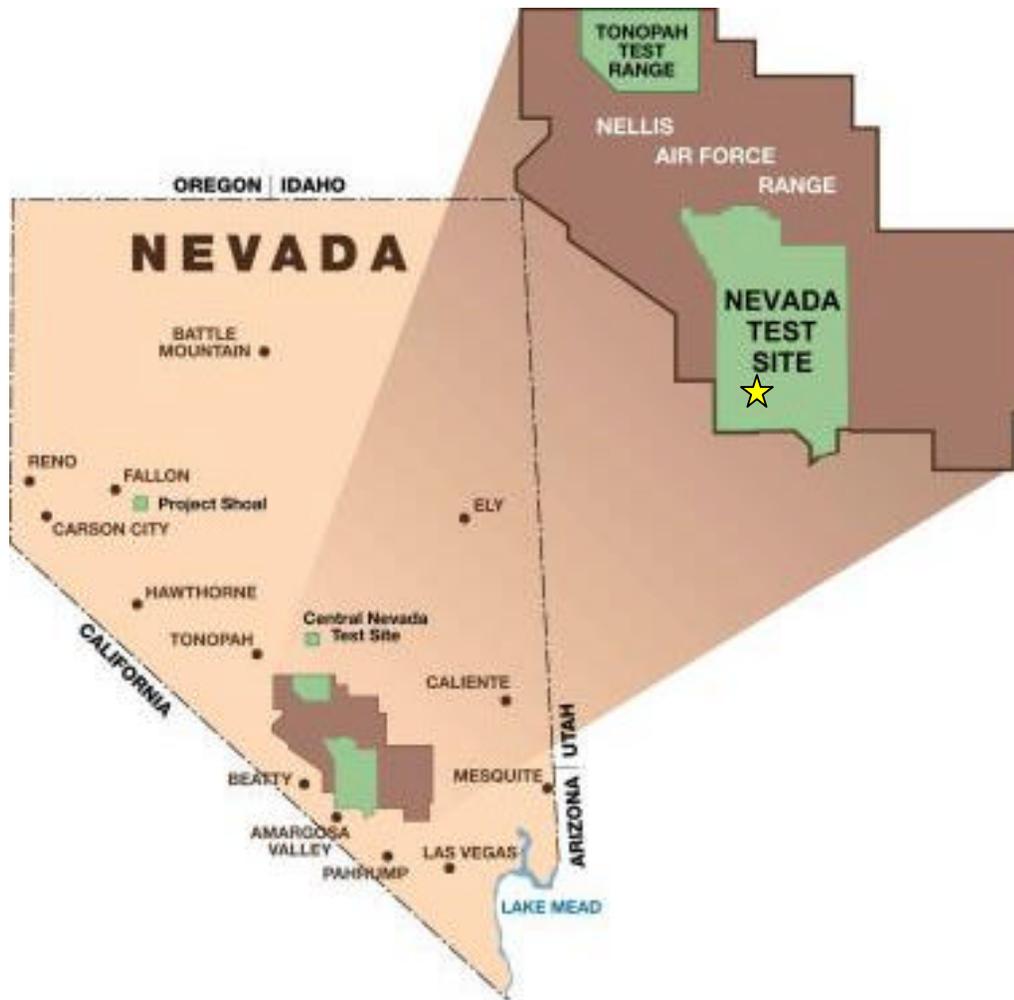
Bechtel/NV – *Site Operations for NTS*

ASCO Power Technologies – *Manufacturer and Testing Support*

**Testing Conducted:** November 12-15, 2001



## Why Nevada Test Site?



Secure Site the size of Rhode Island located 60 miles NW of Las Vegas

Nuclear Testing suspended in 1993

Underutilized building, electrical infrastructure, and equipment

Government mandate to find new uses for site

Directed FY00-01 funds for DP Testing

Part of Larger NTS-DP Plan



**Building 4015**

U.S. DEPARTMENT OF ENERGY  
**NEVADA TEST SITE**  
DISTRIBUTED POWER PROJECT



**DER Test Area Back of Building 4015**



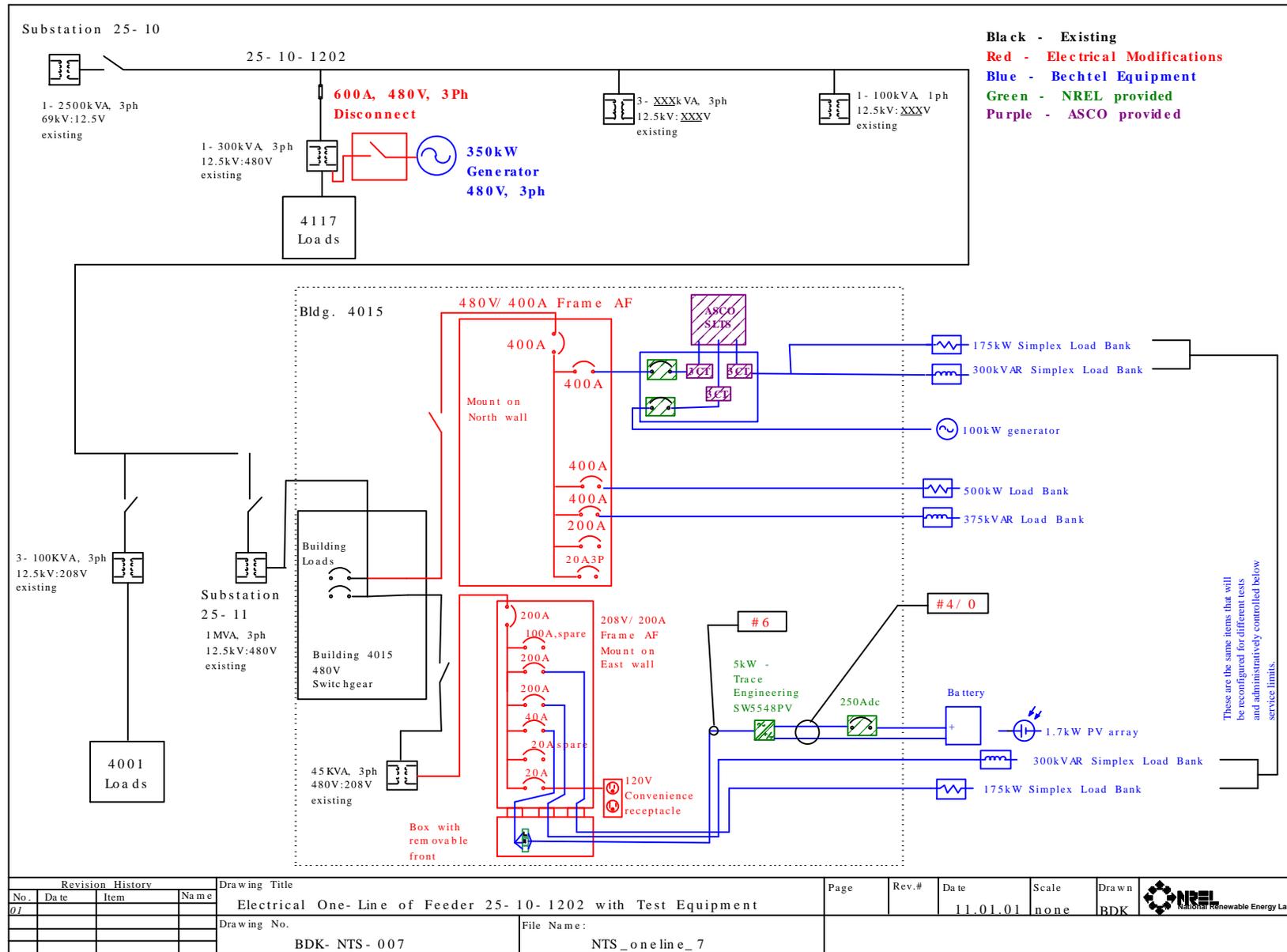
**350kW Utility Simulator**



**Feeder 25-10-1202**



# DPP NTS Test – Electrical One-Line





**350kW Diesel  
Generator**

**Used as Utility  
Simulator**

**420-510V**

**57-62 Hz**





ASCO 7000 Soft-Load Transfer System  
Connected to 100kW generator





**ASCO 7000 Soft-Load Transfer System Display**



**Trace 5kW Inverter**

**15kW and 100kW  
Gensets**

**Resistive and Inductive  
Load banks**





## Data Acquisition Systems Used

- Yokogawa 16 Channel Digital Scope with CTs (ASCO)
- PML 7600 and Yokogawa PZ4000 with Clamp-on CTs (NREL)
- Dranetz Power Platform 4300 (INEEL)



# DPP NTS Test – Test Results



## IEEE P1547 Over/Under Voltage and Frequency Testing

### Under - Voltage

ASCO – Tripped (411.7V)

Trace – Tripped (107.5V)

### Over – Voltage

ASCO – Tripped (500.06V)

Trace – DNT (130V max of Genset)

### Under – Frequency

ASCO – Tripped (57.04Hz)

Trace – Tripped (59.52Hz)

### Over – Frequency

ASCO – Tripped (60.52Hz)

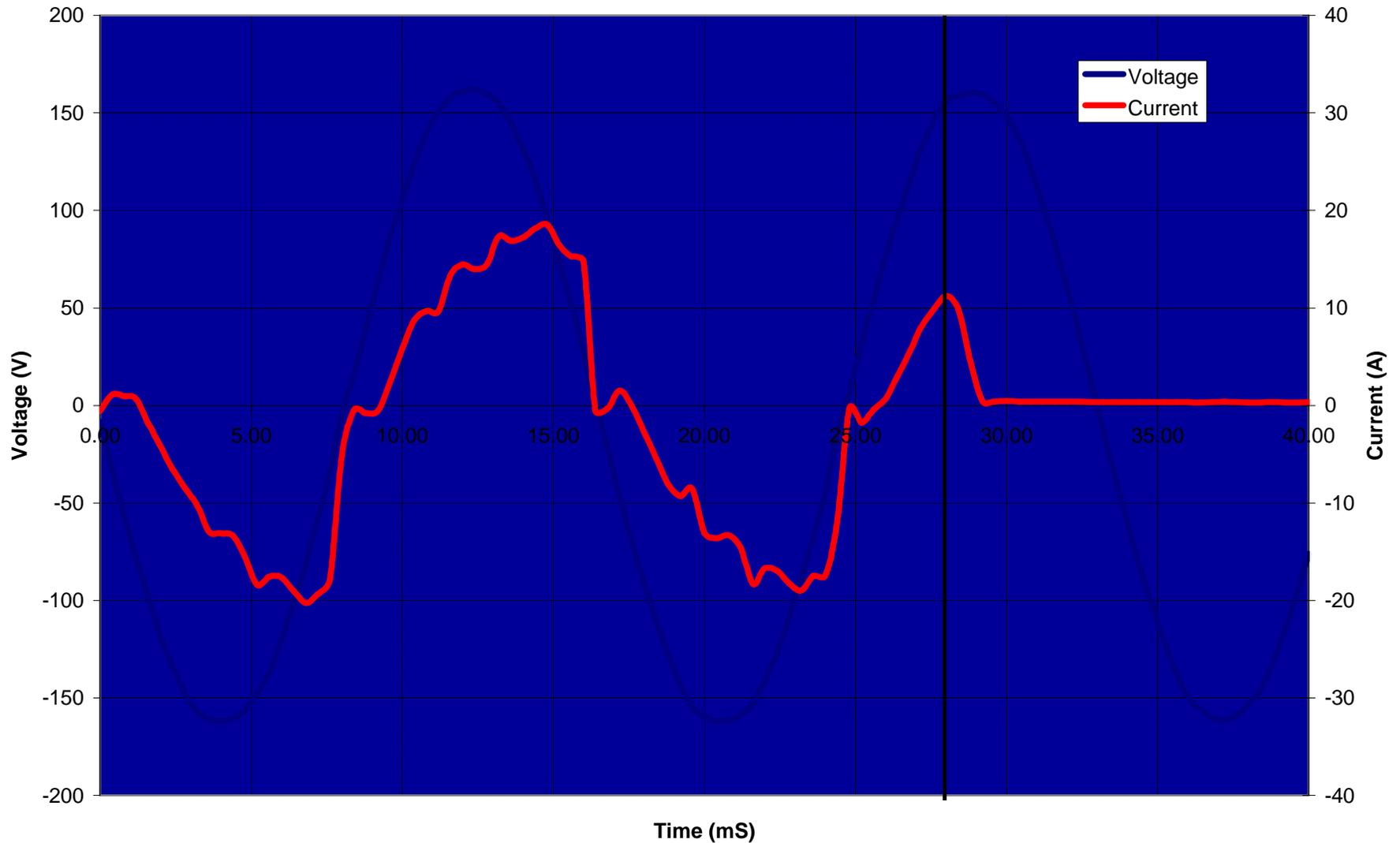
Trace – Tripped (60.42Hz)

## ASCO Over/Under Voltage

T1. Over Voltage Test Data			
Trial #	Time	Trip	
		Setting	Actual
1	18:20:06	506	500.8
2	18:21:38	506	497.1
3	18:38:38	506	500.8
4	18:40:06	506	500.8
5	18:41:25	506	500.8
Avg			500.06
Max			500.80
Min			497.10
Std Dev			1.65

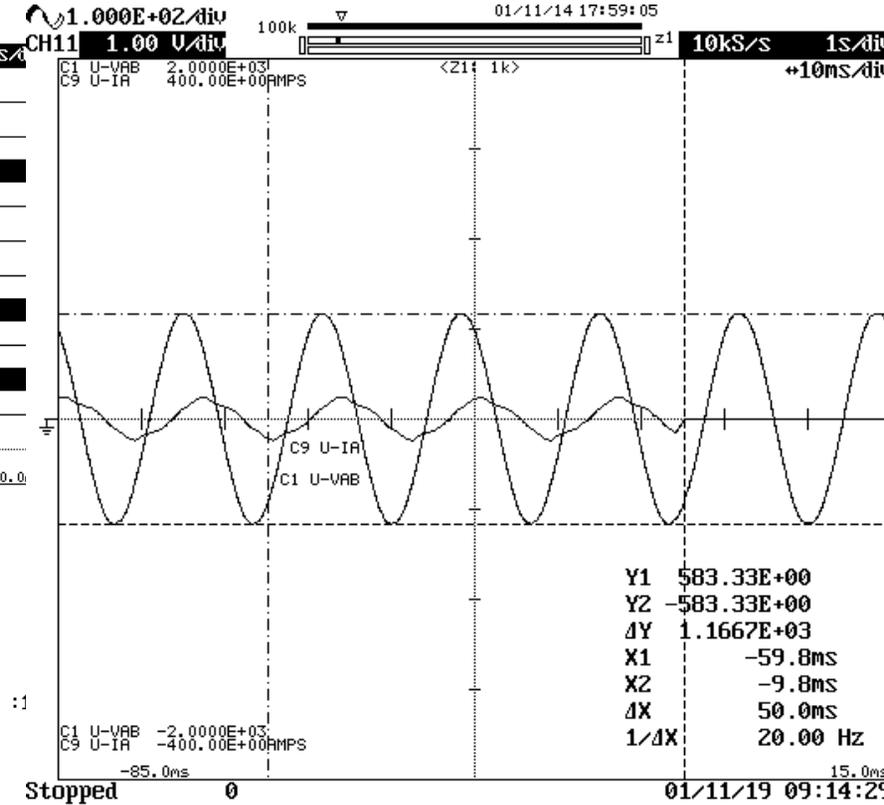
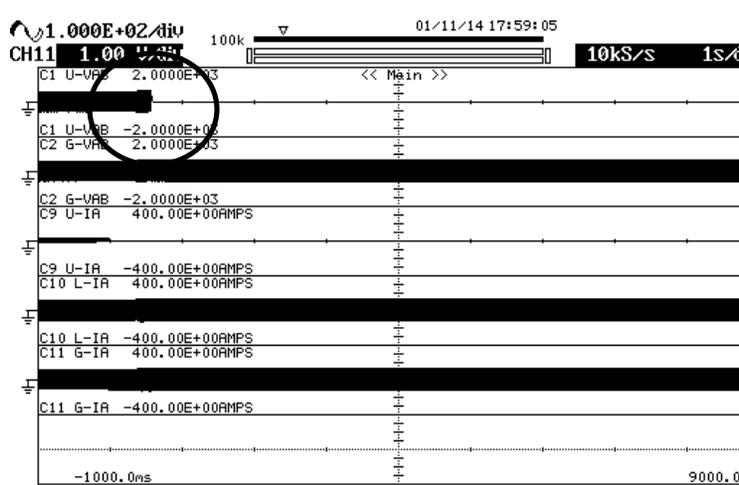
T2. Under Voltage Test Data			
Trial #	Time	Trip	
		Setting	Actual
1	17:59:05	418.6	412.4
2	18:11:31	418.6	412.4
3	18:12:50	418.6	412.4
4	18:13:58	418.6	412.4
5	18:14:55	418.6	408.8
Avg			411.68
Max			412.40
Min			408.80
Std Dev			1.61

Trace 5548 - Over Frequency Test  
Disconnect at 60.42Hz





# DPP NTS Test – Test Results



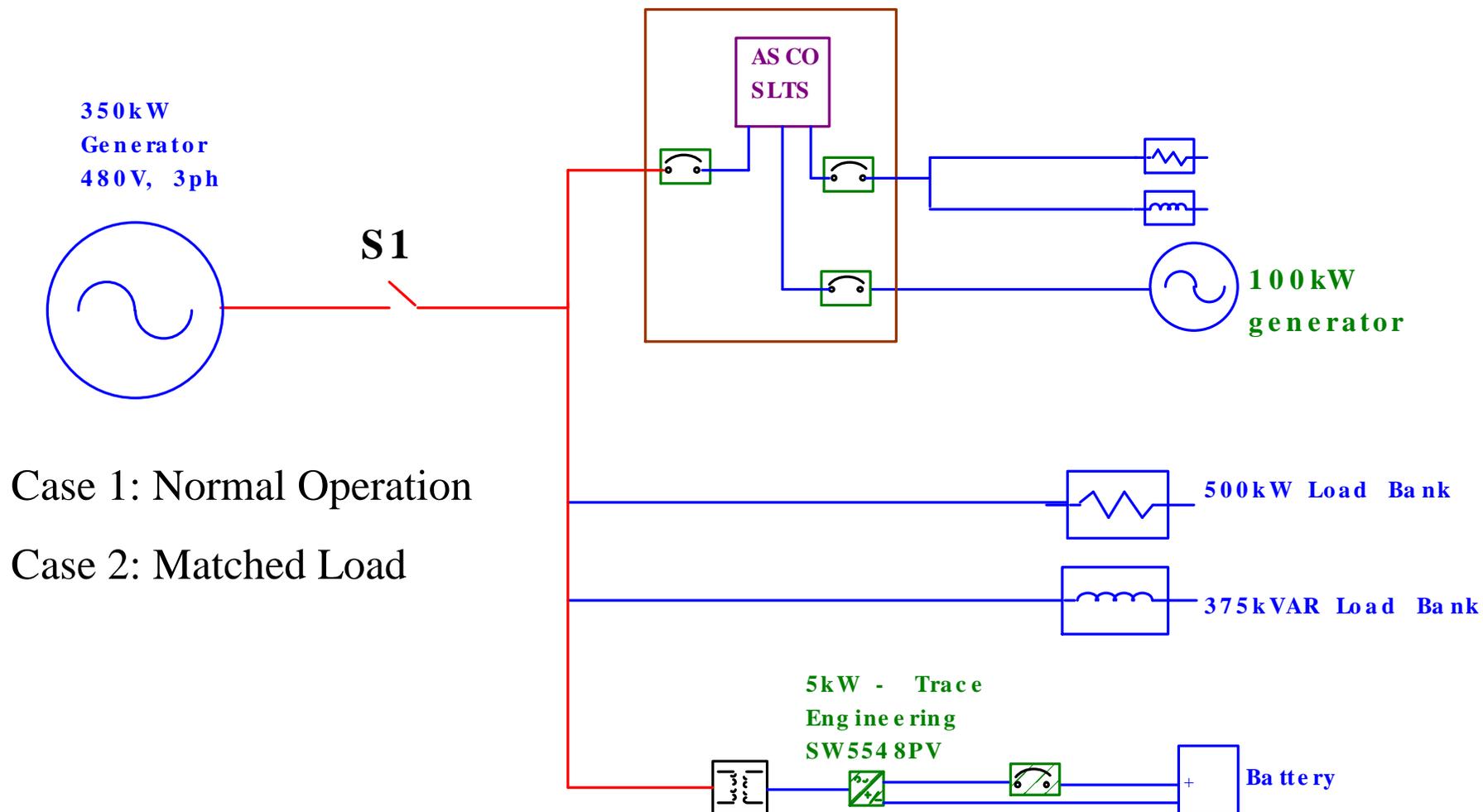
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OFF <input type="checkbox"/> ON <input type="checkbox"/>

ASCO – SLTS

Under Voltage Test

Trip at 412.48V

## IEEE P1547 Unintentional Islanding Testing





# DPP NTS Test – Test Summary



## General

- Generator nominal voltage set to 460 instead of 480.
- Generator voltage limitations of 420 to 510 V.
- Cannot control individual phase voltages with generator setup.
- Testing takes quite a few people to run equipment and collect data.

## Data Acquisition

- Yokogawa 16-channel digital scope (ASCO) and Yokogawa PZ4000 (NREL) provided good data and have accuracy and speed for this type of work.
- Yokogawa PZ4000 (NREL) only has 8 channels for inputs (4 voltage, 4 current). Need additional units for 3-phase applications.
- PML (NREL) connections using serial ports are too slow for good data acquisition.
- Dranetz (INEEL) provided good capture of events but lacked multi-cycle data around events.



# DPP NTS Test – Test Summary



## ASCO 7000 SLTS

- Control wiring to 100kW generator was problematic, but eventually fixed.
- This was the first time the 7000 had been connected to a Detroit Diesel generator.
- On matched load for the anti-islanding test, could get the 100 kW generator to run on for over 10 seconds. This would not be a normal operational mode for the ASCO equipment, but proved that you can sustain an island.

## Trace

- Did not trip on Overvoltage (Set at 128V, went to 130V). But did not have capability to raise voltage without tap change on transformer.
- Tripped within required times for under voltage, under frequency, and over frequency.
- Reset time of 5 min. after trip caused delays in testing several time quickly.
- On matched load (at ASCO switch) for the anti-islanding test the inverter would not sense that it was islanded for over 10 seconds. The size of the 100 kW generator looked like a utility to the inverter.



## DPP NTS Test – Acknowledgements



- **Department of Energy HQ** – Joe Galdo
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- **Idaho National Engineering and Environmental Laboratory** – Gary Seifert and Shawn West
- **Bechtel/NV** – Tom Van Sittert and Larry Cohn
- **ASCO Power Technologies** – Jim Daley, Rob Siciliano, and Dan Hinton

