Upgraded synchronisation, load sharing and generator protection panels for the control three diesel gensets.

**Project overview**

The original analog equipment provided manual synchronisation, manual busbar closure, load control, generator protection relays and voltage regulation.

**LOAD SHARING**

- kW sharing
- kVar sharing
- Soft loading/unloading

**DROOP/ISOCHRONOUS MODE**

**FIRST FAILURE INDICATION**

**SYNCHRONISATION**

- +/- 3VDC voltage interface
- Raise/lower speed interface
- Dead bus closure

**GENERATOR PROTECTION**

- Under/overvoltage (59/27)
- Under/over frequency (81O/U)
- Voltage asymmetry (47)
- Zero voltage monitoring
- Reverse power (32R/F)
- Overload (32)
- Loss of excitation (40Q)
- Indep. time-overcurr.(50/51)
- Differential protection
- Generator winding protection
New System
Three separate cabinets have been designed, built and tested by Turner Engine Controls. Each cabinet provides automatic synchronisation of the generator breaker, active and reactive loadsharing, soft loading and unloading of the diesel gensets.

On the right, is a basic overview of the 400 V busbar. Each generator is protected by a multi-functional relay, a current differential relay and a generator winding temperature relay (no shown). The synchronisation and load sharing is handled by the SPM-D11 unit.

The SPM-D11 series controller is designed to be utilized on three-phase AC generators equipped with Woodward and other compatible speed controls and automatic voltage regulators.

The SPM-D synchronizer provides automatic frequency and voltage matching using either analog or discrete output bias signals (depending on model).

The MFR 13 is a complete generator protection unit packaged into a compact device. Typical applications are generators and switchgear equipment that require independent protection architecture.

A Woodward ESDR4 protection relay is selected. The ESDR 4 offers a three-phase current differential protection for generators, motors, and transformers that are interconnected.

A SPM-D10YB is a three phase synchroniser and in this application it synchronises both buses smoothly. This unit also provides dead bus check:

- System 1 live – 2 system 2 dead
- System 1 dead – 2 system 2 live
- System 1 dead – 2 system 2 dead

TUG 4 series temperature monitoring unit, (not displayed below) is designed to accept up to 16 x PT100 RTD inputs for the direct measuring of temperatures. Two individually configurable trip levels can be programmed for each sensor.

For first failure indication a PLC and an annunciator panel with lamps was built into the front door.

PRODUCTS USED:

SPM-D11
- Synchroniser generator breaker
- Load share unit

SPM-D10YB
- Synchroniser bus-tie breaker

MFR13
- Multi functional Relay

TUG
- Generator winding protection

ESDR4
- Differential protection
- Three phase short circuit
- Ground faults protection

AVR LX10.1
- Automatic Voltage regulator

EX-CHECK RELAY
- Loss of excitation protection

PLC S200 serie
- First Failure indication

More information?
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Load sharing
When multiple generators are on the same bus the load share lines of those SPMD11’s are connected together. The average KW and KVAR load can be derived from the 0-4DC voltage level on these lines. In this way each SPMD11 knows the average kW and kVar level and this will be compared with the actual levels. The kW load will be controlled by giving raise/lower commands to the speed control which is located in the diesel control panel. The kVar load will be controlled via a +/-3VDC bias signal to the AVR.

Bus coupler operation
The SPMD10/YB synchroniser matches the frequency and phase before the paralleling breaker is closed. The synchronising mode corrects the frequency and phase of the applicable generator to lock it to the bus frequency and phase. When there is a difference in frequency/phase, the SPMD10/YB will send digital raise/lower commands to the speed control.

The correction signal from the speed bias output increases or decreases engine speed depending on whether the slip is faster or slower than the bus. Corrections will occur when the phase is not within the configured phase match window. When the frequency and phase are within limits the SPMD10/YB will give out a breaker closure signal.

Factory Acceptance Test
For this specific customer a process narrative document was written and used as guideline for the factory acceptance test. A complete test simulation was set-up where all three control cabinets were connected to three test simulators, allowing all alarms, shutdowns and load sharing to be tested.