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Engineering Note

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Project: Solenoid Energization, Controls, Interlocks and Quench Protection
Doc. No: H960314A

Subject: Solenoid Quench Detector Signals

Signals from Solenoid to Quench Detection Circuitry

The following ten signals from the solenoid will be monitored by the quench detection chassis:

- Differential voltage across each vapor cooled lead (2).
- Differential voltage across each transition lead (2).
- Differential voltage across each chimney lead (2).
- Differential voltage across the outer coil (1).
- Differential voltage across the inner coil (1).
- Differential voltage - Center tap bridge imbalance. One side is center tap of coil, other side is center of balanced bridge between outside leads of coil (1) .
- Differential voltage - Quarter tap bridge imbalance. One side is quarter tap of coil, other side is quarter point of balanced bridge between outside leads of coil (1).

Signals from Quench Detection Circuitry to PLC Control System

All ten of the previously defined signals will be buffered, scaled and presented to the PLC control system for monitoring.

The scaling of the signals as presented to the PLC control system is as follows. Note that all signals have a +5 volt offset. This is to provide fail-safe indication of cable integrity. Scale factors were chosen to provide maximum resolution of expected signals, equalize performance of each amplifier channel; and provide interchangeability of amplifier modules:

Signal	Scaling Information	Frequency Response
Differential voltages across vapor cooled leads, transition leads and chimney leads.	Voltage to PLC = (Vin X 50) + 5V	Step response = 1.2 msec. Freq. response = -3db @ 250Hz, -6db @ 500Hz
Differential voltage across the outer coil, and inner coil.	Voltage to PLC = (Vin X 0.5) + 5V	Step response = 1.2 msec. Freq. response = -3db @ 250Hz, -6db @ 500Hz
Differential voltage representing Center tap bridge imbalance.	Voltage to PLC = (Vin X 25) + 5V	Step response = 1.2 msec. Freq. response = -3db @ 250Hz, -6db @ 500Hz
Differential voltage representing Quarter tap bridge imbalance.	Voltage to PLC = (Vin X 12.5)+5V	Step response = 1.2 msec. Freq. response = -3db @ 250Hz, -6db @ 500Hz

Signals from Quench Detection Circuitry to Interlock Circuitry

The following signals are processed by the Quench Detector Chassis with comparators that have manually adjustable thresholds. The discriminated signals are routed the interlock chassis to provide interlock signals to trip the slow and fast dump processes. Note that all voltages are used except for the differential voltages across the outer and inner coil.

- Differential voltage across each vapor cooled lead (2).
- Differential voltage across each transition lead (2).
- Differential voltage across each chimney lead (2).
- Differential voltage **-** Center tap bridge imbalance. One side is center tap of coil, other side is center of balanced bridge between outside leads of coil (1) .
- Differential voltage **-** Quarter tap bridge imbalance. One side is quarter tap of coil, other side is quarter point of balanced bridge between outside leads of coil (1).

Special Considerations

In addition to the processing discussed above, some signals are hardwired to provide an emergency FAST DUMP signal directly to the dump switch. This is for the purpose of providing a redundant level of solenoid protection:

- Differential voltage **-** Center tap bridge imbalance. One side is center tap of coil, other side is center of balanced bridge between outside leads of coil (1) .
- Differential voltage **-** Quarter tap bridge imbalance. One side is quarter tap of coil, other side is quarter point of balanced bridge between outside leads of coil (1).

Quench Protection Notes

The quench detection circuitry provides three levels of redundancy. 1) The discriminated voltage tap signals to the interlock circuitry are wired to provide a FAST or SLOW dump as specified in the system design note. 2) The quarter tap and center tap signals are discriminated and used as direct emergency FAST DUMP signals as described above. 3) The PLC control system will be programmed to monitor the voltages delivered by the quench detection chassis and may force a SLOW or FAST DUMP under program control depending on final system configuration and programming.