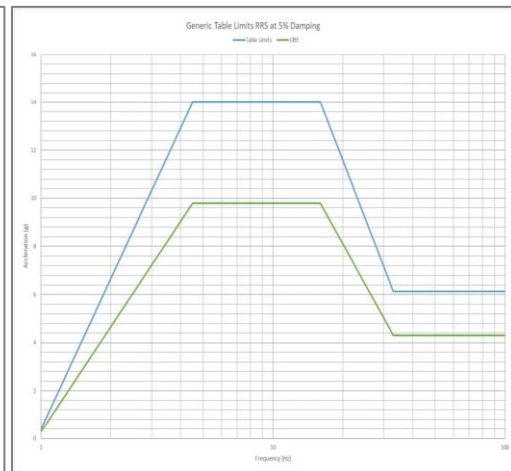


SUMMARY QUALIFICATION REPORT FOR SEL RELAYS

Mild Environment, Generic Qualification of Digital Protective Relays

Schweitzer Engineering Laboratories (SEL) Digital Protective Relays are generically qualified for a mild environment per IEEE 323, consistent with IEEE C37.105-2010, as described by the in-service conditions listed in the table below.

Parameter	Average In-Service Environment	Allowable Excursion	SEL Design Environment
Ambient Temperature	30 °C	10 – 40 °C	-40 – 85 °C (1)
Pressure	Atmospheric	–	80 – 110 kPa
Relative Humidity (non-condensing)	60 %	10 – 90%	5 – 95%
Radiation (total integrated dose)	1 x 10 ³ Rads (2)	–	–
Control Voltage	Rated (3)	80 – 112% (DC) 75 – 120% (AC)	85 – 300 VDC 85 – 264 <u>VAC</u>
Altitude	1500 m	–	2000 m



In the qualification process, each relay underwent baseline functional testing where weight, part number, serial number, and firmware version were recorded. Power supply operability, current and voltage inputs, and associated metering functions were checked. ANSI protective relay function tests followed, with individual functions verified through monitoring assigned output contacts. Relay self-test diagnostics were validated under simulated alarm conditions. Front display panel inputs, contact identification, configuration, and resistance measurements were meticulously scrutinized for operability. Pick-up and drop-out performance of 125 Vdc and 250 Vdc rated discrete inputs were verified. 4-20 mA Analog inputs/outputs, interfaces, and HMI functionality were examined. Insulation resistance measurements ensured electrical integrity.

After baseline testing, mechanical cycle aging commenced. Relays underwent a representative 1,100 cycles, with direct monitoring visually every 100 cycles. Relays functioned as expected, making a 30 A circuit for 200 ms, followed by external breaks per guidance of IEEE of C37.98-2013. Functional testing repeated post-cycle aging.

EMI/RFI testing per RG 1.180 and EPRI TR-1023232, at Category B, Moderate Withstand-Signal levels (Medium exposure plant areas) followed and Post-EMI/RFI.



Seismic tests subjected relays to 14g table limits consisting of 5 OBE and 2 SSE tests. No discontinuity or loss of integrity occurred.

Finally, a thorough inspection and functional testing concluded the rigorous process. The relays emerged successfully, displaying no signs of degradation or defects.

SEL's firmware was assessed following the guidance of EPRI TR-106439 to verify critical characteristics related to dependability. A Commercial Grade Survey was performed to assess the built-in quality, failure modes and failure management, configuration control, problem/error reporting, and reliability of SEL's digital devices. This survey verified that SEL's processes effectively control critical characteristics in a manner equivalent to that of a 10 CFR 50 Appendix B program. This approach was evaluated by an industry leading expert on digital devices in the nuclear power industry and found to be acceptable.

Please contact SEL@curtisswright.com for further information on report #Q2301.0 and #Q2301.1

