SPECIFICATION NUMBER ENG 99-05

SPECIFICATION

FOR

THREE PHASE ELECTRONICALLY CONTROLLED
VACUUM INTERRUPTED 15 kV
RECLOSER CONTROLLER

April 9, 1999

LAKELAND ELECTRIC

ELECTRIC SYSTEM ENGINEERING

LAKELAND, FLORIDA

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SPECIFICATION

1.0 EQUIPMENT SPECIFICATIONS:

The recloser controller shall be microprocessor-based. It shall be a Schweitzer Engineering Laboratories SEL 351-R or approved equal.

2.0 CONTROL COMPATABILITY:

The recloser controller shall be interchangeable with Kyle Form 3, 4 or 5 controllers. It shall interface with Cooper standard recloser control plugs and adapters. It shall be fully compatible with the Cooper WE-VWE group and VSA-VSO group.

3.0 STANDARDS

The controller shall conform to the following standards and/or pass the tests that they detail.

RFI and Interference Tests

ANSI/IEEE C37.60.6.12 – 1981 *Cable Charging Current Interruption test for automatic circuit reclosers and fault interrupters for AC system*, 5 amp rms charging current interrupted, 20 close-open operations, randomly timed (type test with a McGraw-Edison VWVE recloser rated for 27 kV, 12 kA interrupting, 560 amp continuous).

ANSI/IEEE C37.60.6.13 - 1981 *Transformer Magnetizing Current Interruption test for automatic circuit reclosers and fault interrupters for AC systems,* magnetizing current interrupted equal to 3 ½ % of the continuous current rating of the recloser, 20 close-open operations, randomly timed (type test with a McGraw-Edison VWVE recloser rated for 27 kV, 12 kA interrupting, 560 amp continuous).

ANSI/IEEE C37.60.6.14 – 1981 *Control Elements SWC tests for automatic circuit reclosers and fault interrupters for AC systems, Oscillatory Surge Test method, 6.14.1, applied to control element connections to external devices,* 1.0 to 1.5 MHz oscillatory test wave of crest voltage of 2.5 – 3.0 kV occurring in the first half-cycle, decaying to 50% in not less than 6 μs.

ANSI/IEEE C37.90.1 – 1989 *IEEE SWC Tests for Protective Relays and Relay Systems* (3kV oscillatory, 5kV fast transient) (type test).

IEEE C37.90.2 – 1987 *IEEE Trial-Use Standard, Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers,* 10 V/m (type test with enclosure door open).

IEC 801-4 – 1988 *Electromagnetic compatibility for industrial-process measurement and control equipment, Part 4; Electrical fast transient/burst requirements,* Severity Level: 3(10 V/m) (type test).

IEC 255-22-1 – 1988 *Electrical disturbance tests for measuring relays and protective equipment, Part 1: 1 MHz burst disturbance tests.* Severity Level 3 (2.5 kV common mode, 1.0 kV differential) (type test).

IEC 255-22-3 – 1989 Electrical *relays, Section 3: Radiated electromagnetic field disturbance tests,* Severity Level: 3 (10 V/m) (type test).

IEC 255-22-4 – 1992 electrical *disturbance tests for measuring relays and protection equipment, Section 4: Fast transient disturbance test (type test).*

Impulse Tests

ANSI/IEEE C37.60.6.2 – 1981 Insulation *(Dielectric) tests for automatic circuit reclosers and fault interrupters for AC systems,* 1.2 • 50 *µ*s voltage impulse (positive and negative) of crest voltage of 125 kV, applied to recloser with control connected.

IEC 255-5 – 1977 Electrical *relays, Part 5: Insulation tests for electrical relays, Section 6: Dielectric Tests, Series C (2500 Vac on analog inputs including control ac power; 3100 Vdc on optional power supply inputs, contact inputs, and contact outputs excluding Trip and Close). Section 8: Impulse Voltage Tests,* 0.5 Joule, 5 kV (type test).

Vibration and Shock Test

IEC 255-21-1 – 1988 Electrical *relays, Part 21: Vibration, shock, bump, and seismic tests on measuring relays and protection equipment, Section 1 – Vibration tests (sinusoidal), Class 1.*

IEC 255-21-2 – 1988 *Electrical relays, Part 21: Vibration, shock, bump, and seismic tests on measuring relays and protection equipment, Section 2 – Shock and bump tests, Class 1.*

IEC 255-21-3 – 1988 *Electrical relays, Part 21: Vibration, shock, bump, and seismic tests on measuring relays and protection equipment, Section 3 – Seismic tests, Class 2.*

ESD Test

IEC 255-22-2 – 1996 Electrical *disturbance tests for measuring relays and protective equipment, Section 2: Electrostatic discharge tests,* Severity Level: 4 (8 kV contact discharge all points except serial ports, 15 kV air discharge to all other points) (type test).

Burn-in

All units shall be subjected to thermal cycle tests consisting of twenty temperature cycles from ambient to 75º C (167º F) over 48 hours.

4.0 **QUALITY**

The manufacturing facility shall be independently certified to meet ISO 9001 Standards or an approved equivalent.

5.0 ENCLOSURE and RELATED EQUIPMENT

The enclosure shall be minimum a NEMA 3-R rated with a corrosion resistant hinged cover. The enclosure shall have reserved space to mount a radio transceiver measuring 6.8”W x 7.25”H x 2.25”D.

A 120Vac outlet shall be installed in the enclosure.

6.0 BATTERY SYSTEM

The battery charging/discharging shall be made through an internal battery monitor/charger. This will allow the control to keep track of battery capacity. Knowing battery capacity, the control shall be able to put itself to sleep if battery capacity reaches a user-set threshold after an extended outage.

The battery system shall provide a 12Vdc output to power a 1-watt radio transceiver. The transceiver draws <400 mA in transmit mode, <125 mA in receive mode and <30 mA in sleep mode.

The battery system shall be of sufficient capacity to power the controller and radio on a loss of A.C. for a minimum of 18 hours at 25° C.

7.0 CONTROLLER FEATURES

The Controller shall have the following features:

- Underfrequency Load Shedding
- Sequential Events Recorder
- Event Reports
- Enhanced Control Equation capability with a least Six Setting Groups for Designing Custom Schemes
- Sequence coordination
- Recloser Wear Monitor – following ANSI C37.61 – 1973 recommendations
- Demand Ammetering
- Complete metering with three phase voltages, including MWh and MVARh
- Directional overcurrnent elements and fault location
- RS232 SCADA Communications Port with DNP Version 3.00 Level 2 Protocol with Point Mapping
- Recloser to Recloser communications ports to provide improved sensitivity, coordination and speed of protection via communication-assisted trip logic
- Communications-assisted trip logic
    - Permissive Overreaching Transfer Tripping (POTT)
    - Directional Comparison Unblocking (DCUB)
    - Directional Comparison Blocking (DCB)
    - Permissive and Direct Undereaching Transfer Trip (Putt) and DUTT, respectively)
    - Direct Transfer Tripping (DTT)
- Load encroachment logic to prevent tripping on load

- Loss-of-Potential logic
- High-side blown fuse detection
- Load profiling
- Up to Four Recloser and Sequence Coordination
- Fast and Delay Curves for Phase and Ground Overcurrent Protection
- US, IEC, Programmable, and All Traditional Recloser Curves

8.0 TECHNICAL REQUIREMENTS:

8.1 General

Battery Charger

AC Voltage Power Input	106 – 140 Vac, 120 Vac nominal
12 Vdc Output	11-14 Vdc, 6W continuous, 13 W for 1 second.

AC Inputs

AC Voltage Inputs	V_A, V_B, V_C, and V_s 300 $V_{L\text{-}N}$ for 1 second
AC Current Inputs	1 A Nominal: 3 A continuous, 100 A for 1 second, linear to 20 A symmetrical. 250 A for 1 cycle. Burden: 0.13VA @ 1A, 1.31VA @ 3A Sensitive Earth Fault: 0.05 A nominal Channel IN current input: 1/5A continuous, 20A for 1 second. Linear to 1.5A symmetrical. 100 A for 1 cycle. Burden 0.0004VA @ 0.05A, 0.36VA @ 1.5A.

Frequency and Rotation	60 Hz system frequency with ABC/ACB phase rotation user-selectable.
Output Contacts	Per IEC 255-0-20: 1974, using the simplified method
Except Trip and Close	6 A continuous carry 30 A make per IEEE C37.90 : 1989 100 A for one second 270 Vac/360 Vdc MOV for differential surge protection Pickup/dropout time: <5 ms

Breaking Capacity (L/R=40ms):

24V	0.5A	10,000 operations
48V	0.5A	10,000 operations
125V	0.3A	10,000 operations
250V	0.2A	10,000 operations

Cyclic Capacity (L/R = 40 ms):

24V	0.5A	2.5 cycles per second
48V	0.5A	2.5 cycles per second
125V	0.3A	2.5 cycles per second
250V	0.2A	2.5 cycles per second

Trip and Close Outputs	5A make and carry for 0.2 seconds repetitive 60 Vdc continuous
Optoisolated Input Ratings	250Vdc: on for 200-300 Vdc; Off below 150Vdc 125Vdc: on for 105-150 Vdc; Off below 75Vdc 48Vdc: on for 38.4- 60 Vdc; Off below 28.8Vdc 24Vdc: on for 16.0- 30 Vdc. With nominal control voltage applied, each optoisolated input shall draw no more than approximately 4 ma of current.
Time-Code Input	Relay module shall accept time-code input via one serial port. Relay time shall be synchronized to within ± 5 ms of time-source input.
Serial Communications	Minimum three (3) serial ports shall be available in addition to local maintenance port. The ports shall have 2100 Vdc of isolation. Per-port baud rates shall be selectable up to 38400.
Routine Dielectric Test	Control ac power: 2500 Vac for 10 seconds. Optional power supply inputs, optoisolated inputs, analog inputs, and output contacts except Trip and close: 3100 Vdc for 10 seconds.
Operation Temperature	The entire enclosure shall be operational tested to withstand a temperature range of -40º C to +85º C. This is to allow for a 20º C rise in cabinet interior temperature due to sunshine.

8.2 **Relay Element Pickup Ranges and Accuracy**

Instantaneous/Definite-Time Overcurrent Elements

Pickup Range: 0.05 – 20.00 A, .0.1 A steps (1A nominal)

	0.20 – 34.00 A, 0.01 A steps (1A nominal – for phase-to-phase elements)
	0.005 – 1.5 A, 0.001 A steps (0.05A nominal channel IN current input)
Steady-State Pickup Accuracy:	±0.01 A and ±3% of setting (1A nominal)
	±0.01 A and ±5% of setting (005A nominal channel IN current input)
Transient Overreach:	±5% of pickup
Time Delay	0.00 – 16,000.00 cycles, 0.25-cycle steps
Timer Accuracy:	±0.25 cycle and ±0.1% of setting

Time-Overcurrent Elements

Pickup Range:	0.10 – 3.20 A, 0.01 A steps (1A nominal)
	0.005 – 1.5 A, 0.001 A steps (0.05 A nominal channel IN current input)
Steady-State Pickup Accuracy	±0.01A and ±3% of setting (1A nominal)
	±1 ma and ±5% of setting (0.05A nominal channel IN current input)
Time Dial Range:	0.50 – 15.00, 0.01 steps
	0.10 – 2.00, 0.01 steps (recloser curves)
Curve Timing Accuracy:	±1.50 cycles and ±4% of curve time for current between 2 and 30 multiples of pickup

Under- and Overvoltage Elements

Pickup Ranges:	0.0 – 150.0 V, 0.1 V steps (various elements)
	1.0 0.0 – 260.0 V, 0.1 V steps (phase-to-phase elements)
Steady-State Pickup Accuracy:	±1 V and ±5% of setting
Transient Overreach:	±5% of pickup

Synchronism-Check Elements

Slip Frequency Pickup Range:	0.005 – 0.500 Hz, 0.001 Hz steps

Slip Frequency Pickup Accuracy:	±0.003 Hz
Phase Angle Range:	0 - 80º, 1º steps
Phase Angle Accuracy:	±2º

Under- and Overfrequency Elements

Pickup Range:	55.00 – 65.00 Hz, 0.01 Hz steps
Steady-State plus Transient Overshoot:	±0.01 Hz
Time Delay:	2.00 – 16,000.00 cycles, 0.25-cycle steps
Timer Accuracy:	±0.25 cycle and ±0.1% of setting

Timers

Pickup Ranges:	0.0	– 999,999.00 cycles, 0.25-cycle steps (reclosing relay and some programmable timers)
	1.0	0.00 – 16,000.00 cycles, 0.25-cycle steps (some programmable and other various timers)
Pickup and dropout accuracy for all timers:	±0.25 cycle and ±0.1% of setting	

8.3 **Metering Accuracy**

Voltages V_A, V_B, V_C, V_S, $3•V_0$, V_1, V_2	±0.2% (33.5 – 150 V)
Currents I_A, I_B, I_C	±3.0 mA and ±0.1% (0.1 – 2 A) (1 A nominal)
Currents I_N, I_1, $3•I_0$,$3•I_2$	±0.01 A and ±3% (0.1 – 20 A) (1 A nominal)
	±1 ma and ±5% (0.01 – 1.5 A) (0.05 A nominal channel IN current Input
Phase Angle Accuracy	±1.0°

9.0 **YEAR 2000 COMPLIANCE:**

Any and all software and equipment shall conform to the “Year 2000 Compliance” statement; Attachment A. Attachment shall be signed and returned with the proposal.