RODE – Recloser Interface Task Force Meetting Minutes

October 11, 2017 – Portland, Maine, USA

Chair: Mark Feltis

Meeting Minutes

1. Call to Order — Mark Feltis

Order was called

2. Introduction of Members and Guests — Mark Feltis

Introductions were made.

3. Attendance — Mark Feltis

20 attendees total (See Annex)

4. Purpose — Mark Feltis, Kate Cummings, Ian Rokser

Task force scope was reviewed (scope is listed in Annex, following Attendance table). This initial scope offering was put together in Summer 2017 by:

- Kate Cummings, G&W Electric
- Bradley Lewis, American Electric Power (AEP)
- Ian Rokser, Eaton
- Nenad Uzelac, G&W Electric
- Mark Feltis, Schweitzer Engineering Labs

Existing, known recloser interfaces in North America were reviewed (listed in Annex, following the task force scope). They were put together by Mark Feltis … he added the 32-Pin Recloser Interface – Rectangular (Tavrida) since the Portland, Maine meeting.

Kate Cummings reviewed other connections that come into the recloser control enclosure, other than just the recloser control cable. Such incoming connections are:

- power (most often 120 Vac)
- secondary voltage signals - often 120 or 67 Vac; can also be outboard low-energy analog (LEA) devices
- communication cables
- antennas

Ian Rokser reviewed the importance of the connectors themselves:

- what are the wire gauges that can be used
- importance of seal placement in the connector – to keep out moisture
- going from military grade to commercial grade – any changes in quality; what are the various standards that connectors adhere to

- "scoop-proof" with respect to pins not inadvertently touching (nor touching outer shell) when connection is being made
- field life; maximum voltage rating

5. Discussion All

- The group discussed the proposed scope. After the above listed presentations, it was decided that the scope should initially be expanded/clarified to include incoming:
  - power (most often 120 Vac)
  - secondary voltage signals - often 120 or 67 Vac; can also be outboard low-energy analog (LEA) devices; in essence, these are signals that originate from the primary system and make their way (through transformation of some sort) into the recloser control enclosure
- Recommended standards/guides that the task force look at:
  - IEEE C37.11 Electrical Control for AC High-Voltage Circuit Breakers … it might have some interface ideas/guidelines already thought out
  - IEEE 789-2013 Standard Performance Requirements for Communications and Control Cables for Application in High-Voltage Environments
  - IEEE Power Systems Instrumentation and Measurements Committee – reported that they have (or are in the midst of producing) a "guide for testing smart grid sensors and intelligent electronic device systems." Mark Feltis looked online for the existence of such a guide (or of it being in progress), but couldn't find anything … even went to their website: http://psim.pes-spdc.org/
  - Question brought up about existing, applicable standards on coupling (are there any such standards?) … there are plenty of wires in recloser control cables and thus "coupling opportunities."
- Other parameters to consider:
  - Limitations on cable length – important consideration for signal strength and for enough energy to get through to the actuator
  - Anti-tampering with the control cable connection at the recloser control enclosure … was it decided that this would be in the purview of C37.75, the enclosure working group?
  - Importance of connectors was stressed by more than one utility attendee.
- Question directed to the six attendees from electric utilities: Do you think it is important to work towards a standard recloser control interface? The apparent unanimous feedback was: Yes
- An invitation was given out for more attendees to formally join this task force
  - Contact Mark Feltis (mark_feltis@selinc.com)
  - The present members of the task force are the same ones previously listed as having worked on the task force scope this past summer.
  - Task force member Bradley Lewis was unable to attend the Portland, Maine meeting as they had a second son just arrive … congratulations, Bradley and family!

6. Follow Up Items (before the Spring 2018 meeting) All

- Vendors will put together information on present connectors used for cables connected to the recloser or recloser control enclosure that deal with the recloser control cable, incoming power, and incoming signals as previously discussed (no communications connections or antenna connections are considered).
  It is understood that Ian Rokser has a template of sorts that he can share that will help in gathering/organizing such information.
- Vendors and utilities will provide recloser/recloser control connection information that details cable arrangements and also the use of junction boxes to arrange cable flow/merging.
- Review scope, per above discussion.

7. Next Meeting

- Spring 2018: Disney's Contemporary Resort, Lake Buena Vista, Florida (April 22-27, 2018)

Annex

Attendance		
Name	**Representing**	**Email**
Mark Feltis	Schweitzer Engineering Labs	mark_feltis@selinc.com
Kate Cummings	G&W Electric	kcummings@gwelec.com
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The following (for the remainder of this document) is information that was presented at the task force meeting on Wednesday, October 11, 2017. Comments concerning it are found in the preceding minutes.

Scope:

This task force is set up to consider the interface between the control unit and switching device of an automatic circuit recloser (three-phase units, including those with single-phase operation capability). It will look at existing, in-service interfaces and document their signals, for ease of comparison and to understand "where we have been" as an industry. It will also look at the more recent inclusion of sensors (usually for power system voltages) in such interfaces, whether they be integral to the switching device or external add-on units. The task force especially seeks the participation of electric utility engineers and their experience/thoughts on such interfaces. The task force will produce a report of its findings and also summarize what future interface work should be done, if any.

Following are a listing of existing, known recloser interfaces in North America.

Often, more than one vendor uses the interface – first vendor to offer the interface is listed.
Please provide feedback / corrections / clarifications.

14-pin Recloser Interface (Eaton)
The de facto standard for decades. 24 Vdc trip and close "get things going."
Separate "low-voltage" close cable brings 120 Vac to recloser to provide close power for main contacts and wind the tripping springs. Different recloser versions use primary voltage to provide close power.

Pin # / letter	Function	Description / comments
A	power	24 Vdc power for trip and close circuit
B	status	Monitored trip circuit point, between trip coil (-) and 52a (+)
C	trip/status	Monitored trip circuit point, between 52a (-) and control trip output
D	status	Paralleled with Pin B
E	close/status	Monitored close circuit point, between close coil (-) and control close output
F	status	Monitored close circuit point, between close coil (+) and 69 (yellow handle) contact (-)
G	current	Phase 1 current
H	current	Phase 2 current
J	current	Phase 3 current
K	current	Residual current return; connected to ground at bottom of control cabinet
L	ground	connected to ground at bottom of control cabinet
M	ground	Connection to recloser tank; connected to ground at bottom of control cabinet
N	none	Not connected
P	none	Not connected

In some traditional reclosers (14-pin), an accessory battery-charging current transformer was connected to pins K and L – coming effectively shorted out in a standard configuration (pins K and L both connected to ground at bottom of control cabinet.

19-pin Recloser Interface (Eaton)
Trip/close power (53 Vdc) brought into recloser via control cable (no extra "low-voltage" close cable needed). Energy storage in recloser.
120 Vac (for recloser heater) brought into recloser via control cable.
LEA (low-energy analog) voltages can be brought in via separate cable. Exclusively resistive divider?

Pin # / letter	Function	Description / comments
A		
B		
C	trip/status	Monitored trip circuit point, between 52a (-) and control trip output
D		connected to ground at bottom of control cabinet
E	close/status	Monitored close circuit point, between 52b (-) and control close output
F	enable	VTC interface
G	current	Phase 1 current
H	current	Phase 2 current
J	current	Phase 3 current
K	current	Residual current return; connected to ground at bottom of control cabinet
L	power	Return for 53 Vdc power; connected to ground at bottom of control cabinet
M	ground	Connection to recloser tank; connected to ground at bottom of control cabinet
N	power	Return for 53 Vdc power; connected to ground at bottom of control cabinet
P		connected to ground at bottom of control cabinet
R	power	53 Vdc power for trip and close circuit
S	power	53 Vdc power for trip and close circuit
T	power	53 Vdc power for trip and close circuit
U	power	120 Vac power (H) for recloser heater
V	power	120 Vac power (N) for recloser heater

24-pin Recloser Interface (ABB)
Triple-single capability (53 Vdc). "H-bridge" trip/close circuits.
120 Vac (for recloser heater) brought into recloser via control cable.
LEA (low-energy analog) voltages brought in via control cable. Exclusively capacitive divider?

Pin # / letter	Function	Description / comments
1	power	120 Vac power (H) for recloser heater
2	voltage	Source-side phase 2 LEA voltage
3	voltage	Source-side LEA voltage wye neutral point; connected to ground at bottom of control cabinet
4	status	69 (yellow handle) contact
5	status	52a-1 contact
6	status	52b-2 contact
7	whetting voltage	12 Vdc whetting voltage for 52a, 52b, and 69 (yellow handle) contacts
8	trip/close	Trip-3 (+), Close-3 (-)
9	trip/close	Trip-2 (+), Close-2 (-)
10	trip/close	Trip-1 (+), Close-1 (-)
11	current	Phase 2 current
12	current	Residual current return; connected to ground at bottom of control cabinet
13	power	120 Vac power (N) for recloser heater
14	voltage	Source-side phase 3 LEA voltage
15	voltage	Source-side phase 1 LEA voltage
16	status	52a-2 contact
17	status	52a-3 contact
18	status	52b-3 contact
19	status	52b-1 contact
20	trip/close	Close-3 (+), Trip-3 (-)
21	trip/close	Close-2 (+), Trip-2 (-)
22	trip/close	Close-1 (+), Trip-1 (-)
23	current	Phase 3 current
24	current	Phase 1 current

26-pin Recloser Interface (Eaton)
Triple-single capability (53 Vdc). Separate trip and close circuits for each phase.
LEA (low-energy analog) voltages brought in via control cable. Exclusively resistive divider?

Pin # / letter	Function	Description / comments
A	power	53 Vdc power for trip and close circuit 1
B	power	53 Vdc power for trip and close circuit 2
C	power	53 Vdc power for trip and close circuit 3
D	whetting voltage	12 Vdc whetting voltage for 69 (yellow handle) contacts
E	trip/status	Monitored trip circuit point, between 52a-1 (-) and control trip output
F	trip/status	Monitored trip circuit point, between 52a-2 (-) and control trip output
G	trip/status	Monitored trip circuit point, between 52a-3 (-) and control trip output
H	close/status	Monitored close circuit point, between 52b-1 (-) and control close output
J	close/status	Monitored close circuit point, between 52b-2 (-) and control close output
K	close/status	Monitored close circuit point, between 52b-3 (-) and control close output
L	whetting voltage	Return for 12 Vdc whetting voltage for 69 (yellow handle) contacts
M	ground	Connection to recloser tank; connected to ground at bottom of control cabinet
N	power	Return for 53 Vdc power for trip and close circuit 1; connected to ground at bottom of control cabinet
P	power	Return for 53 Vdc power for trip and close circuit 2; connected to ground at bottom of control cabinet
R	power	Return for 53 Vdc power for trip and close circuit 3; connected to ground at bottom of control cabinet
S	status	69-1 (yellow handle) contact
T	status	69-2 (yellow handle) contact
U	status	69- (yellow handle) contact
V	current	Phase 1 current
W	current	Phase 2 current
X	current	Phase 3 current
Y	current	Residual current return; connected to ground at bottom of control cabinet
Z	voltage	Source-side phase 3 LEA voltage
a	voltage	Source-side phase 1 LEA voltage
b	voltage	Source-side phase 2 LEA voltage
d		

27-pin Recloser Interface (Joslyn)
Triple-single capability (155 Vdc). Separate trip and close circuits for each phase.
Each phase current has both leads brought out.

Pin # / letter	Function	Description / comments
A	close	Close-1
C	close	Close-1 return; connected to ground at bottom of control cabinet
D	close	Close-2
E	close	Close-2 return; connected to ground at bottom of control cabinet
F	close	Close-3
G	close	Close-3 return; connected to ground at bottom of control cabinet
H	trip	Trip-1
I	trip	Trip-1 return; connected to ground at bottom of control cabinet
J	trip	Trip-2
K	trip	Trip-3
L	trip	Trip-3 return; connected to ground at bottom of control cabinet
M	current	Phase 1 current return
N	current	Phase 1 current
R	current	Phase 2 current return
S	trip	Trip-2 return; connected to ground at bottom of control cabinet
T	current	Phase 3 current return
U	current	Phase 3 current
V	status	69 (yellow handle) contact
W	status	52a-1 contact
X	current	Phase 2 current
Y	whetting voltage	12 Vdc whetting voltage for 52a and 69 (yellow handle) contacts
Z	status	52a-2 contact
a	status	52a-3 contact
b		
c		
d		
e		

32-pin Recloser Interface (G&W Electric)
Triple-single capability (155 Vdc). "H-bridge" trip/close circuits.
LEA (low-energy analog) voltages brought in via control cable (optionally from both sides). Exclusively capacitive divider? Resistive divider LEAs for Elastimold.

Pin # / letter	Function	Description / comments
A	current	Phase 1 current
B	current	Phase 2 current
C	current	Phase 3 current
D	current	Residual current return
E		
F	whetting voltage	12 Vdc whetting voltage for 52a and 69 (yellow handle) contacts
G	ground	Connection to recloser tank and residual current return circuit; connected to ground at bottom of control cabinet
H		
J	voltage	Load-side phase 1 LEA voltage
K	voltage	Load-side phase 2 LEA voltage
L	voltage	Load-side phase 3 LEA voltage
M	voltage	Load-side LEA voltage wye neutral point
N	voltage	Source-side phase 1 LEA voltage
P	voltage	Source-side phase 2 LEA voltage
R	voltage	Source-side phase 3 LEA voltage
S	voltage	Source-side LEA voltage wye neutral point
T		
U	status	52a-1 contact
V	status	52a-2 contact
W	status	52a-3 contact
X	status	Paralleled 69-1, 69-2, and 69-3 (yellow handle) contacts
Y	trip/close	Close-1 (+), Trip-1 (-)
Z	trip/close	Trip-1 (+), Close-1 (-)
a		
b		
c		
d		
e		
f	trip/close	Close-2 (+), Trip-2 (-)
g	trip/close	Trip-2 (+), Close-2 (-)
h	trip/close	Close-3 (+), Trip-3 (-)
j	trip/close	Trip-3 (+), Close-3 (-)

32-pin Recloser Interface - Rectangular (Tavrida)
Not triple-single capable (155 Vdc). "H-bridge" trip/close circuits paralleled into one trip/close input on Tavrida recloser.
LEA (low-energy analog) voltages brought in via control cable from both sides. Capacitive divider with bottom capacitor on terminal block inside control enclosure.
Pins 4, 8, 22, 23, 24, 30, 31, and 32 are all connected together via a terminal block inside the enclosure. It has a separate circuit (not part of the recloser interface) that detects 69 (yellow handle) contact operation in the trip/close circuit.

Pin # / letter	Function	Description / comments
1	trip/close	Close (+), Trip (-)
2		
3	trip/close	Trip (+), Close (-)
4	ground	connected to ground at bottom of control cabinet
5	status	52b-1 contact
6		
7	whetting voltage	12 Vdc whetting voltage for 52b-1 contact
8	ground	connected to ground at bottom of control cabinet
9	status	52b-2 contact (not connected to control)
10	current	Phase 1 current
11	current	Phase 2 current
12	current	Phase 3 current
13	status	52b-2 contact (not connected to control)
14	current	Residual current return
15		
16		
17	status	52b-3 contact (not connected to control)
18	voltage	Source-side phase 1 LEA voltage
19	voltage	Source-side phase 2 LEA voltage
20	voltage	Source-side phase 3 LEA voltage
21	status	52b-3 contact (not connected to control)
22	voltage	Source-side phase 1 LEA voltage neutral point
23	voltage	Source-side phase 2 LEA voltage neutral point
24	voltage	Source-side phase 3 LEA voltage neutral point
25	status	52a contact (not connected to control)
26	voltage	Load-side phase 1 LEA voltage
27	voltage	Load-side phase 2 LEA voltage
28	voltage	Load-side phase 3 LEA voltage
29	status	52a contact (not connected to control)
30	voltage	Load-side phase 1 LEA voltage neutral point
31	voltage	Load-side phase 2 LEA voltage neutral point
32	voltage	Load-side phase 3 LEA voltage neutral point

40-pin Recloser Interface (Siemens) pins D1 through D10 not used
Triple-single capability (155 Vdc). "H-bridge" trip/close circuits.
120 Vac (for recloser heater) brought into recloser via control cable.
Each phase current has both leads brought out.
LEA (low-energy analog) voltages brought in via separate cable. Exclusively resistive divider?

Pin # / letter	Function	Description / comments
A1	current	Phase 1 current
A2	current	Phase 1 current return
A3		
A4	status	69-1 (yellow handle) contact
A5	status	52a-1 contact
A6	status	52b-1 contact
A7	whetting voltage	12 Vdc whetting voltage for 52a-1, 52b-1, and 69-1 (yellow handle) contacts
A8	power	120 Vac power (N) for recloser heater
A9	trip/close	Trip-1 (+), Close-1 (-)
A10	trip/close	Close-1 (+), Trip-1 (-)
B1	current	Phase 2 current
B2	current	Phase 2 current return
B3		
B4	status	69-2 (yellow handle) contact
B5	status	52a-2 contact
B6	status	52b-2 contact
B7	whetting voltage	12 Vdc whetting voltage for 52a-2, 52b-2, and 69-2 (yellow handle) contacts
B8		
B9	trip/close	Trip-2 (+), Close-2 (-)
B10	trip/close	Close-2 (+), Trip-2 (-)
C1	current	Phase 3 current
C2	current	Phase 3 current return
C3		
C4	status	69-3 (yellow handle) contact
C5	status	52a-3 contact
C6	status	52b-3 contact
C7	whetting voltage	12 Vdc whetting voltage for 52a-3, 52b-3, and 69-3 (yellow handle) contacts
C8	power	120 Vac power (H) for recloser heater
C9	trip/close	Trip-3 (+), Close-3 (-)
C10	trip/close	Close-3 (+), Trip-3 (-)

42-pin Recloser Interface

Rather an extension of 32-pin interface (G&W Electric), with the following additions:

LEA voltage neutral points brought in separately for each phase. LEA power supply circuit included.

52b contacts brought in for each phase, in addition to 52a contacts for each phase.

Existing 32-pin reclosers can work with 42-pin control via adapter cable.

Pin # / letter	Function	Description / comments
1	status	52a-3 contact
2	trip/close	Close-1 (+), Trip-1 (-)
3	trip/close	Trip-1 (+), Close-1 (-)
4	trip/close	Close-2 (+), Trip-2 (-)
5	trip/close	Trip-2 (+), Close-2 (-)
6	trip/close	Close-3 (+), Trip-3 (-)
7	trip/close	Trip-3 (+), Close-3 (-)
8	status	52a-2 contact
9	status	52a-1 contact
10		
11	power	12 Vdc (+) power for LEA power supply
12	power	12 Vdc (-) power for LEA power supply
13		
14		
15	status	Paralleled 69-1, 69-2, and 69-3 (yellow handle) contacts
16	status	52b-3 contact
17	status	52b-2 contact
18		
19		
20		
21	current	Phase 1 current
22	status	52b-1 contact
23		
24		
25	ground	Connection to recloser tank and residual current return circuit (on recloser tank side); connected to ground at bottom of control cabinet
26		
27	current	Residual current return
28	current	Phase 2 current
29	whetting voltage	12 Vdc whetting voltage for 52a, 52b, and 69 (yellow handle) contacts
30	voltage	Load-side phase 1 LEA voltage neutral point
31	voltage	Load-side phase 2 LEA voltage neutral point
32	voltage	Load-side phase 3 LEA voltage neutral point
33	voltage	Source-side phase 2 LEA voltage neutral point
34	voltage	Source-side phase 3 LEA voltage neutral point
35	current	Phase 3 current
36	voltage	Load-side phase 1 LEA voltage
37	voltage	Load-side phase 2 LEA voltage
38	voltage	Load-side phase 3 LEA voltage

39	voltage	Source-side phase 1 LEA voltage neutral point
40	voltage	Source-side phase 1 LEA voltage
41	voltage	Source-side phase 2 LEA voltage
42	voltage	Source-side phase 3 LEA voltage

Summary comments

Different voltage levels: 53 Vdc vs. 155 Vdc

Different trip/close circuit arrangements:

"H-bridge" trip/close circuits
vs.
Separate trip and close circuits for each phase

Different LEA circuits: capacitive divider vs. resistive divider

Different trip and close output behavior:

Defined pulse widths
vs.
unlatch on breaker feedback

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Future interchangeability:
Ideally just swap out control or recloser … or would it be OK to make settings change for such differences as trip and close pulse widths?

What other signals should be put through the recloser control cable, if any?

Comment: Except for recloser heater, bringing in secondary level voltages from the primary system (e.g., 120 Vac or 67 Vac) has been via extra cable connection (not via the recloser control cable).