Distribution Automation at Great Lakes Energy (GLE)

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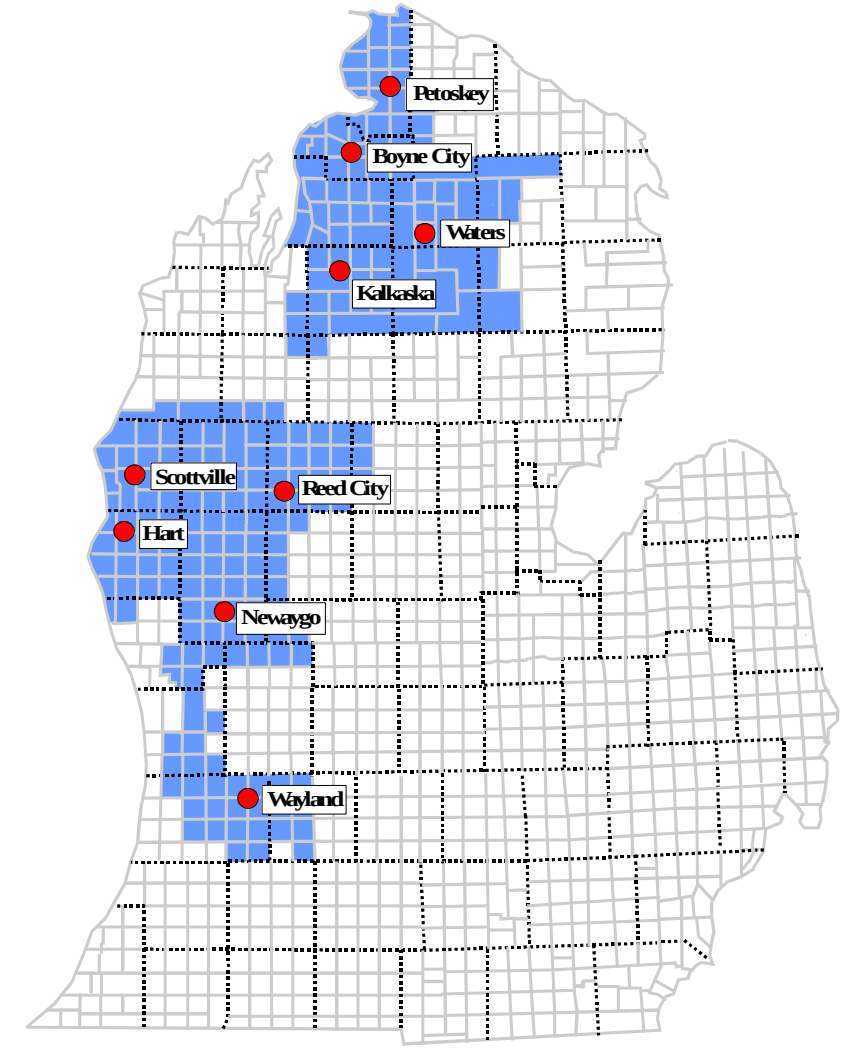
Manager, Distribution Systems Technology

Agenda

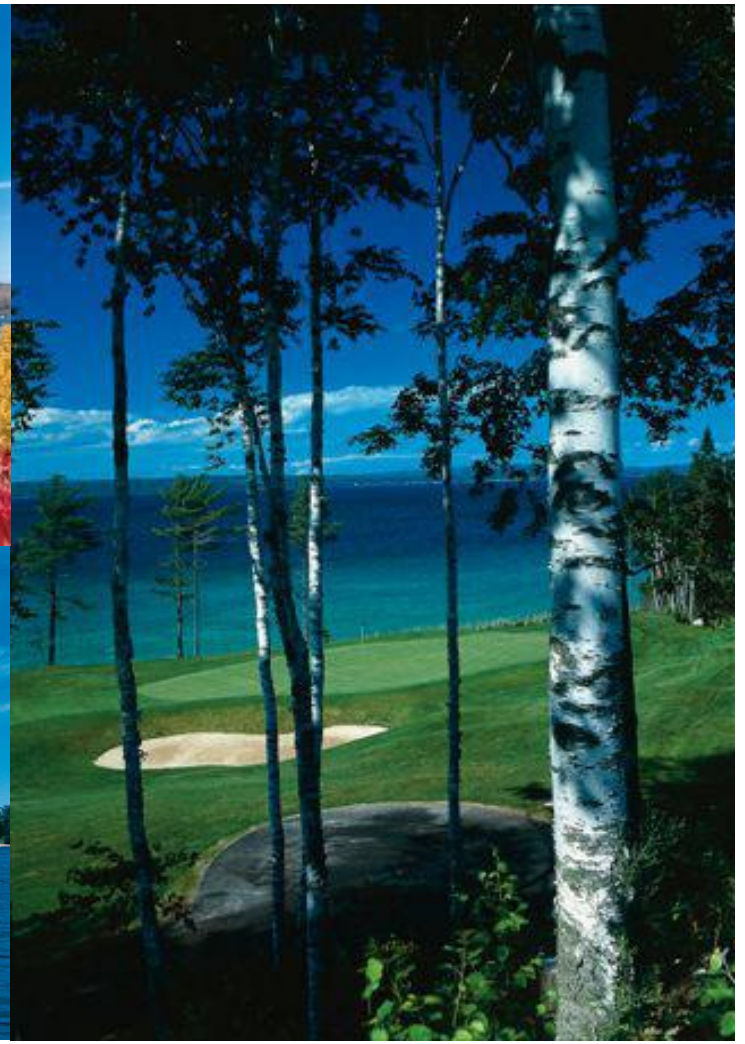
- Great Lakes Energy Overview

- Great Lakes Energy DA (FLISR) Program Overview
  - Who
  - What
  - Where
  - Why
  - When
  - How Does the System Work
  - Some setup screens in NCD
  - Protection plan for the lineman

Great Lakes Energy



- 125,000 active electric meters
- 26 counties
- 11,000 miles of overhead line
- 3,100 miles of underground line
- 82 substations
- 9 district offices
- 32% seasonal customers
- 24/7 Dispatch



Distribution Automation - What

- DA = Can be FDIR, FLISR, CVR, DR, or …

- For GLE, DA is an FDISR system that communicates to IED's in the field such as SEL 651R and SEL 2411
  - Fault Detection, Isolation, Sectionalizing, and Recovery

Distribution Automation - What

- Distribution Automation – A system in which a number of feeders can reconfigure themselves in response to an outage event within 3 or 4 minutes.
  - FDIR – Fault Detection, Isolation and Restoration
  - FLISR - Fault Detection, Isolation, Sectionalizing and Restoration
  - FLIR – Fault Location, Isolation an Restoration

- Lineman's Definition – Computers that decide to open and close switches and electronic reclosers.

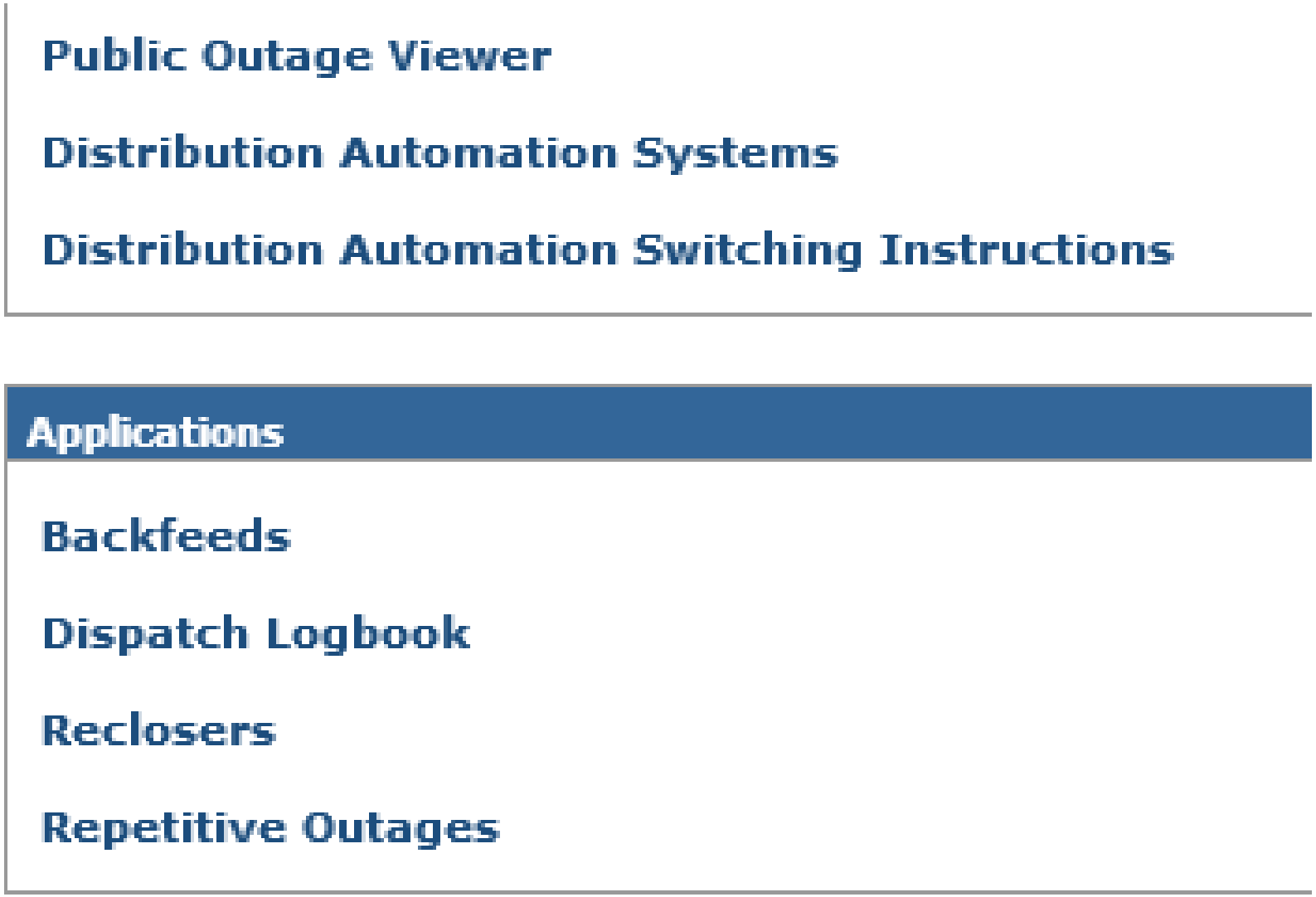
Distribution Automation – Where?

- How we chose Locations for the Distribution Automation schemes
  - Worst performing feeder history over last 3 years
    - Number of outages
    - Number of members affected
  - Engineering review for capacity
    - Wire size
    - Load to be picked up
    - Future work plans
  - Transmission protection system
    - Will a Transmission outage most likely affect both substations?
  - Cell communications makes it easier to site midline reclosers
    - Serial Radio communications no longer being added

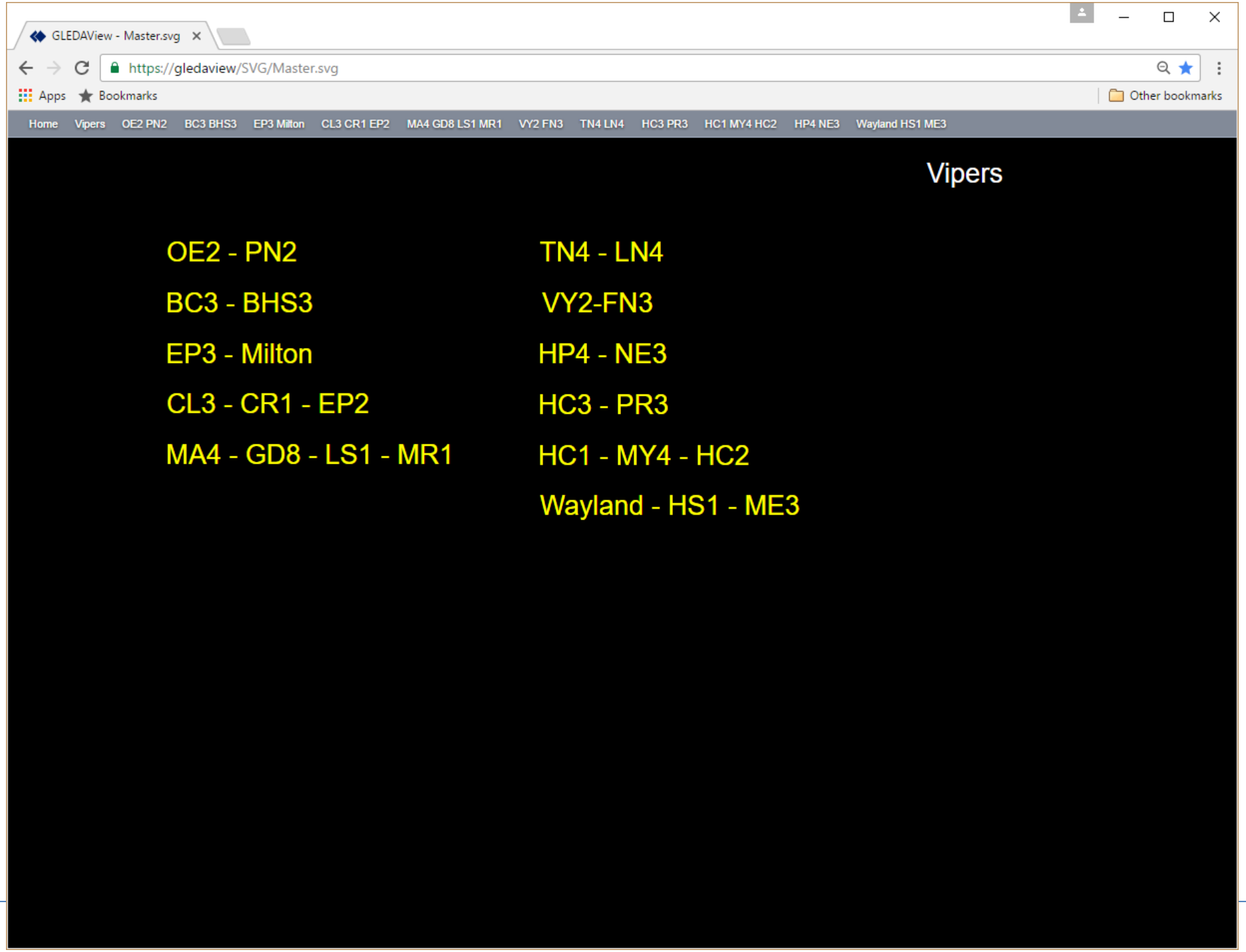
Distribution Automation - Where

- All 9 Districts have a DA(FDISR) System
  - 11 Systems
  - 32 Feeders
  - 34 Electronic Reclosers (Vipers)
  - 18 Motorized Tie Switches
- 7 Stand alone midline Electronic Reclosers (Vipers)
- Only 2 substations with communications inside the fence.

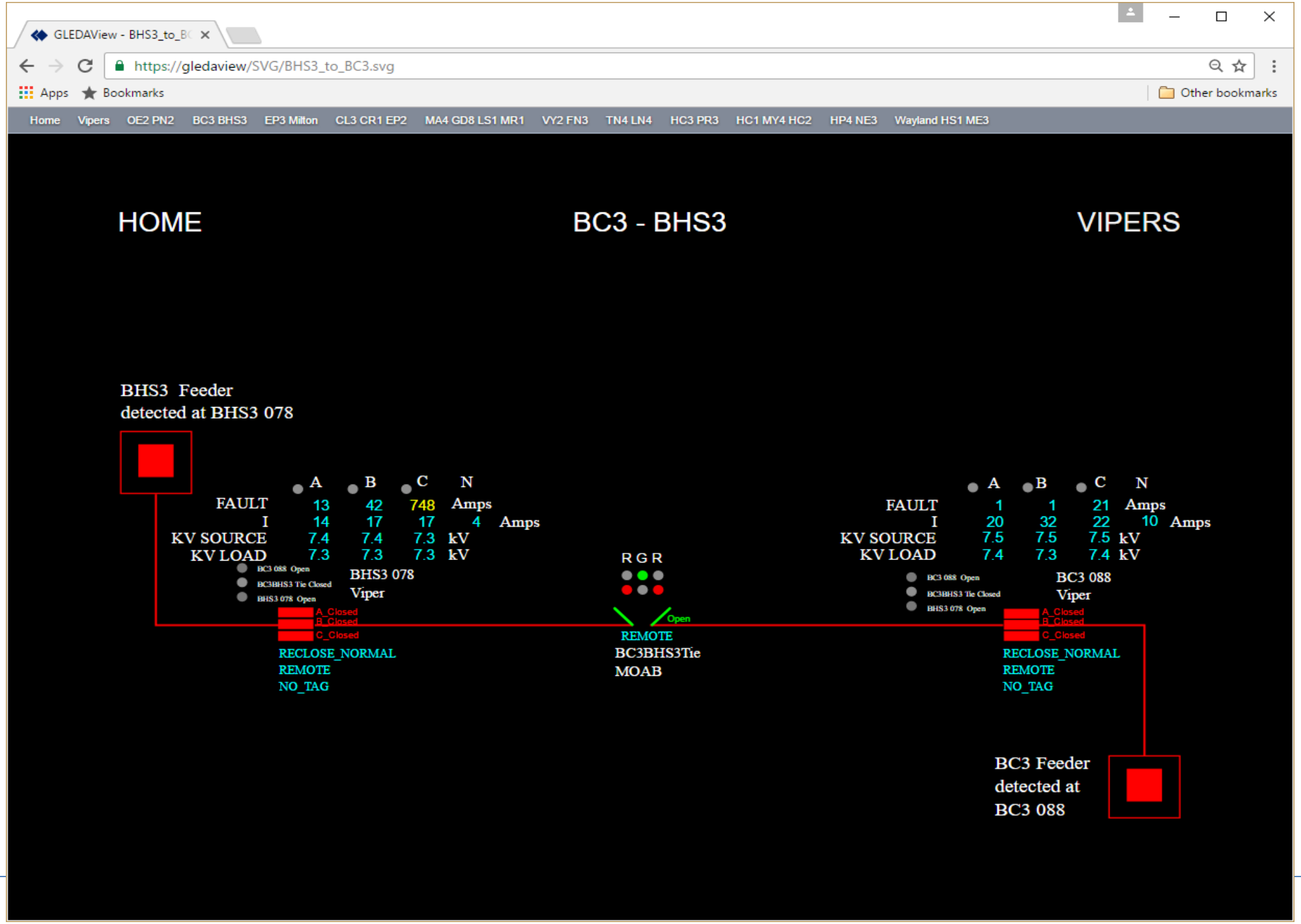
Available for the Lineworkers Computers in Their Trucks.



First page


GLEDAView - Master.svg
https://gledaview/SVG/Master.svg
Apps
Bookmarks
Other bookmarks
Home
Vipers
OE2 PN2
BC3 BHS3
EP3 Milton
CL3 CR1 EP2
MA4 GD8 LS1 MR1
VY2 FN3
TN4 LN4
HC3 PR3
HC1 MY4 HC2
HP4 NE3
Wayland HS1 ME3
Vipers
OE2 - PN2
BC3 - BHS3
EP3 - Milton
CL3 - CR1 - EP2
MA4 - GD8 - LS1 - MR1
TN4 - LN4
VY2-FN3
HP4 - NE3
HC3 - PR3
HC1 - MY4 - HC2
Wayland - HS1 - ME3

First System to be Installed.



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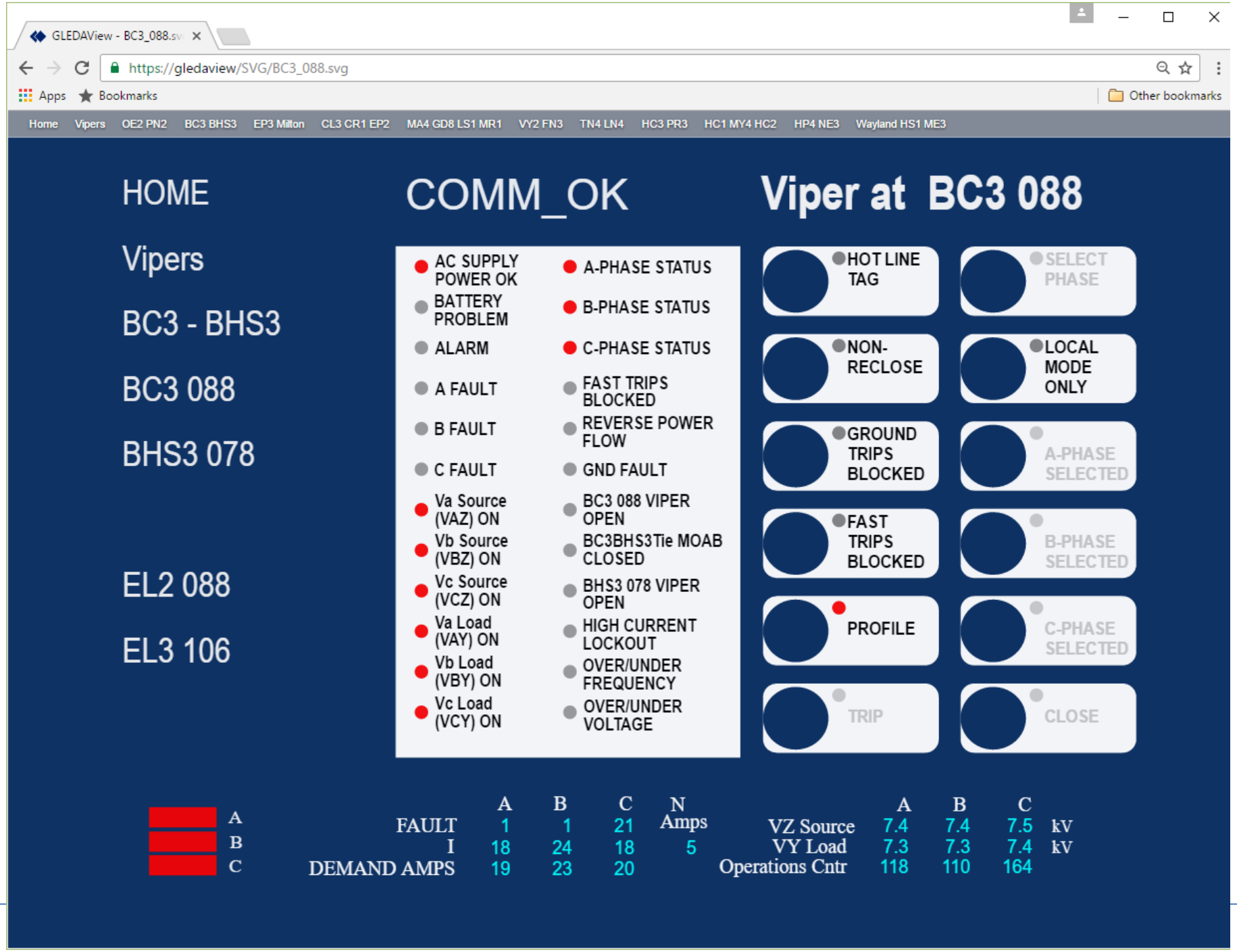
View of the SEL 651



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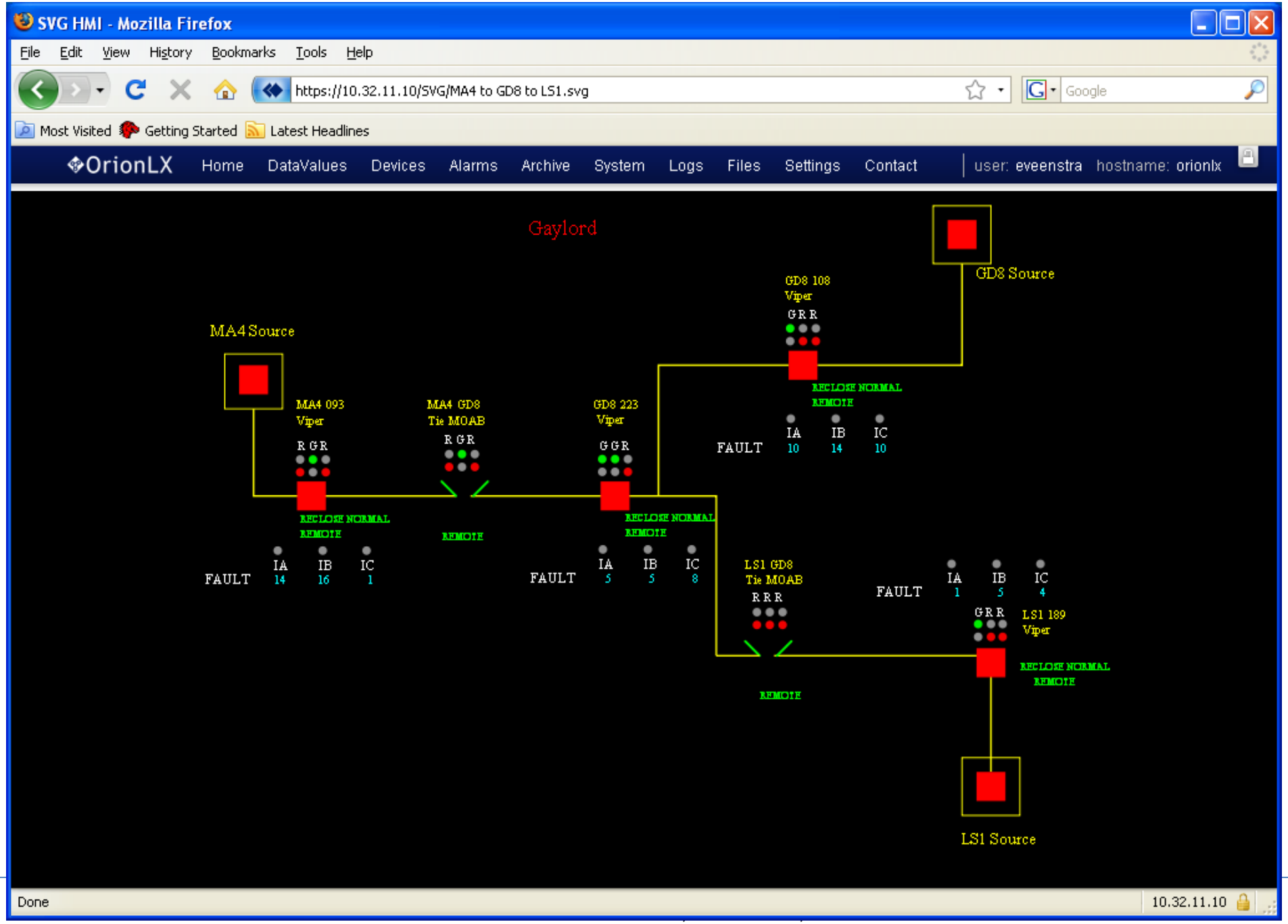
Gaylord Scheme in Normal mode in 2012

Orion WEBserver One line



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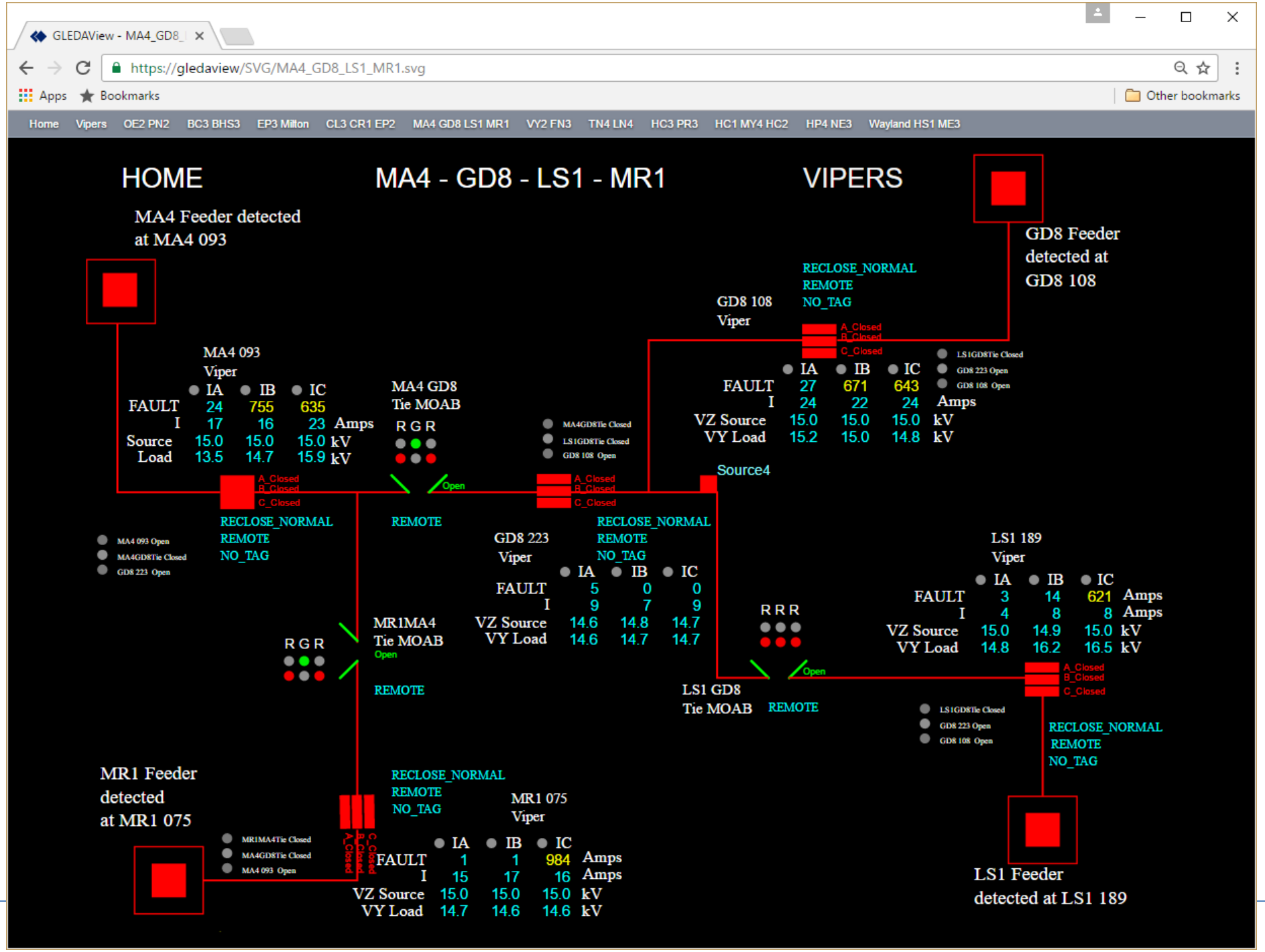
Gaylord System in Normal mode

– Today's view



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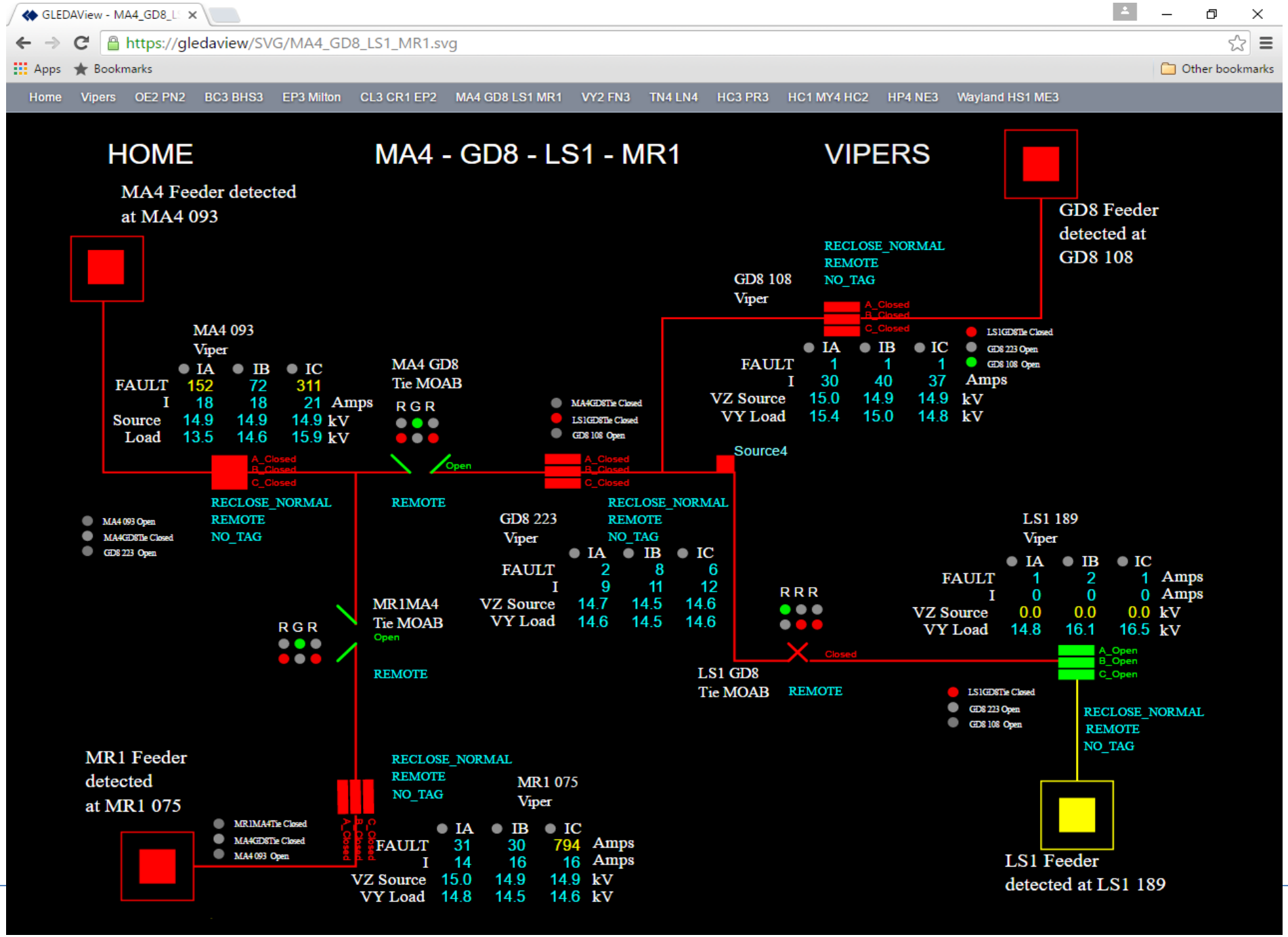
Gaylord System in an alternate mode



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Distribution Automation – Why?

- Reliability improvement – SAIDI

  System Average Interruption Duration Index

- Actual outage minutes that were avoided in 2008
  - EP3 to MN1 – 2,151 avoided outage hours
  - BC3 to BHS3 – 8,943 avoided outage hours
  - 1.7 % of 2008 outage hours avoided
  - 2008 SAIDI minute reduction of 4.5 minutes
- 2010
  - Storm in October – lost Boyne City sub twice – auto restoration would have been nice.

- 2015 Corporate Goal – 182.1 minutes - Achieved 176.2
  - Approximately 21,455 outage hours saved by DA which calculates to 10.6 SAIDI minutes saved
  - Without DA would have been 186.8 – would not have met our corporate goal.
- 2016 YTD – 23 events - Saved 23,302 Outage hours – 11.46 SAIDI minutes

Distribution Automation - When

- First 2 systems installed 2008

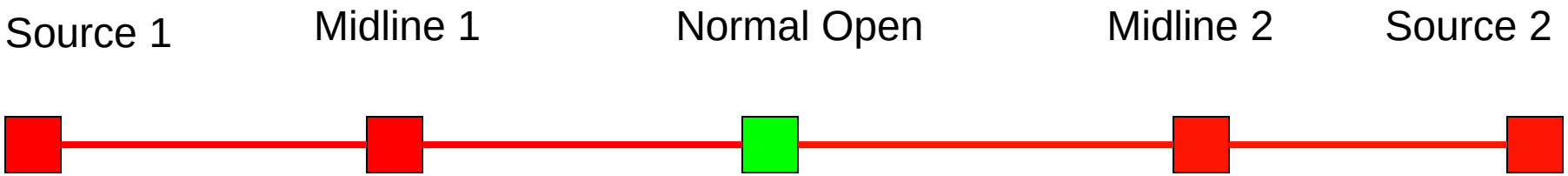
- 2010 – Added automated restoration
- 2011 – Added e-mail alerts
- 2012 – adding devices to most of the simple DA systems
- 2012 - Also trying to add cell phone communications instead of radio
- 2013 – Cell modems working well – now the new standard
- 2014 – Began conversion of troublesome radio connections to cell
- 2015 and 2016 – Coast mode!

Updates Since 2012

- I now have DA “systems” – I no longer come up with “schemes” to mess with the lineman
- All new installations use cell modems
- One OrionLX is dedicated as a view only for Corporate to view one-lines and SEL-651R simulations.
  - Corporate computers can view one-lines any where on the network
  - View-only on Company computers including lineman in their trucks
  - Can View 651R simulations
- Two systems that are doing load checking
- Added 60 seconds Local Loss Of Potential detection as a Latch bit at the Electronic Recloser.
- Added 79CYx detection to LogicPak which adds a 30 second delay to a fault detection.
- Moved some unreliable radio communications to Cell modems.

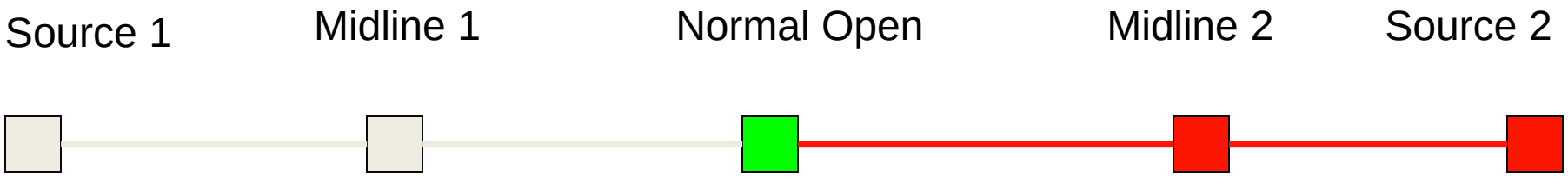
How Does It work?

DA Normal Condition



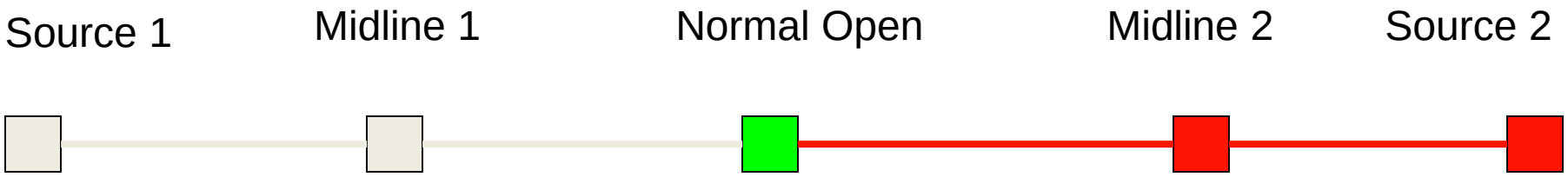
- Red = Closed – Energized
- Green = Open
- Black – De-energized

DA Loss of Source



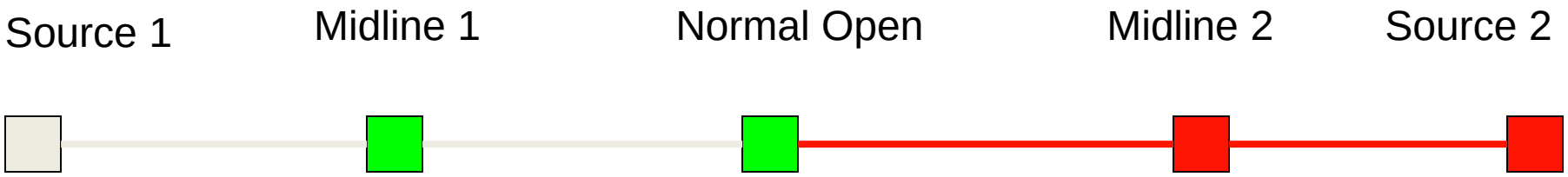
- Lose a source – Power supplier outage
- Wait 1 minute to see if source will be restored Get an e-mail of LOP

DA Loss of Source



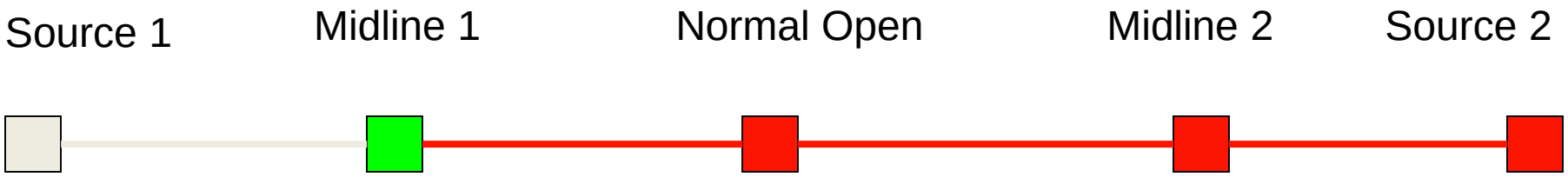
- LOP for 60 seconds is the Trigger
- Check for:
  - Midline 1 is
    - closed, no faults, remote mode, is in normal reclose , and not in hot line tag
  - Tie switch NO is
    - Open
  - Midline 2 is
    - Closed, has voltage on source side, and no faults

DA Loss of Source



- Lose a source – Power supplier outage
- Wait 1 minute to see if source will be restored
- Open Midline electronic recloser - Get e-mails showing each contact open
  - Confirm open

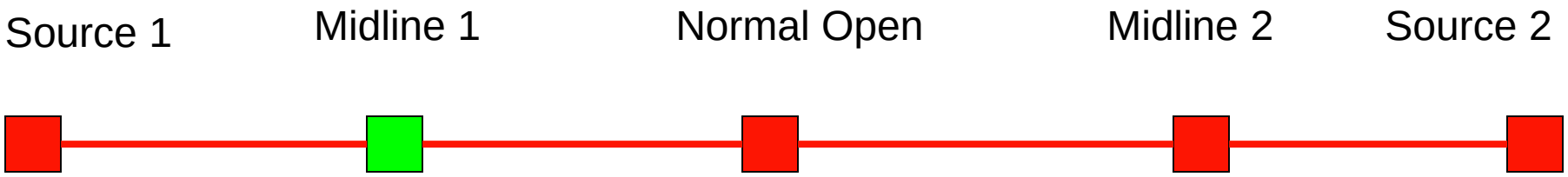
DA Loss of Source



- Lose a source – Power supplier outage
- Wait 1 minute to see if source will be restored
- Open Midline electronic recloser
- Close Normal Open point
  - Restores power to ½ the feeder from the alternate source and sends an e-mail.

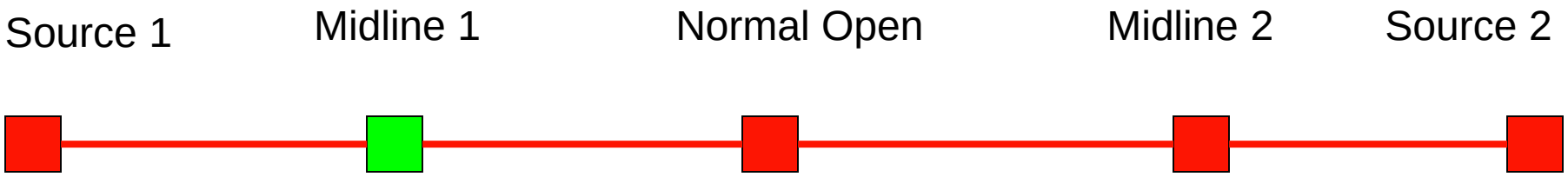
FROM	SUBJECT	RECEIVED	MESSAGE
DistAutomation...	BC3BHS3Tie to BC3088 Viper @Logic...	Wed 10/5/2016 3:02 PM	DA System has Backfed Value: 1 D...
DA System has Backfed Value: 1 Date/Time: 2016-10-05 23:01:44.495 EDT <end>			
DistAutomation...	SwitchClosed @BC3BHS3Tie	Wed 10/5/2016 3:02 PM	True Tie is CLOSED Value: 1 Date/...
True Tie is CLOSED Value: 1 Date/Time: 2016-10-05 23:01:44.495 EDT <end>			
DistAutomation...	FMD_79LOC @BC3_/088_Viper	Wed 10/5/2016 3:02 PM	Viper C Phase LOCKED OPEN Value...
Viper C Phase LOCKED OPEN Value: 1 Date/Time: 2016-10-05 15:01:23.619 EDT <end>			
DistAutomation...	FMD_79LOB @BC3_/088_Viper	Wed 10/5/2016 3:02 PM	Viper B Phase LOCKED OPEN Value...
Viper B Phase LOCKED OPEN Value: 1 Date/Time: 2016-10-05 15:01:23.619 EDT <end>			
DistAutomation...	FMD_79LOA @BC3_/088_Viper	Wed 10/5/2016 3:02 PM	Viper A Phase LOCKED OPEN Valu...
Viper A Phase LOCKED OPEN Value: 1 Date/Time: 2016-10-05 15:01:23.619 EDT <end>			
DistAutomation@	FMD_52AA @BC3_/088_Viper	Wed 10/5/2016 3:02 PM	Viper A Phase is OPEN Value: 0 Da

DA Restore to Normal



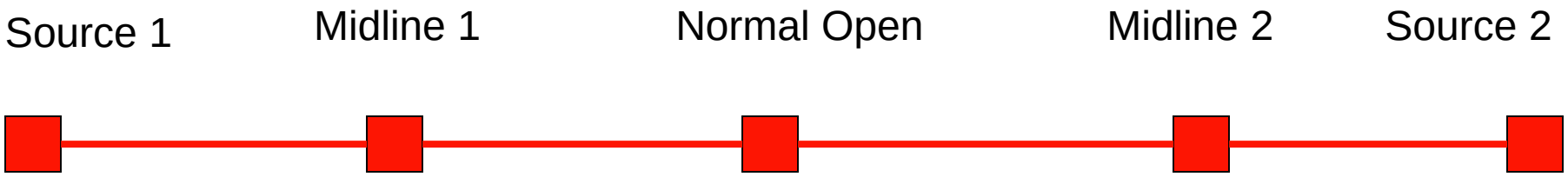
- Lose a source – Power supplier outage
- Wait 1 minute to see if source will be restored
- Open Midline electronic recloser
- Close Normal Open point
- Source 1 outage is restored

DA Restore to Normal



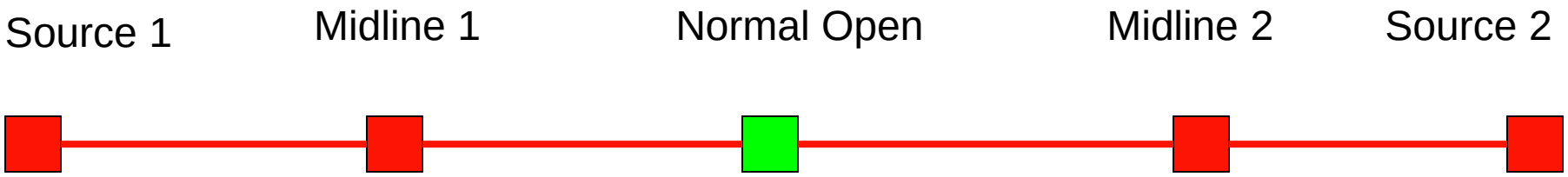
- Source is restored – Trigger is: Midline 1 Potential restored on all 3 source phases
- – Check for:
  - Midline 1 is in Remote, no fault, Normal reclose, all contacts open
  - Tie NO is in Remote, no faults on Midline 1 or 2

DA Restore to Normal



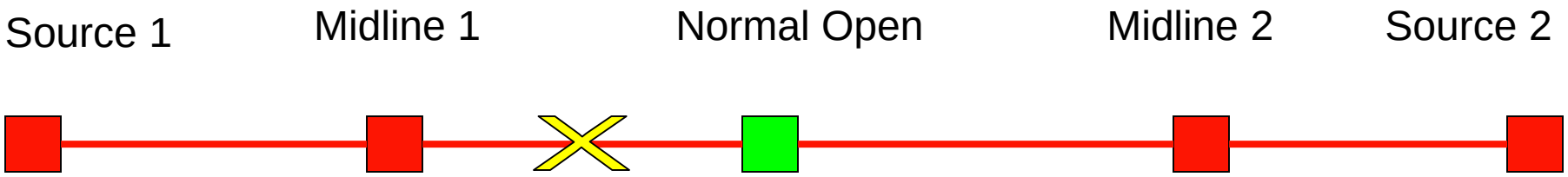
- Lose a source – Power supplier outage
- Wait 1 minute to see if source will be restored
- Open Midline electronic recloser
- Close Normal Open point
- Source 1 outage is restored
- Midline electronic recloser is closed to returned to normal

DA Restore to Normal



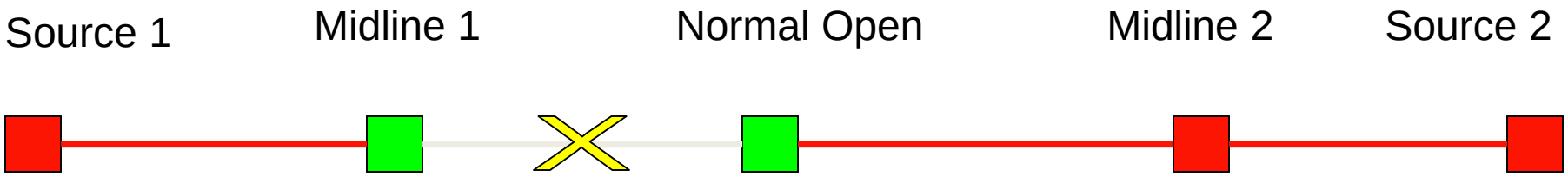
- Lose a source – Power supplier outage
- Wait 1 minute to see if source will be restored
- Open Midline electronic recloser
- Close Normal Open point
- Source 1 outage is restored
- Midline electronic recloser is closed and Normal Open is opened to return to normal state

DA Fault Condition 2



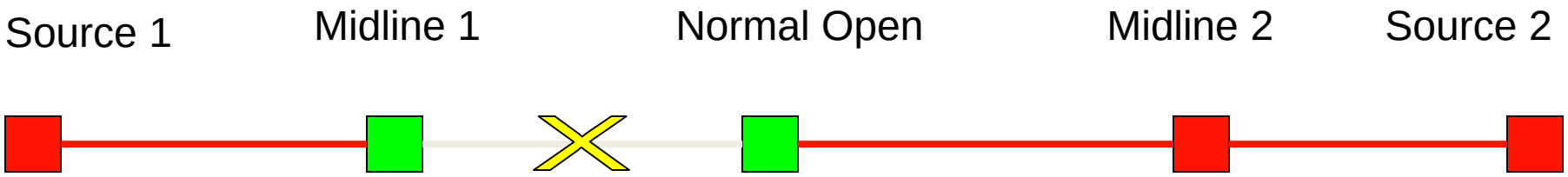
- Red = Closed – Energized
- Green = Open
- Black – De-energized
- Yellow X = Location of the Fault

DA Fault Condition 2



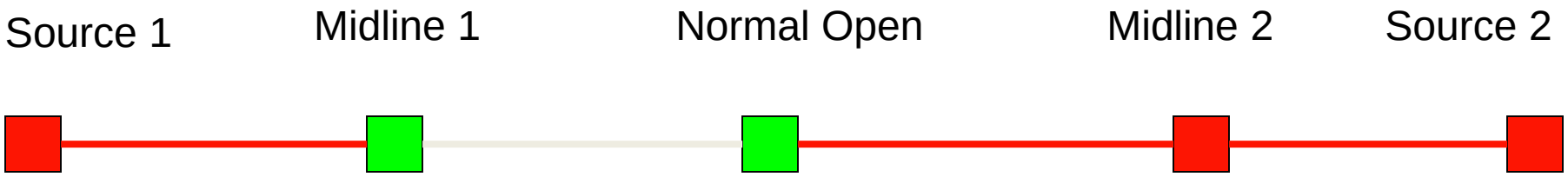
- Electronic Recloser at the midline would operate as it normally would
  - Go through it's 4 operations to lockout

DA Fault Condition 2



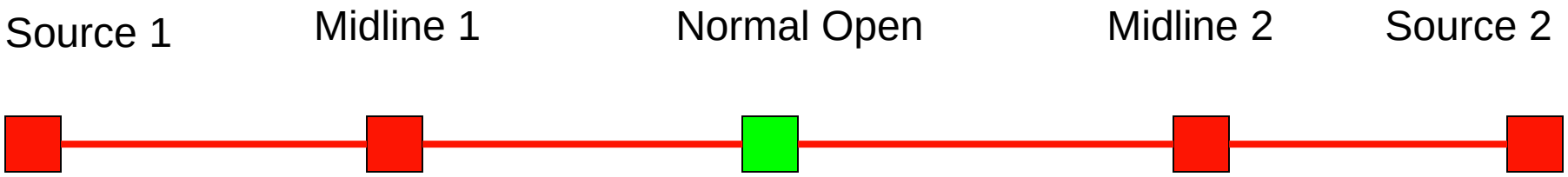
- Electronic Recloser at the midline would operate as it normally would
- No other action takes place by the scheme

DA Fault Condition 2

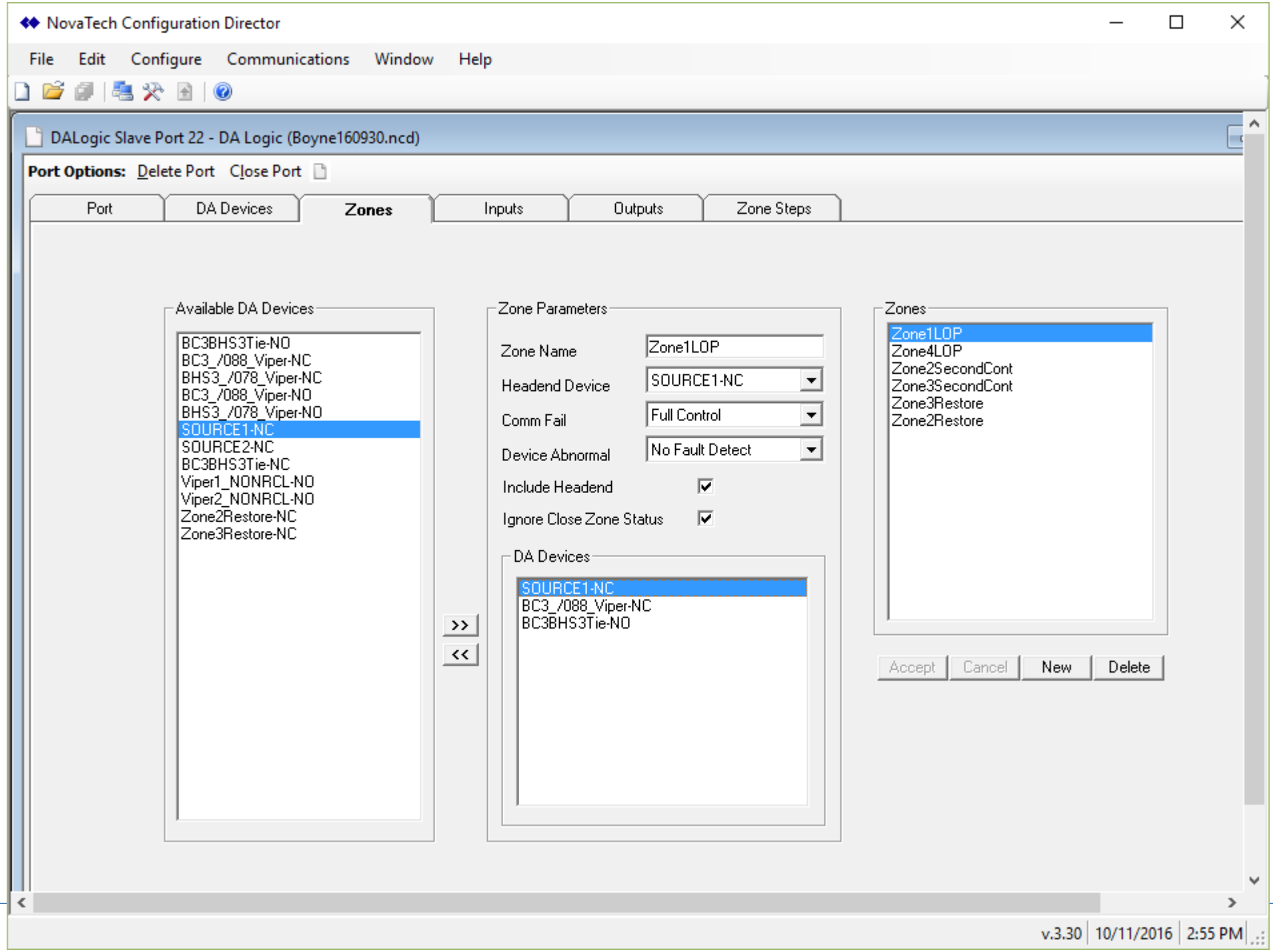


- Electronic Recloser at the midline would operate as it normally would
- No other action takes place by the scheme
- Fault is cleared by lineman

DA Fault Condition 2



- Electronic Recloser at the midline would operate as it normally would
- No other action takes place by the scheme
- Fault is cleared by lineman
- Midline would get closed in by lineman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File
Edit
Configure
Communications
Window
Help
DALogic Slave Port 22 - DA Logic (Boyne160930.ncd)
Port Options: Delete Port Close Port
Port
DA Devices
Zones
Inputs
Outputs
Zone Steps
Available DA Devices
BC3BHS3Tie-NO
BC3_/088_Viper-NC
BHS3_/078_Viper-NC
BC3_/088_Viper-NO
BHS3_/078_Viper-NO
SOURCE1-NC
SOURCE2-NC
BC3BHS3Tie-NC
Viper1_NONRCL-NO
Viper2_NONRCL-NO
Zone2Restore-NC
Zone3Restore-NC
>>
<<
Zone Parameters
Zone Name
Zone1LOP
Headend Device
SOURCE1-NC
Comm Fail
Full Control
Device Abnormal
No Fault Detect
Include Headend
Ignore Close Zone Status
DA Devices
SOURCE1-NC
BC3_/088_Viper-NC
BC3BHS3Tie-NO
Zones
Zone1LOP
Zone4LOP
Zone2SecondCont
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Zone3Restore
Zone2Restore
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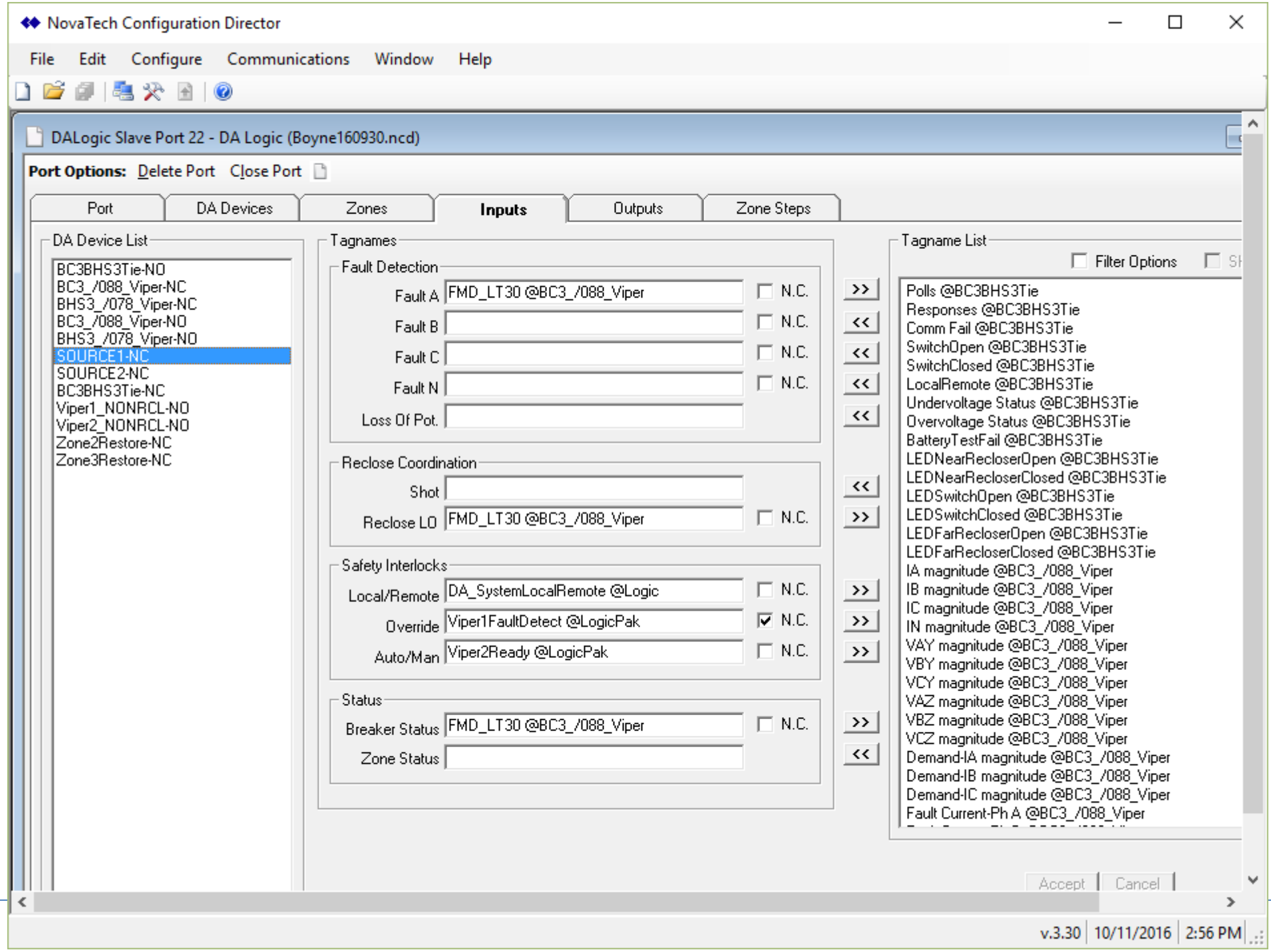
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Port DA Devices Zones Inputs Outputs Zone Steps
DA Device List
BC3BHS3Tie-NO
BC3_/088_Viper-NC
BHS3_/078_Viper-NC
BC3_/088_Viper-NO
BHS3_/078_Viper-NO
SOURCE1-NC
SOURCE2-NC
BC3BHS3Tie-NC
Viper1_NONRCL-NO
Viper2_NONRCL-NO
Zone2Restore-NC
Zone3Restore-NC
Tagnames
Fault Detection
Fault A FMD_LT30 @BC3_/088_Viper N.C.
Fault B N.C.
Fault C N.C.
Fault N N.C.
Loss Of Pot.
Reclose Coordination
Shot
Reclose LO FMD_LT30 @BC3_/088_Viper N.C.
Safety Interlocks
Local/Remote DA_SystemLocalRemote @Logic N.C.
Override Viper1FaultDetect @LogicPak N.C.
Auto/Man Viper2Ready @LogicPak N.C.
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Zone Status
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Polls @BC3BHS3Tie
Responses @BC3BHS3Tie
Comm Fail @BC3BHS3Tie
SwitchOpen @BC3BHS3Tie
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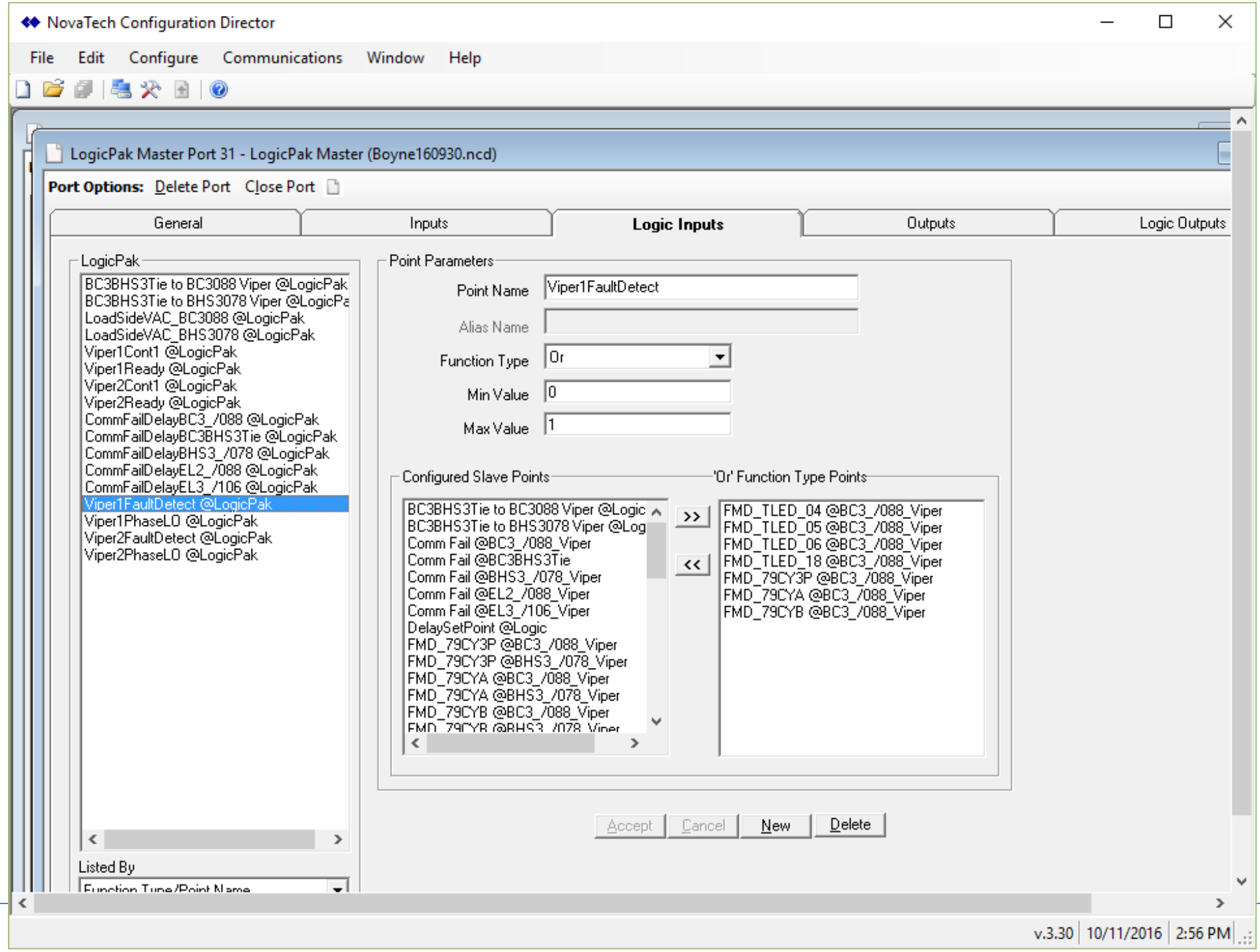
IB magnitude @BC3_/088_Viper
IC magnitude @BC3_/088_Viper
IN magnitude @BC3_/088_Viper
VAY magnitude @BC3_/088_Viper
VBY magnitude @BC3_/088_Viper
VCY magnitude @BC3_/088_Viper
VAZ magnitude @BC3_/088_Viper
VBZ magnitude @BC3_/088_Viper
VCZ magnitude @BC3_/088_Viper
Demand-IA magnitude @BC3_/088_Viper
Demand-IB magnitude @BC3_/088_Viper
Demand-IC magnitude @BC3_/088_Viper
Fault Current-Ph A @BC3_/088_Viper
Accept Cancel
v.3.30 10/11/2016 2:56 PM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File
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LogicPak Master Port 31 - LogicPak Master (Boyne160930.ncd)
Port Options: Delete Port Close Port
General
Inputs
Logic Inputs
Outputs
Logic Outputs
LogicPak
BC3BHS3Tie to BC3088 Viper @LogicPak
BC3BHS3Tie to BHS3078 Viper @LogicPa
LoadSideVAC_BC3088 @LogicPak
LoadSideVAC_BHS3078 @LogicPak
Viper1Cont1 @LogicPak
Viper1Ready @LogicPak
Viper2Cont1 @LogicPak
Viper2Ready @LogicPak
CommFailDelayBC3_/088 @LogicPak
CommFailDelayBC3BHS3Tie @LogicPak
CommFailDelayBHS3_/078 @LogicPak
CommFailDelayEL2_/088 @LogicPak
CommFailDelayEL3_/106 @LogicPak
Viper1FaultDetect @LogicPak
Viper1PhaseLO @LogicPak
Viper2FaultDetect @LogicPak
Viper2PhaseLO @LogicPak
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Function Type/Point Name
Point Parameters
Point Name
Viper1FaultDetect
Alias Name
Function Type
Or
Min Value
0
Max Value
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Configured Slave Points
BC3BHS3Tie to BC3088 Viper @Logic
BC3BHS3Tie to BHS3078 Viper @Log
Comm Fail @BC3_/088_Viper
Comm Fail @BC3BHS3Tie
Comm Fail @BHS3_/078_Viper
Comm Fail @EL2_/088_Viper
Comm Fail @EL3_/106_Viper
DelaySetPoint @Logic
FMD_79CY3P @BC3_/088_Viper
FMD_79CY3P @BHS3_/078_Viper
FMD_79CYA @BC3_/088_Viper
FMD_79CYA @BHS3_/078_Viper
FMD_79CYB @BC3_/088_Viper
>>
<<
'Or' Function Type Points
FMD_TLED_04 @BC3_/088_Viper
FMD_TLED_05 @BC3_/088_Viper
FMD_TLED_06 @BC3_/088_Viper
FMD_TLED_18 @BC3_/088_Viper
FMD_79CY3P @BC3_/088_Viper
FMD_79CYA @BC3_/088_Viper
FMD_79CYB @BC3_/088_Viper
Accept
Cancel
New
Delete
v.3.30
10/11/2016
2:56 PM

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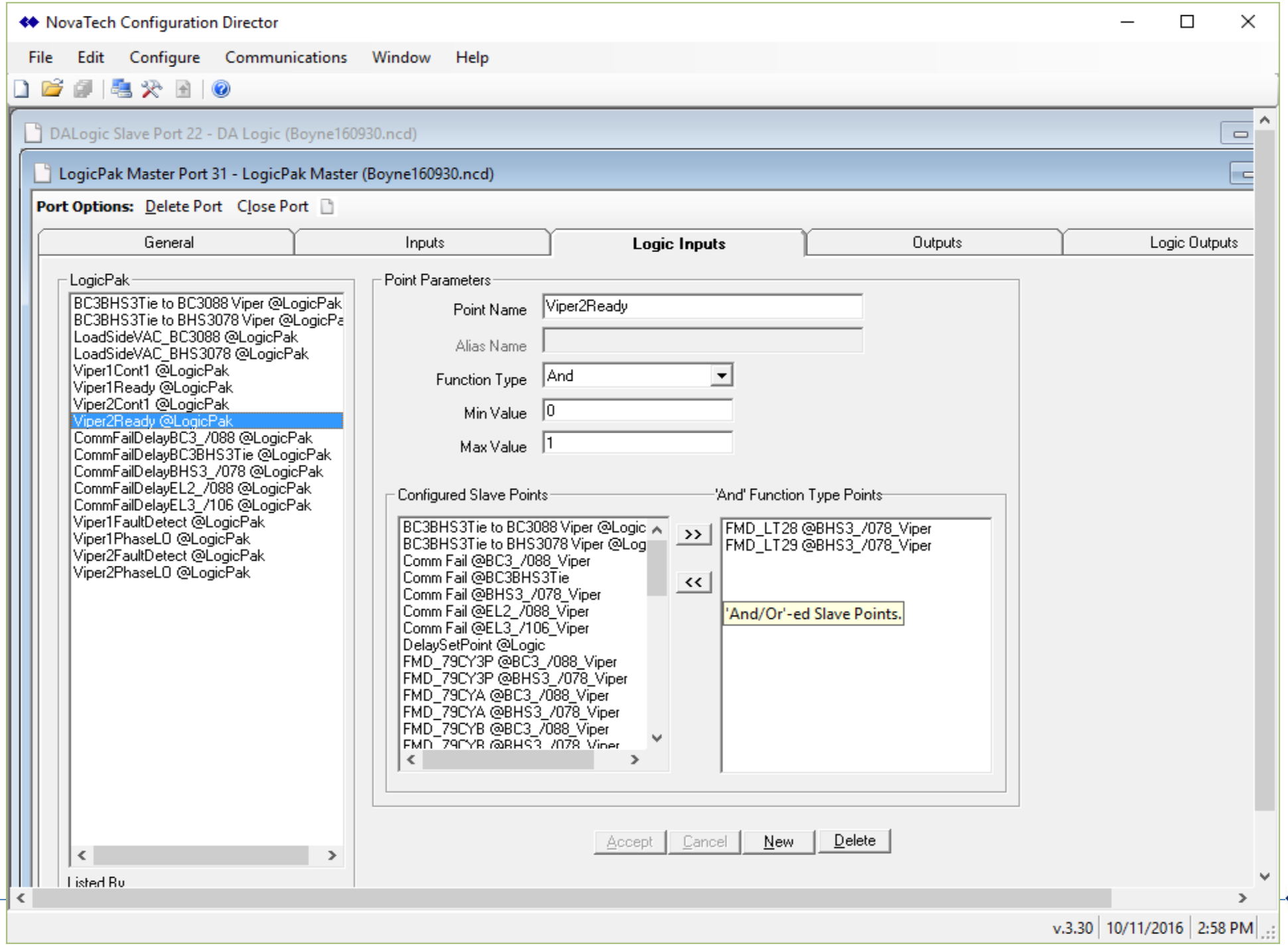
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File Edit Configure Communications Window Help
DALogic Slave Port 22 - DA Logic (Boyne160930.ncd)
LogicPak Master Port 31 - LogicPak Master (Boyne160930.ncd)
Port Options: Delete Port Close Port
General Inputs Logic Inputs Outputs Logic Outputs
LogicPak
BC3BHS3Tie to BC3088 Viper @LogicPak
BC3BHS3Tie to BHS3078 Viper @LogicPa
LoadSideVAC_BC3088 @LogicPak
LoadSideVAC_BHS3078 @LogicPak
Viper1Cont1 @LogicPak
Viper1Ready @LogicPak
Viper2Cont1 @LogicPak
Viper2Ready @LogicPak
CommFailDelayBC3_/088 @LogicPak
CommFailDelayBC3BHS3Tie @LogicPak
CommFailDelayBHS3_/078 @LogicPak
CommFailDelayEL2_/088 @LogicPak
CommFailDelayEL3_/106 @LogicPak
Viper1FaultDetect @LogicPak
Viper1PhaseLO @LogicPak
Viper2FaultDetect @LogicPak
Viper2PhaseLO @LogicPak
Listed By
Point Parameters
Point Name Viper2Ready
Alias Name
Function Type And
Min Value 0
Max Value 1
Configured Slave Points
BC3BHS3Tie to BC3088 Viper @Logic
BC3BHS3Tie to BHS3078 Viper @Log
Comm Fail @BC3_/088_Viper
Comm Fail @BC3BHS3Tie
Comm Fail @BHS3_/078_Viper
Comm Fail @EL2_/088_Viper
Comm Fail @EL3_/106_Viper
DelaySetPoint @Logic
FMD_79CY3P @BC3_/088_Viper
FMD_79CY3P @BHS3_/078_Viper
FMD_79CYA @BC3_/088_Viper
FMD_79CYA @BHS3_/078_Viper
FMD_79CYB @BC3_/088_Viper
>>
<<
'And' Function Type Points
FMD_LT28 @BHS3_/078_Viper
FMD_LT29 @BHS3_/078_Viper
'And/Or'-ed Slave Points.
Accept Cancel New Delete
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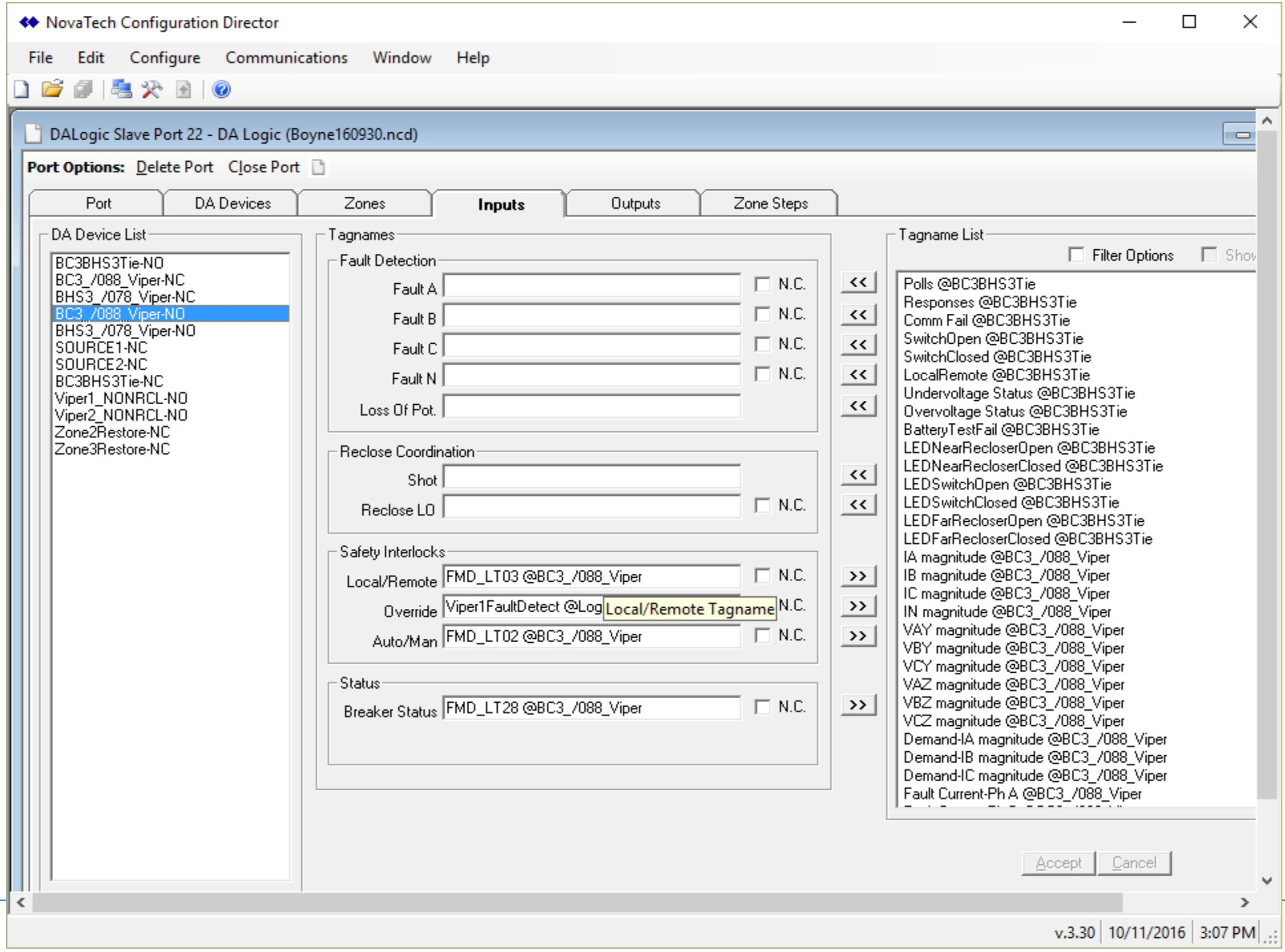
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File
Edit
Configure
Communications
Window
Help
DALogic Slave Port 22 - DA Logic (Boyne160930.ncd)
Port Options: Delete Port Close Port
Port
DA Devices
Zones
Inputs
Outputs
Zone Steps
DA Device List
BC3BHS3Tie-NO
BC3_/088_Viper-NC
BHS3_/078_Viper-NC
BC3_/088_Viper-NO
BHS3_/078_Viper-NO
SOURCE1-NC
SOURCE2-NC
BC3BHS3Tie-NC
Viper1_NONRCL-NO
Viper2_NONRCL-NO
Zone2Restore-NC
Zone3Restore-NC
Tagnames
Fault Detection
Fault A
Fault B
Fault C
Fault N
Loss Of Pot.
N.C.
Reclose Coordination
Shot
Reclose LO
Safety Interlocks
Local/Remote
FMD_LT03 @BC3_/088_Viper
Override
Viper1FaultDetect @Log
Local/Remote Tagname
Auto/Man
FMD_LT02 @BC3_/088_Viper
Status
Breaker Status
FMD_LT28 @BC3_/088_Viper
Tagname List
Filter Options
Polls @BC3BHS3Tie
Responses @BC3BHS3Tie
Comm Fail @BC3BHS3Tie
SwitchOpen @BC3BHS3Tie
SwitchClosed @BC3BHS3Tie
LocalRemote @BC3BHS3Tie
Undervoltage Status @BC3BHS3Tie
Overvoltage Status @BC3BHS3Tie
BatteryTestFail @BC3BHS3Tie
LEDNearRecloserOpen @BC3BHS3Tie
LEDNearRecloserClosed @BC3BHS3Tie
LEDSwitchOpen @BC3BHS3Tie
LEDSwitchClosed @BC3BHS3Tie
LEDFarRecloserOpen @BC3BHS3Tie
LEDFarRecloserClosed @BC3BHS3Tie
IA magnitude @BC3_/088_Viper
IB magnitude @BC3_/088_Viper
IC magnitude @BC3_/088_Viper
IN magnitude @BC3_/088_Viper
VAY magnitude @BC3_/088_Viper
VBY magnitude @BC3_/088_Viper
VCY magnitude @BC3_/088_Viper
VAZ magnitude @BC3_/088_Viper
VBZ magnitude @BC3_/088_Viper
VCZ magnitude @BC3_/088_Viper
Demand-IA magnitude @BC3_/088_Viper
Demand-IB magnitude @BC3_/088_Viper
Demand-IC magnitude @BC3_/088_Viper
Fault Current-Ph A @BC3_/088_Viper
Accept
Cancel
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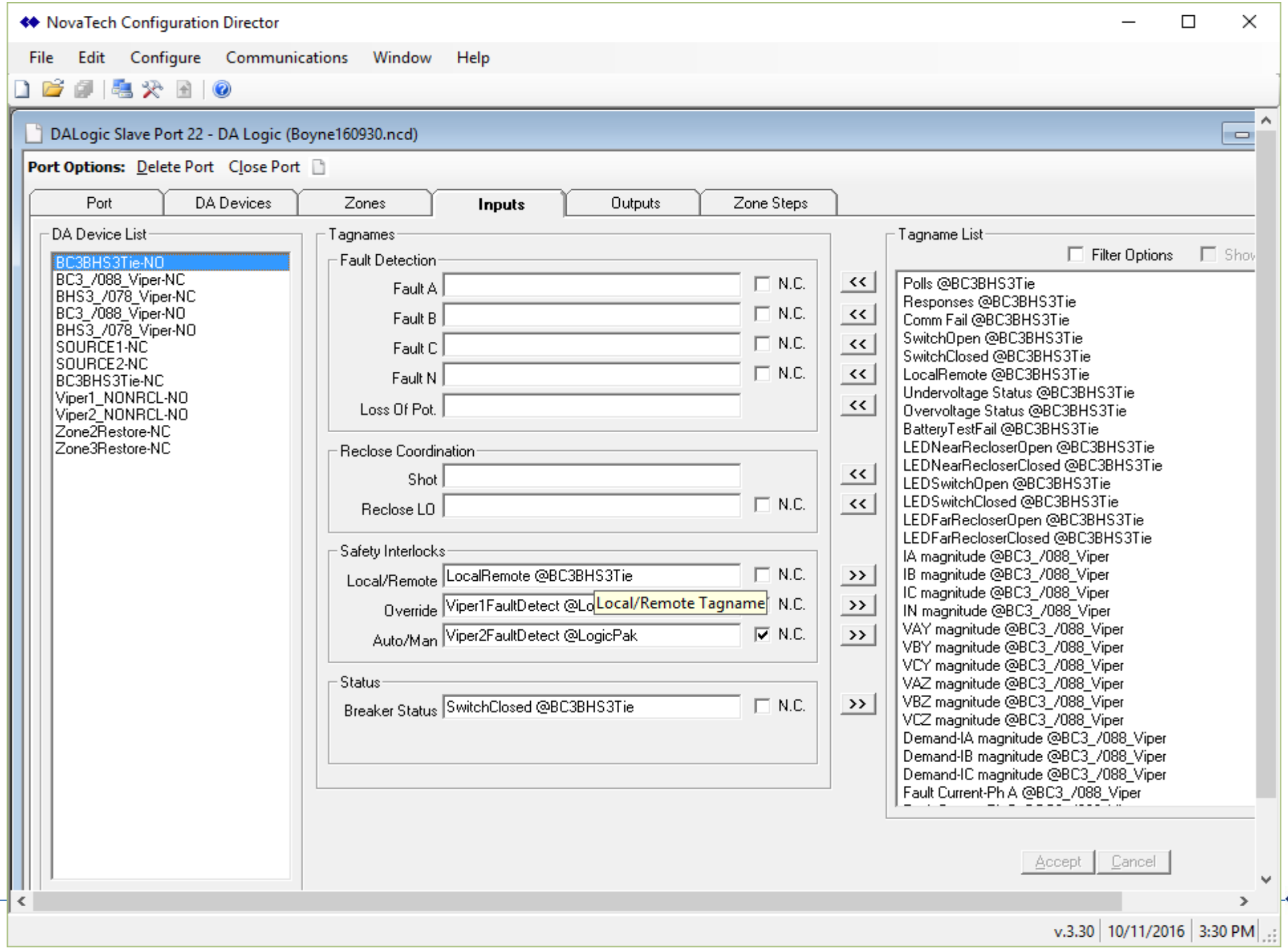
NovaTech Configuration Director
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Configure
Communications
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Help
DALogic Slave Port 22 - DA Logic (Boyne160930.ncd)
Port Options: Delete Port Close Port
Port
DA Devices
Zones
Inputs
Outputs
Zone Steps
DA Device List
BC3BHS3Tie-NO
BC3_/088_Viper-NC
BHS3_/078_Viper-NC
BC3_/088_Viper-NO
BHS3_/078_Viper-NO
SOURCE1-NC
SOURCE2-NC
BC3BHS3Tie-NC
Viper1_NONRCL-NO
Viper2_NONRCL-NO
Zone2Restore-NC
Zone3Restore-NC
Tagnames
Fault Detection
Fault A
Fault B
Fault C
Fault N
Loss Of Pot.
N.C.
Reclose Coordination
Shot
Reclose LO
Safety Interlocks
Local/Remote
Override
Auto/Man
LocalRemote @BC3BHS3Tie
Viper1FaultDetect @Lo
Local/Remote Tagname
Viper2FaultDetect @LogicPak
Status
Breaker Status
SwitchClosed @BC3BHS3Tie
Tagname List
Filter Options
Polls @BC3BHS3Tie
Responses @BC3BHS3Tie
Comm Fail @BC3BHS3Tie
SwitchOpen @BC3BHS3Tie
SwitchClosed @BC3BHS3Tie
LocalRemote @BC3BHS3Tie
Undervoltage Status @BC3BHS3Tie
Overvoltage Status @BC3BHS3Tie
BatteryTestFail @BC3BHS3Tie
LEDNearRecloserOpen @BC3BHS3Tie
LEDNearRecloserClosed @BC3BHS3Tie
LEDSwitchOpen @BC3BHS3Tie
LEDSwitchClosed @BC3BHS3Tie
LEDFarRecloserOpen @BC3BHS3Tie
LEDFarRecloserClosed @BC3BHS3Tie
IA magnitude @BC3_/088_Viper
IB magnitude @BC3_/088_Viper
IC magnitude @BC3_/088_Viper
IN magnitude @BC3_/088_Viper
VAY magnitude @BC3_/088_Viper
VBY magnitude @BC3_/088_Viper
VCY magnitude @BC3_/088_Viper
VAZ magnitude @BC3_/088_Viper
VBZ magnitude @BC3_/088_Viper
VCZ magnitude @BC3_/088_Viper
Demand-IA magnitude @BC3_/088_Viper
Demand-IB magnitude @BC3_/088_Viper
Demand-IC magnitude @BC3_/088_Viper
Fault Current-Ph A @BC3_/088_Viper
Accept
Cancel
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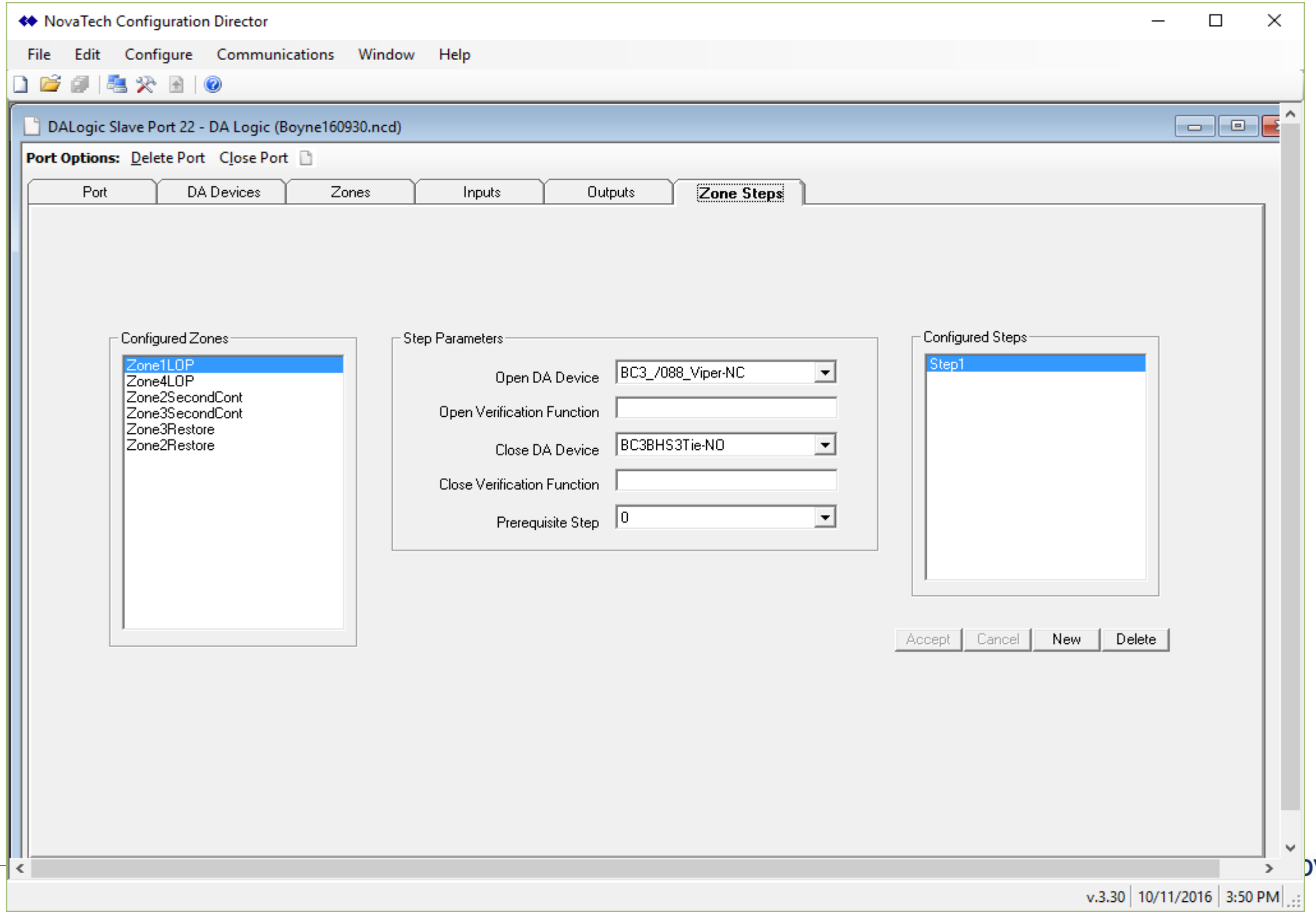
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Window
Help
DALogic Slave Port 22 - DA Logic (Boyne160930.ncd)
Port Options: Delete Port Close Port
Port
DA Devices
Zones
Inputs
Outputs
Zone Steps
Configured Zones
Zone1LOP
Zone4LOP
Zone2SecondCont
Zone3SecondCont
Zone3Restore
Zone2Restore
Step Parameters
Open DA Device
BC3_/088_Viper-NC
Open Verification Function
Close DA Device
BC3BHS3Tie-NO
Close Verification Function
Prerequisite Step
0
Configured Steps
Step1
Accept
Cancel
New
Delete
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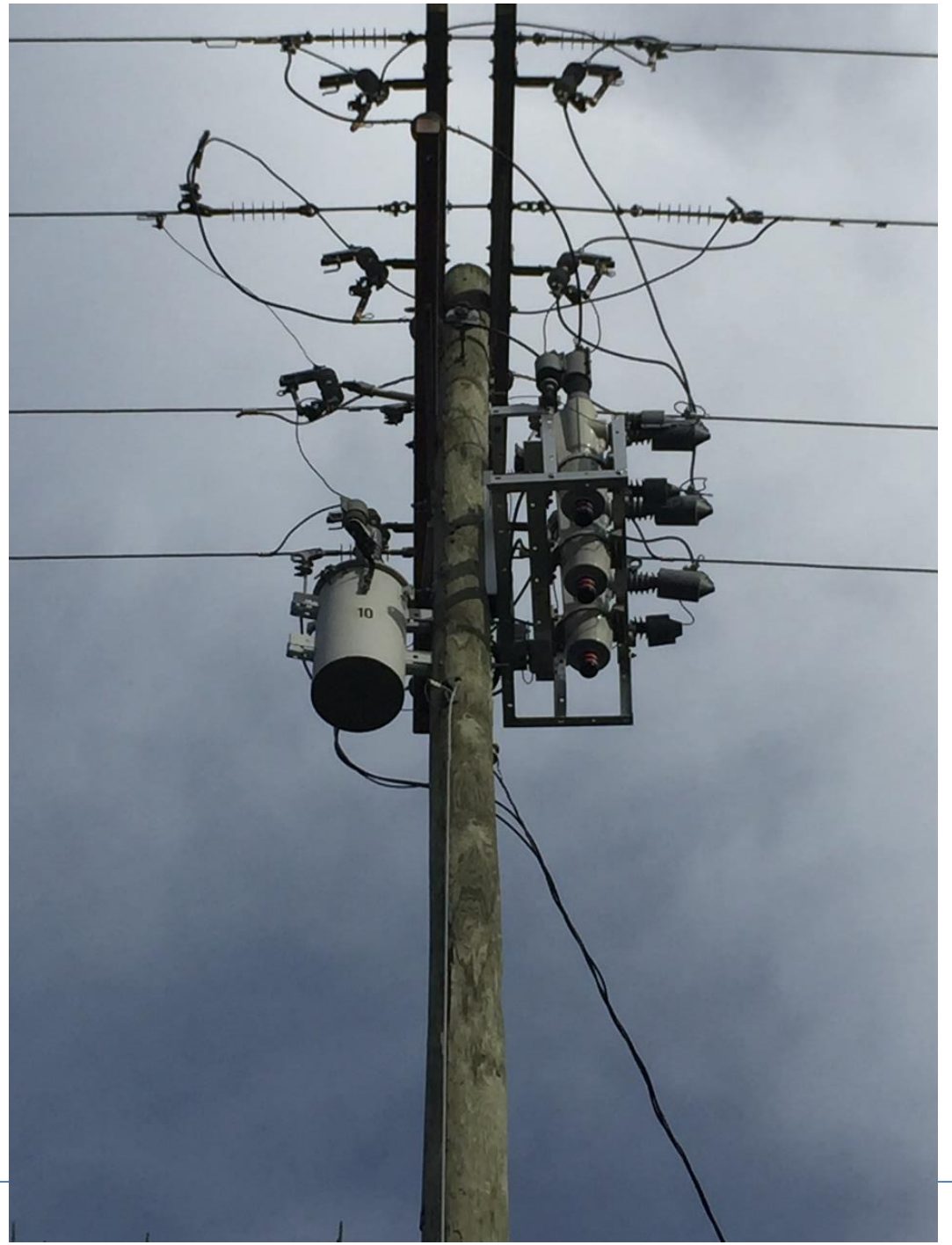
Protect those working around this automated equipment

- Warning Signs
- Labels
- Remote LED indication
- Isolation Instructions
  - Isolate from BOTH (or more) sources
  - Use the solid blades
- Test
- Ground

Protecting yourself – Sign on the outside of the cabinet:

Viper Installation

Overhead Portion of the Viper Installation



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Viper Installation – Normal signage for a Viper installation:

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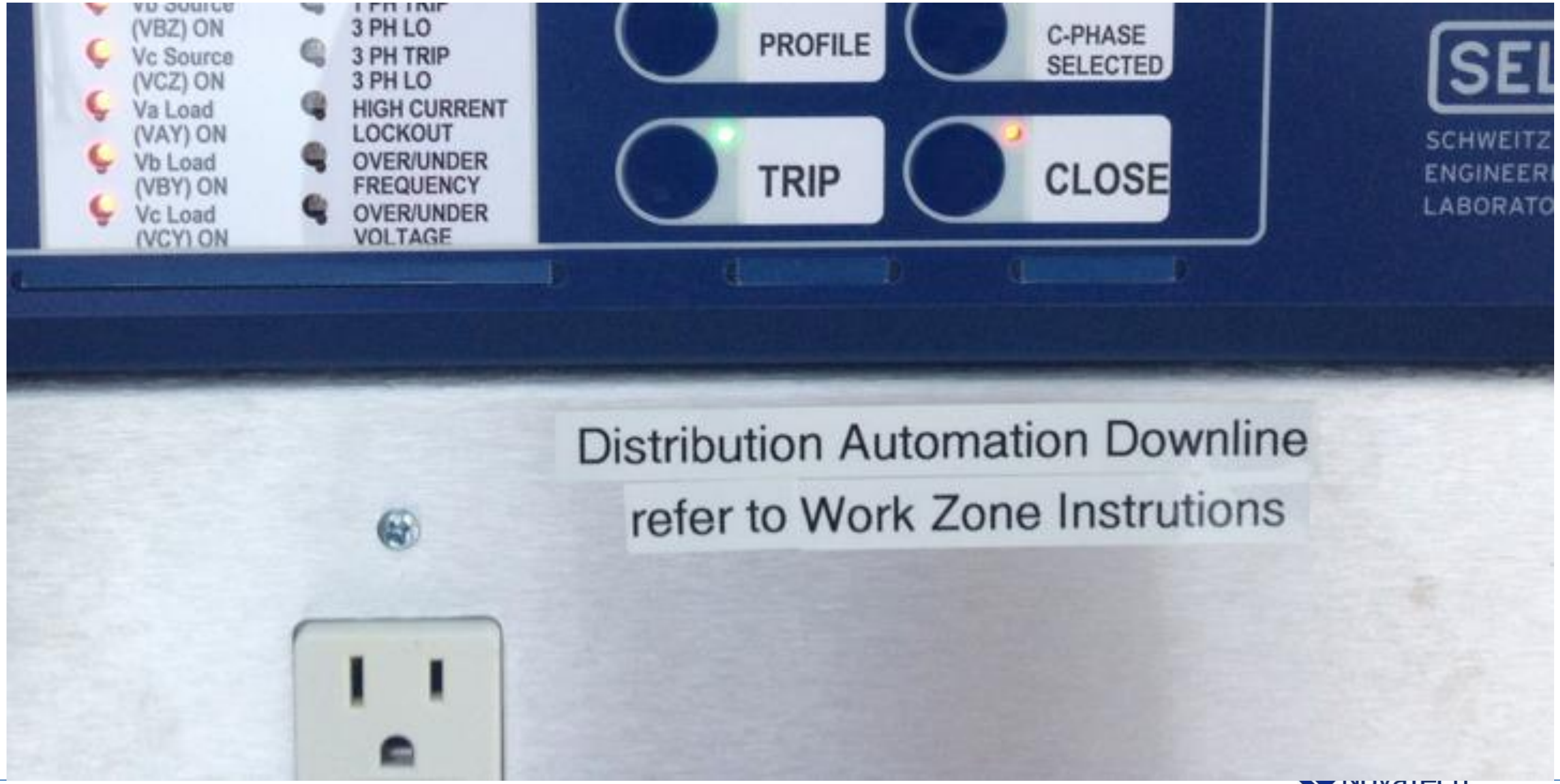
Inside the Viper Cabinet – Another note to lineman:



Viper Installation – Note of control possible:

Instructions for CL3 088

Last updated 7/15/2016

This device can be remotely controlled by Distribution Automation

If using **Hot Line Tag** or **Non Reclose**,

lock the MOAB at CR1CL3Tie

For de-energized work –

The work zone must be visibly isolated from ALL potential sources.

- Has a visible open been created on both ends of the work zone?
  - Sectionalizing points
    - CL3 014 VIPER
      - CL3 047 S.B. w/FI
      - CL3 058 S.B.
      - CL3 074 S.B. w/FI
    - EP2CL3Tie @ CL3 076N MOAB
    - CL3 088 VIPER
      - CL3 098 S.B. w FI
      - CL3 107-1 S.B.
      - CL3 118 S.B. w FI @ 119
      - CL3 128 S.B. w FI
      - CL3 131 S.B. w FI
    - CR1CL3Tie @ CL3 175 MOAB

Isolation instructions for the midline CL3 088 Viper

- Put Viper in "Local Mode Only"

MOAB Installation - Locked

Viper Installation – Unlocked Position

Protect Yourself

- Warning Signs
- Labels
- Remote LED indication
- Isolation Instructions
  - Isolate from BOTH (or more) sources
  - Use the solid blades
- Test
- Ground

Keeping the lights on!

Questions?

Thank you

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