TRC2022

**{RLYTYPE} RELAY**

|  |  |
| --- | --- |
| **Customer Name** | {CUSTCOMPANYNAME} |
| **Project Name** | {PROJECTNAME} |
| **Date Submitted** | {DATE} |

|  |
| --- |
| **Customer Contact** |
| **{CUSTCONTACTNAME}** |
| {CUSTCONTACTROLE} |
| {CUSTCOMPANYNAME} |
| {CUSTCONTACTADDRESS1} |
| {CUSTCONTACTADDRESS2} |
| [{CUSTCONTACTEMAIL}](mailto:Jayme.Garcia@trccompanies.com) |
| {CUSTCONTACTPHONE} |

|  |
| --- |
| **PRS Contact** |
| **{PRSCONTACTNAME}** |
| {PRSCONTACTROLE} |
| {PRSCOMPANYNAME} |
| {PRSCONTACTADDRESS1} |
| {PRSCONTACTADDRESS2} |
| {PRSCONTACTEMAIL} |
| {PRSCONTACTPHONE} |

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| --- | --- | --- |
| **Revision Table** | | |
| **Rev** | **Notes** | **Date** |
| 0 | Initial version | {DATE} |
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# Introduction

This settings basis document describes all the protection settings used in the {RLYTYPE} relay.

## References

The settings have been developed based on the following references:

1. Site Plans - “20220630\_SUN11.21.001\_Mineral Gap IFC\_SS”
2. Relay DC Elementary Schematic/Relay Three-Line Drawing – “Mineral-Gap-SWGR-DWG”
3. Coordination Study:
   1. SU11-21-001-MinGap-09232021 - All Devices (AC, DC) -REV1.pdf
   2. SU11-21-001-MinGap-09232021 - 32-Reverse-PWR.pdf
   3. TCC-Mineral-Gap-MV1-GND-TCC-REV1.pdf
   4. TCC-Mineral-Gap-MV1-Phase-TCC-REV1.pdf
   5. TCC-Mineral-Gap-MV2-Phase-TCC-REV1.pdf
   6. SU11.21.001\_Relay-Settings.xlsx
4. Relay Part Number – “Mineral-Gap\_SEL-351-7\_Final-Part-No”

# Relay Information

|  |  |
| --- | --- |
| **Recloser** | {RLYTYPE} |
| **Device No.** | 27, 50P, 50G, 51P, 51G, 59, 59N, 81, 32, 67 |
| **Part No.** | 035174C2E51XX1 |
| **Firmware Version** | R518-V1 |

## SEL-351-7 CT/VT Connections

|  |  |
| --- | --- |
| **IA, IB, IC, IN** | {CTRPRI}:{CTRSEC} |
| **VA, VB, VC, VS** | {PTR}:1 |

## SEL-351-7 Relay Inputs

|  |  |
| --- | --- |
| **IN101** | Breaker Close Ready Status |
| **IN102** | 52A Breaker Status |
| **IN103- IN106** | Spare |

## SEL-351-7 Relay Outputs

|  |  |
| --- | --- |
| **OUT101** | Spare |
| **OUT102** | CLOSE (Spare3-Phase Breaker Close) |
| **OUT103** | TRIP (Spare3-Phase Breaker Trip) |
| **OUT1****04-OUT107** | Spare |
| **ALRMOUT** | !(SALARM+HALARM) |

## SEL-351-7 Relay Remote Bits

|  |  |
| --- | --- |
| **RB01** | DTT Rx |
| **RB02** | SCADA Trip |
| **RB03** | SCADA Close |

# Protection Elements

For all protection settings used. Please see Attachment 1. These settings were provided by TRC.

## 27 Phase Undervoltage

The {RLYTYPE} relay provides two levels of phase-to-neutral undervoltage protection. The two undervoltage elements are set to protect against abnormal operating conditions. The pickup and time delay settings are set per customer comments:

1. Level 1: Pickup at {29P1%}% of nominal voltage with a time delay of {27P1D} cyc.
2. Level 2: Pickup at {29P2%}% of nominal voltage with a time delay of {27P2D} cyc.

### Calculations

## 59 Phase Overvoltage

The {RLYTYPE} relay provides two levels of phase-to-neutral overvoltage protection. The two overvoltage elements are set to protect against abnormal operating conditions. The pickup and time delay settings are set per customer comments:

1. Level 1: Pickup at {59P1%}% of nominal voltage with a time delay of {59P1D} cyc.
2. Level 2: Pickup at {59P2%}% of nominal voltage with a time delay of {59P2D} cyc.

### Calculations

## 59N Zero Sequence Overvoltage

The {RLYTYPE} relay provides one level of zero sequence overvoltage protection. This overvoltage element is set to protect against abnormal operating conditions, such as a single-phase open. The pickup and time delay settings are set as follows:

1. Pickup at approximately {59N1%}% of nominal phase-to-neutral voltage with no intentional delay.

### Calculations

## 81 Frequency

The SEL-351-7 relay provides four levels of frequency protection. The elements can be set as either underfrequency or overfrequency protection, depending on whether the element’s pickup is set below or above the system’s nominal frequency (60 Hz). For this application, two underfrequency and one overfrequency elements are set. The elements are set to protect against abnormal operating conditions. The pickup and time delay settings are set per customer comments:

1. Underfrequency
   1. Level 1: 81D1P Pickup at 59.8Hz with a time delay of 17997 cyc. Since the maximum time delay on the SEL-351-7 frequency element is 16000, SV11T is used to extend the pickup another 1997 cycles to achieve the desired 17997 cycle (299.95 second) delay.
   2. Level 2: 81D3P Pickup at 57Hz with a time delay of 6.50 cyc.
2. Overfrequency
   1. Level 1: 81D2P Pickup at 60.5Hz with a time delay of 6.50 cyc.

Additionally, the frequency elements (both underfrequency and overfrequency) are blocked when the system voltage drops below a specified level. The voltage block of the frequency elements is set to 48.0Vsec (40% of Vnom).

## 50P Phase Definite-Time Overcurrent

The SEL-351-7 relay provides three levels of phase definite-time overcurrent protection. The first element is set by the customer. The second overcurrent element is set to detect phase faults and block the anti-islanding scheme from operating. The third element is set to detect a loss of phase (e.g., single-phase islanding).

1. Level 2: Pickup at approximately 120% of the site’s full-load current with no intentional delay.
2. Level 3: The pickup of the element is set to the minimum of the following (with no intentional delay):
   1. 10% of the site’s full-load current.
   2. Lowest setting possible in the SEL-351-7 of 0.25 Amps secondary

### Calculations

50P1P is set to customer setpoint in Attachment 1.

## 50G Residual Ground Definite-Time Overcurrent

The SEL-351-7 relay provides two levels of ground definite-time overcurrent protection. One of these overcurrent elements is set to detect single-phase-to-ground faults and block the anti-islanding scheme from operating. The pickup and time delay settings are set as follows:

1. Pickup at approximately 100% of the site’s full-load current with no intentional delay. For calculating full-load current, the maximum MW capacity of the site is used:

### Calculations

50G1P is set to customer setpoint in Attachment 1.

# Protection Settings

## 27 Undervoltage

### Blocking Elements

None.

### Tripping Actions

POI Breaker

### Relay Settings

**Group 1/Set 1/General Settings**

PTR (Phase (VA, VB, VC) PT Ratio): 60.00

VNOM (Phase Nominal Voltage L-N (V, sec)): 120.00

**Group 1/Set 1/Voltage Elements**

EVOLT (Voltage Elements): Y

27P1P (Phase Undervoltage Pickup (V, sec)): 105.59

27P2P (Phase Undervoltage Pickup (V, sec)): 60.00

**Group 1/Set 1/SELogic Variable Timers**

SV1PU (SV\_Timer Pickup (cyc)): 117.00

SV1DO (SV\_Timer Dropout (cyc)): 0.00

SV3PU (SV\_Timer Pickup (cyc)): 6.50

SV3DO (SV\_Timer Dropout (cyc)): 0.00

**Group 1/Logic 1/Trip/Communication-Assisted Trip Logic**

TR (Other Trip Conditions) := 51PT+LV1+67P1T+51GT+67G1T+**SV1T**+SV2T+**SV3T**+SV4T+SV9+SV10T+SV11T+81D2T+81D3T+OC+RB1+RB2

**Group 1/Logic 1/SELogic Variable Timer Inputs**

SV1 (SELogic Control Equation Variable 1) : (**27A1**+**27B1**+**27C1**)\*52A

SV3 (SELogic Control Equation Variable 3) : (**27A2**+**27B2**+**27C2**)\*52A

**Group 1/Logic 1/Output Contacts**

OUT103 (Output Contact 103): TRIP

## 59 Overvoltage

### Blocking Elements

None.

### Tripping Actions

POI Breaker

### Relay Settings

**Group 1/Set 1/General Settings**

PTR (Phase (VA, VB, VC) PT Ratio): 60.00

VNOM (Phase Nominal Voltage L-N (V, sec)): 120.00

**Group 1/Set 1/Voltage Elements**

EVOLT (Voltage Elements): Y

59P1P (Phase Overvoltage Pickup (V, sec)): 131.99

59P2P (Phase Overvoltage Pickup (V, sec)): 143.99

**Group 1/Set 1/SELogic Variable Timers**

SV2PU (SV\_Timer Pickup (cyc)): 57.00

SV2DO (SV\_Timer Dropout (cyc)): 0.00

SV4PU (SV\_Timer Pickup (cyc)): 6.50

SV4DO (SV\_Timer Dropout (cyc)): 0.00

**Group 1/Logic 1/Trip/Communication-Assisted Trip Logic**

TR (Other Trip Conditions) : = 51PT+LV1+67P1T+51GT+67G1T+SV1T+**SV2T**+SV3T+**SV4T**+SV9+SV10T+SV11T+81D2T+81D3T+OC++RB1+RB2

**Group 1/Logic 1/SELogic Variable Timer Inputs**

SV2 (SELogic Control Equation Variable 2) : (**59A1**+**59B1**+**59C1**)\*52A

SV4 (SELogic Control Equation Variable 4) : (**59A2**+**59B2**+**59C2**)\*52A

**Group 1/Logic 1/Output Contacts**

OUT103 (Output Contact 103): TRIP

## 50P Phase Time Overcurrent

Overcurrent coordination was performed by TRC. See Attachment 1.

### Blocking Elements

None.

### Tripping Actions

POI Breaker

### Relay Settings

**Group 1/Set 1/General Settings**

CTR (Phase (IA, IB, IC) CT Ratio): 120.00

**Group 1/Set 1/Phase Overcurrent Element**

E50P (Phase): 3

50P1P (Level 1 (A,sec)): 10.00

50P2P (Level 2 (A,sec)): 1.39

50P3P (Level 3 (A,sec)): 0.25

67P1D (Level 1 (cyc)): 0.50

67P2D (Level 2 (cyc)): 0.00

67P3D (Level 3 (cyc)): 0.00

**Group 1/Set 1/SELogic Variable Timers**

SV6PU (SV\_Timer Pickup (cyc)): 6.00

SV6DO (SV\_Timer Dropout (cyc)): 0.00

SV7PU (SV\_Timer Pickup (cyc)): 1.75

SV7DO (SV\_Timer Dropout (cyc)): 90.00

SV9PU (SV\_Timer Pickup (cyc)): 0.00

SV9DO (SV\_Timer Dropout (cyc)): 0.00

**Group 1/Logic 1/Trip/Communication-Assisted Trip Logic**

TR (Other Trip Conditions) := 51PT+LV1+**67P1T**+51GT+67G1T+SV1T+SV2T+SV3T+SV4T+**SV9**+SV10T+SV11T+81D2T+81D3T+OC+RB1+RB2

**Group 1/Logic 1/SELogic Variable Timer Inputs**

SV6 (SELogic Control Equation Variable 6) : SV5T\*(!**50A3**+ !**50B3**+ !**50C3**)

SV7 (SELogic Control Equation Variable 7) : **50P2**+50G2

SV9 (SELogic Control Equation Variable 9) : **SV6T**\*! **SV7T**\*SV8T

**Group 1/Logic 1/Output Contacts**

OUT103 (Output Contact 103): TRIP

## 50G Residual Ground Overcurrent

Overcurrent coordination was performed by TRC. See Attachment 1.

### Blocking Elements

None.

### Tripping Actions

### POI Breaker

### Relay Settings

**Group 1/Set 1/General Settings**

CTR (Phase (IA, IB, IC) CT Ratio): 120.00

**Group 1/Set 1/Residual Ground Overcurrent Element**

E50G (Residual Ground): 2

50G1P (Level 1 (A,sec)): 1.00

50G2P (Level 2 (A,sec)): 1.15

67G1D (Level 1 (cyc)): 3.0

67G2D (Level 2 (cyc)): 0.00

**Group 1/Set 1/SELogic Variable Timers**

SV7PU (SV\_Timer Pickup (cyc)): 1.75

SV7DO (SV\_Timer Dropout (cyc)): 90.00

SV9PU (SV\_Timer Pickup (cyc)): 0.00

SV9DO (SV\_Timer Dropout (cyc)): 0.00

**Group 1/Logic 1/Trip/Communication-Assisted Trip Logic**

TR (Other Trip Conditions) := 51PT+LV1+67P1T+51GT+**67G1T**+SV1T+SV2T+SV3T+SV4T+SV9+SV10T+SV11T+81D2T+81D3T+OC+RB1+RB2

**Group 1/Logic 1/SELogic Variable Timer Inputs**

SV7 (SELogic Control Equation Variable 7) : 50P2+**50G2**

SV9 (SELogic Control Equation Variable 9) : SV6T\*!**SV7T**\*SV8T

**Group 1/Logic 1/Output Contacts**

OUT103 (Output Contact 103): TRIP

## 51P Phase Time Overcurrent and Directional Time Overcurrent

Overcurrent coordination was performed by TRC. See Attachment 1.

### Blocking Elements

None.

### Tripping Actions

POI Breaker

### Relay Settings

**Group 1/Set 1/General Settings**

CTR (Phase (IA, IB, IC) CT Ratio): 120.00

**Group 1/Set 1/Phase Time-Overcurrent Element**

E51P (Phase): 2

51P1P (Pickup (A,sec)): 1.32

51P1C (Curve): U3

51P1TD (Time Dial): 0.66

51P1RS (EM Reset Delay): N

51PTC (Torque Control A Phase): 1

51A1P (Pickup (A,sec)): 0.65

51A1C (Curve): U3

51A1TD (Time Dial): 0.67

51A1RS (EM Reset Delay): N

51ATC (Torque Control A Phase): 32PR\*

51B1P (Pickup (A,sec)): 0.65

51B1C (Curve): U3

51B1TD (Time Dial): 0.67

51B1RS (EM Reset Delay): N

51BTC (Torque Control B Phase): 32PR\*

51C1P (Pickup (A,sec)): 0.65

51C1C (Curve): U3

51C1TD (Time Dial): 0.67

51C1RS (EM Reset Delay): N

51CTC (Torque Control C Phase): 32PR\*

**Group 1/Logic 1/Trip/Communication-Assisted Trip Logic**

TR (Other Trip Conditions) := **51PT**+**LV1**+67P1T+51GT+67G1T+SV1T+SV2T+SV3T+SV4T+SV9+SV10T+SV11T+81D2T+81D3T+OC+ RB1+RB2

ULTR (Unlatch Trip Conditions) := !(**51P**+51G)

**Group 1/Logic 1/Logic Variable Equations**

LV1 (Logic Variable Equation 1) : (**51AT**+**51BT**+**51CT) \* !HBL2T**

**Group 1/Logic 1/Output Contacts**

OUT103 (Output Contact 103): TRIP

\*Torque control for 51A, 51B and 51C is set to trip for reverse faults by setting 51xTC to ‘32PR’.

It is desirable for the 51 directional OC element to continue timing when transformer inrush is detected yet trip the breaker if the time-overcurrent element remains asserted after the inrush condition has subsided. Therefore, the harmonic blocking element has been added to the logic variable equation as opposed to the torque control equation.

## 51G Residual Ground Time Overcurrent

Overcurrent coordination was performed by TRC. See Attachment 1.

### Blocking Elements

None.

### Tripping Actions

POI Breaker

### Relay Settings

**Group 1/Set 1/General Settings**

CTR (Phase (IA, IB, IC) CT Ratio): 120.00

**Group 1/Set 1/Neutral Ground Time-Overcurrent Element**

E51G (Phase): 1

51G1P (Pickup (A,sec)): 0.50

51G1C (Curve): U3

51G1TD (Time Dial): 0.67

51G1RS (EM Reset Delay): N

**Group 1/Logic 1/Trip/Communication-Assisted Trip Logic**

TR (Other Trip Conditions) : = 51PT+LV1+67P1T+**51GT**+67G1T+SV1T+SV2T+SV3T+SV4T+SV9+SV10T+SV11T+81D2T+81D3T+OC+ RB1+RB2

ULTR (Unlatch Trip Conditions) : = !(51P+**51G**)

**Group 1/Logic 1/Output Contacts**

OUT103 (Output Contact 103): TRIP

## 59N Zero-Seq Overvoltage

### Blocking Elements

None.

### Tripping Actions

POI Breaker

### Relay Settings

**Group 1/Set 1/General Settings**

PTR (Phase (VA, VB, VC) PT Ratio): 60.00

VNOM (Phase Nominal Voltage L-N (V, sec)): 120.00

**Group 1/Set 1/Voltage Elements**

EVOLT (Voltage Elements): Y

59N1P (Zero-Seq (3V0) Overvolt. PU (V, sec)): 12.00

**Group 1/Set 1/SELogic Variable Timers**

SV5PU (SV\_Timer Pickup (cyc)): 0

SV5DO (SV\_Timer Dropout (cyc)): 60.00

SV6PU (SV\_Timer Pickup (cyc)): 6.00

SV6DO (SV\_Timer Dropout (cyc)): 0.00

SV9PU (SV\_Timer Pickup (cyc)): 0.00

SV9DO (SV\_Timer Dropout (cyc)): 0.00

**Group 1/Logic 1/Trip/Communication-Assisted Trip Logic**

TR (Other Trip Conditions) := 51PT+LV1+67P1T+51GT+67G1T+SV1T+SV2T+SV3T+SV4T+**SV9**+SV10T+SV11T+81D2T+81D3T+OC+RB1+RB2

**Group 1/Logic 1/SELogic Variable Timer Inputs**

SV5 (SELogic Control Equation Variable 5) : **59N1**

SV6 (SELogic Control Equation Variable 6) : **SV5T**\*(!50A3+!50B3+!50C3)

SV9 (SELogic Control Equation Variable 9) : **SV6T**\*!SV7T\*SV8T

**Group 1/Logic 1/Output Contacts**

OUT103 (Output Contact 103): TRIP

## 81 Frequency

### Blocking Elements

None.

### Tripping Actions

POI Breaker

### Relay Settings

**Group 1/Set 1/General Settings**

PTR (Phase (VA, VB, VC) PT Ratio): 60.00

VNOM (Phase Nominal Voltage L-N (V, sec)): 120.00

**Group 1/Set 1/Frequency Elements**

E81 (Frequency Elements): 3

27B81P (Undervoltage Block (V, sec): 48.00

81D1P (Pickup (Hz): 59.80

81D1D (Time Delay (cyc): 16000.00

81D2P (Pickup (Hz): 60.50

81D2D (Time Delay (cyc): 6.50

81D3P (Pickup (Hz): 57.00

81D3D (Time Delay (cyc): 6.50

81TC (Frequency Element torque Control): !27B81

**Group 1/Set 1/SELogic Variable Timers**

SV10PU (SV\_Timer Pickup (cyc)): 1997.00

SV10DO (SV\_Timer Dropout (cyc)): 0.00

**Group 1/Logic 1/Trip/Communication-Assisted Trip Logic**

TR (Other Trip Conditions) := 51PT+LV1+67P1T+51GT+67G1T+SV1T+SV2T+SV3T+SV4T+SV9+**SV10T**+SV11T+**81D2T**+**81D3T**+OC+RB1+RB2

**Group 1/Logic 1/SELogic Variable Timer Inputs**

SV10 (SELogic Control Equation Variable 10) : **81D1T**

**Group 1/Logic 1/Output Contacts**

OUT103 (Output Contact 103): TRIP

## Power Elements

### Blocking Elements

None.

### Tripping Actions

POI Breaker

### Relay Settings

**Group 1/Set 1/General Settings**

PTR (Phase (VA, VB, VC) PT Ratio): 60.00

CTR (Phase (IA, IB, IC) CT Ratio): 120.00

VNOM (Phase Nominal Voltage L-N (V, sec)): 120.00

**Group 1/Set 1/Power Elements**

EPWR (Power Elements): 3P1

3PWR1P (3-Phase Pwr Ele Pickup (VA, sec)): 438

PWR1T (Pwr Ele Type): +WATTS

PWR1D (Pwr Ele Time Delay): 16000.00

**Group 1/Set 1/SELogic Variable Timers**

SV11PU (SV\_Timer Pickup (cyc)): 1997.00

SV11DO (SV\_Timer Dropout (cyc)): 0.00

**Group 1/Logic 1/Trip/Communication-Assisted Trip Logic**

TR (Other Trip Conditions) := 51PT+LV1+67P1T+51GT+67G1T+SV1T+SV2T+SV3T+SV4T+SV9+SV10T+**SV11T**+81D2T+81D3T+OC+RB1+RB2

**Group 1/Logic 1/SELogic Variable Timer Inputs**

SV11 (SELogic Control Equation Variable 11) : **3PWR1**

**Group 1/Logic 1/Output Contacts**

OUT103 (Output Contact 103): TRIP

## Directional Elements

### Relay Settings

**Group 1/Set 1/General Settings**

PTR (Phase (VA, VB, VC) PT Ratio): 60.00

CTR (Phase (IA, IB, IC) CT Ratio): 120.00

VNOM (Phase Nominal Voltage L-N (V, sec)): 120.00

**Group 1/Set 1/Line Settings and Fault Locator: Settings are left default**

Z1MAG (Pos-Seq Line Impedance Mag.): 2.14

Z1ANG (Pos-Seq Line Impedance Angle): 68.86

Z0MAG (Zero-Seq Line Impedance Mag.): 6.38

Z0ANG (Zero-Seq Line Impedance Angle): 72.47

**Group 1/Set 1/Directional Element Settings**

E32 Directional Control: Y

ELOP Loss-Of-Potential: Y

DIR1 Level 1: N

DIR2 Level 2: N

DIR3 Level 3: N

DIR4 Level 4: N

ORDER Ground Dir. Priority: Q

50P32P Phase Dir. Element 3-Phase PU: 0.50

Z2F Forward Dir. Z2 Threshold: -0.30

Z2R Reverse Dir. Z2 Threshold: 0.30

50QFP Forward Dir. 3I2 Pickup: 0.50

50QRP Reverse Dir. 3I2 Pickup: 0.25

a2 Pos-Seq Restraint Factor, I2/I1: 0.10

k2 Zero-Seq Restraint Factor, I2/I0: 0.20

## Second Harmonic Blocking

### Relay Settings

**Group 1/Set 1/General Settings**

PTR (Phase (VA, VB, VC) PT Ratio): 60.00

CTR (Phase (IA, IB, IC) CT Ratio): 120.00

VNOM (Phase Nominal Voltage L-N (V, sec)): 120.00

**Group 1/Set 1/ Second Harmonic Blocking Settings**

**Settings**

EHBL2 Second Harmonic Blocking: Y

HBL2P Second Harmonic Pickup: 10

HBL2PU Second Harmonic Pickup Delay: 0.00

HBL2DO Second Harmonic Dropout Delay: 2.00

HBL2TC Second Harmonic Blocking Torque Control Equation: 1

**Group 1/Logic 1/Trip/Communication-Assisted Trip Logic**

TR (Other Trip Conditions) : = 51PT+**LV1**+67P1T+51GT+67G1T+SV1T+SV2T+SV3T+SV4T+SV9+SV10T+SV11T+81D2T+81D3T+OC+ RB1+RB2

**Group 1/Logic 1/Logic Variable Equations**

LV1 (Logic Variable Equation 1) : (51AT+51BT+51CT) \* **!HBL2T**

**Group 1/Logic 1/Output Contacts**

OUT103 (Output Contact 103): TRIP

It is desirable for the 51OC element to continue timing when transformer inrush is detected yet trip the breaker if the time-overcurrent element remains asserted after the inrush condition has subsided. Therefore, the harmonic blocking element has been added to the logic variable equation as opposed to the torque control equation.

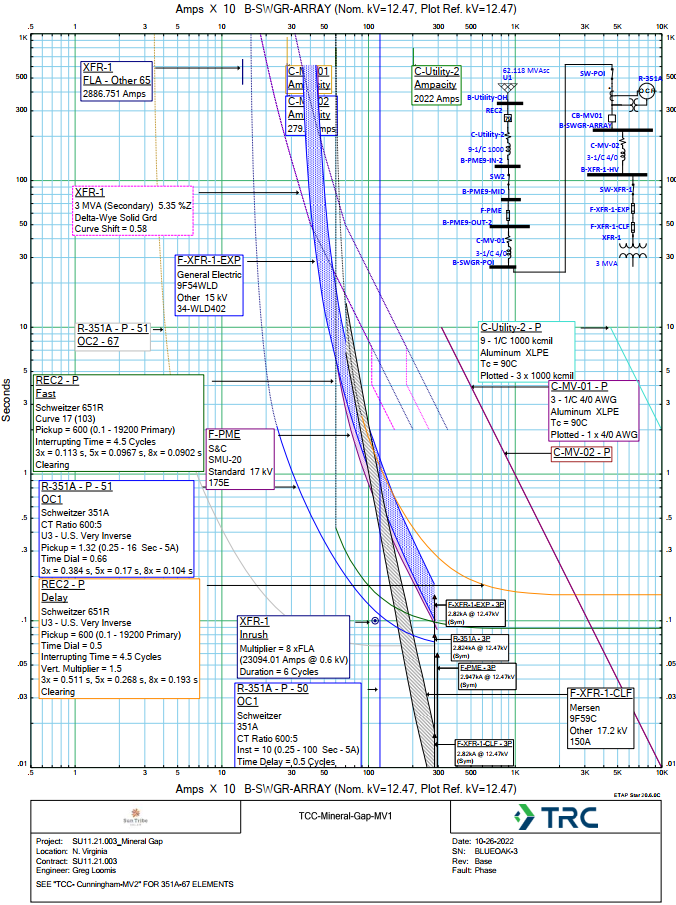
## Anti-Islanding

The SEL-351-7 relay provides customizable logic, which is used to implement an anti-islanding scheme. The following is an outline of the settings implemented in the relay and a brief explanation of the operation of the scheme:

1. SELogic variable SV5 is used to detect a single-phase open condition (by using a zero-sequence overvoltage element) and initiate the operation of the scheme. A 1 second extension provides sufficient time for other checks in the logic to be made.
2. SV5:= 59N1
3. SV5PU:= 0.00 cyc
4. SV5DO:= 60.00 cyc
5. SELogic variable SV6 is used to verify that the cause of the zero-sequence overvoltage element picking up is an open-phase condition (i.e., low magnitude current in at least one phase).
6. SV6:= SV5T\*(!50A3+!50B3+!50C3)
7. SV6PU:= 6.00 cyc
8. SV6DO:= 0.00 cyc
9. SELogic variable SV7 is used to verify that the zero-sequence overvoltage condition was not caused by a nearby single-phase-to-ground or double-phase-to-ground fault. A short pickup delay of 1.75 cycles allows the output of this variable to block operation of the scheme before SV6 times out. A 1.5 second extension provides continued blocking until SV7 drops out.
10. SV7:= 50P2+50G2
11. SV7PU:= 1.75 cyc
12. SV7DO:= 90.00 cyc
13. SELogic variable SV8 is used to delay enabling the scheme until after the breaker has been closed for 20 seconds, in order to avoid tripping due to zero-sequence overvoltages caused by transformer energization.
14. SV8:= 52A
15. SV8PU:= 1200.00 cyc
16. SV8DO:= 0.00 cyc
17. SELogic variable SV9 is the output of the logic, which is included in the trip equation to trip the breaker for islanding conditions.
18. SV9:= SV6T\*!SV7T\*SV8T
19. SV9PU:= 0.00 cyc
20. SV9DO:= 0.00 cyc

# Attachment 1 – TCC

The figures below show the coordination study provided by TRC.



Chart, schematic

Description automatically generated

Schematic

Description automatically generated

Pickup value of the 67 directional current was increased to 75% of nominal 104A primary based on an email conversation