**Assessment Categories for the potential of a misoperation during a GMD event**:

Category A: High probability GMD event caused outage (greater or equal than 40% probability)

Category B: Lower probability GMD event caused outage (less than 40% & greater than 5% probability)

Category 0: Not identified as an appreciable risk for GMD event caused outage (less than 5% probability)

|  |  |  |  |
| --- | --- | --- | --- |
| Standard Current Based Generator Protection | Microprocessor Relay | Solid State Relay | Electromechanical Relay |
|  |  |  |  |
| (87) Differential | Category 0 | Category 0 | Category 0 |
| (46) Negative Sequence | Category 0 | Note 1 | Note 1 |
| (40) Loss of Field | Category 0 | Category 0 | Category 0 |
| (51VR) - Voltage Restraint Overcurrent | Category 0 | Note 2 | Note 2 |
| (51VC) - Voltage Controlled Overcurrent | Category 0 | Category 0 | Category 0 |
| (21) Distance | Category 0 | Note 2 | Note 2 |
|  |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| Standard Current Based GSU Protection Elements | Microprocessor Relay | Solid State Relay | Electromechanical Relay |
|  |  |  |  |
| (87) Differential | Category 0 | Category 0 | Category 0 |
| (51) Overcurrent | Category 0 | Note 2 | Note 2 |
| (51N) HV Neutral Overcurrent | Category 0 | Note 3 | Note 3 |
|  |  |  |  |

**Note: 1**

Categorize the pickup setting of the (46) negative sequence element according to the formulas below.

All current values are listed in per unit [pu] of generator base values:

 I2.RELAY.PICKUP = Negative Sequence (I2) current pickup value in per unit [pu]

 IGIC.GSU.NEU = The true RMS Geomagnetic induced currents flowing in the high voltage neutral of a generator step-up transformer in per unit [pu]

$$CATEGORY A: I\_{2.RELAY.PICKUP}\leq 60\%×\frac{I\_{GIC.GSU.NEU}}{3}$$

$$CATEGORY B: 60\%×\frac{I\_{GIC.GSU.NEU}}{3}< I\_{2.RELAY.PICKUP} \leq 125\%×\frac{I\_{GIC.GSU.NEU}}{3}$$

$$CATEGORY 0: I\_{2.RELAY.PICKUP}>125\%×\frac{I\_{GIC.GSU.NEU}}{3}$$

**Note: 2**

The relay application is Category 0, if the relay settings are in compliance with PRC-025-2.

**Note: 3**

Categorize the pickup setting of the GSU high voltage neutral (51N) overcurrent element according to the formulas below.

Current values are compared upon a common base, either in transformer neutral primary current in amps [A] or secondary current to the relay in amps [A]:

 IN.RELAY.PICKUP = Neutral current pickup value in amps [A]

 IGIC.GSU.NEU = The true RMS Geomagnetic induced currents flowing in the high voltage neutral of a generator step-up transformer in amps [A]

$$CATEGORY A: I\_{N.RELAY.PICKUP}\leq 100\%×I\_{GIC.GSU.NEU}$$

$$CATEGORY B: 100\%×I\_{GIC.GSU.NEU}< I\_{N.RELAY.PICKUP} \leq 125\%×I\_{GIC.GSU.NEU}$$

$$CATEGORY 0: I\_{N.RELAY.PICKUP}>125\%×I\_{GIC.GSU.NEU}$$