NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

MIDAS In-Depth Training

October 2021

RELIABILITY | RESILIENCE | SECURITY




Identifying Protection Systems

Protection System Definition

- Protective relays which respond to electrical quantities
- Communications systems necessary for correct operation of protective functions
- Voltage and current sensing devices providing inputs to protective relays
- Station dc supply associated with protective functions (including station batteries, battery chargers, and non-battery-based dc supply)
- Control circuitry associated with protective functions through the trip coil(s) of the circuit breakers or other interrupting devices

Composite Protection System

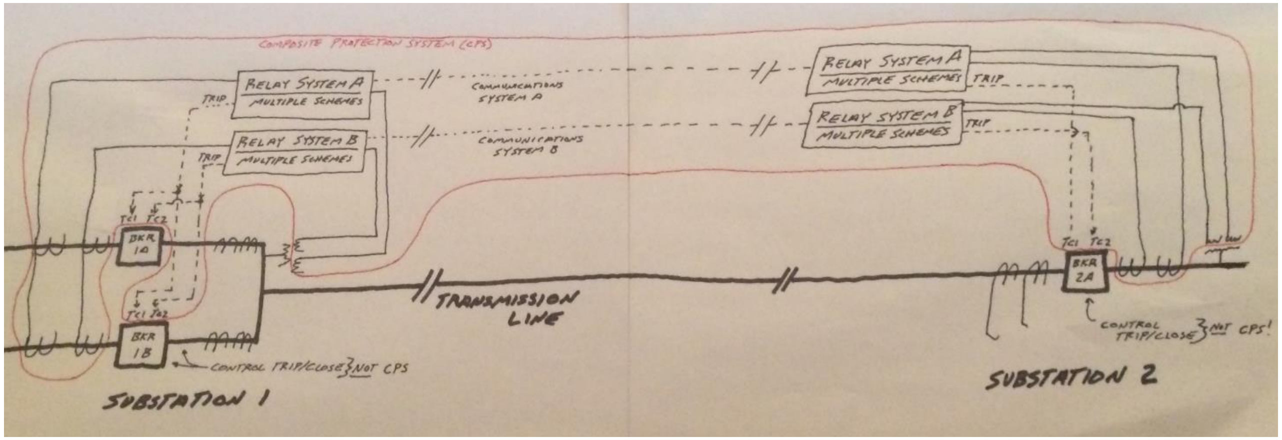
- The total complement of Protection System(s) that function collectively to protect an Element. Backup protection provided by a different Element's Protection System(s) is excluded.
- The Composite Protection System definition is based on the principle that an Element's multiple layers of protection are intended to function collectively.

Composite Protection System

- Protection Systems for BES Elements, with the following exclusions:
  - Non-protective functions that are embedded within a Protection System.
  - Protective functions intended to operate as a control function during switching.
  - Special Protection Systems (SPS).
  - Remedial Action Schemes (RAS).
  - Protection Systems of individual dispersed power producing resources identified under Inclusion I4 of the BES definition where the Misoperations affected an aggregate nameplate rating of less than or equal to 75 MVA of BES Facilities.

Composite Protection System – Line Example

- The Composite Protection System of the Alpha-Beta line (Circuit #123) is comprised of current differential, permissive overreaching transfer trip (POTT), step distance (classic zone 1, zone 2, and zone 3), instantaneous-overcurrent, time-overcurrent, out-of-step, and overvoltage protection. The protection is housed at the Alpha and Beta substations, and includes the associated relays, communications systems, voltage and current sensing devices, DC supplies, and control circuitry.



Composite Protection System – Transformer Example

- The Composite Protection System of the Alpha transformer (#2) is comprised of internal differential, overall differential, instantaneous-overcurrent, and time-overcurrent protection. The protection is housed at the Alpha substation, and includes the associated relays, voltage and current sensing devices, DC supplies, and control circuitry.

Composite Protection System – Generator Example

- The Composite Protection System of the Beta generator (#3) is comprised of generator differential, overall differential, overcurrent, stator ground, reverse power, volts per hertz, loss-of-field, and undervoltage protection. The protection is housed at the Beta generating plant and at the Beta substation, and includes the associated relays, voltage and current sensing devices, DC supplies, and control circuitry.

Composite Protection System – Breaker Failure Example

- Breaker failure protection provides backup protection for the breaker, and therefore is part of the breaker’s Composite Protection System. Considering breaker failure protection to be part of another Element’s Composite Protection System could lead to an incorrect conclusion that a breaker failure operation automatically satisfies the “Slow Trip” criteria of the Misoperation definition.

Counting Protection System Operations

Composite Protection System Operation Counting

- The correct operation of a Composite Protection System
- The unintended operation of a Composite Protection System
- The failure of a Composite Protection System to operate
- BES only, do not report Sub-trans or distribution operations to MIDAS

Inclusion of Misoperations

- The Composite Protection System Operations count reported is inclusive of all Composite Protective System Operations, not just correct Composite Protection System Operations. This means that every reported Misoperation will have at least one associated Composite Protection System Operation.

Multiple Independent Correct Operations

- All correct operations, outside of the reclosing (automatic or manual) sequence, should be reported. Unlike Misoperations, this is inclusive of multiple operations occurring within a 24-hour period.
- Example: There was a storm in the area and there were 6 vegetation contacts with the line within a 24-hour period and 3 of them misoperated. How many operations and misoperations should be reported?

A. Three operations, one misoperation.

B. Six operations, three misoperations.

C. One operation, one misoperation.

D. Four operations, one misoperation.

Control System Operations

- Operations that are initiated by control systems (not by Protection Systems), such as those listed in Chapter 2, are not reported as operations of a Composite Protection System.

Control System Operation Example

ACME PCB 326 tripped due to a low SF6 gas monitor relay. The gas level was checked and was confirmed to be within normal range. The gas monitor relay was found to be faulty, and was replaced.

How many operations and how many misoperations should be reported?

A. One operation. This operation is a reportable misoperation.
B. This is a non-reportable event.
C. One operation, no misoperations to report.
D. None of the above.

Control System Operation Example Answer

Answer: B. This is a non-reportable event.

Explanation: A SF6 gas relay does not respond to electrical quantities and therefore does not qualify as a protection system operation/misoperation.

Reference: NERC Glossary of Terms – Protection System

Control System Operation Example

A 230/115kV bank was removed from service due to an incorrect operation of a sudden-pressure relay.

How many operations and misoperations should be reported?

A. One operation. This operation is a reportable misoperation.

B. One operation, no misoperations to report.

C. This is a non-reportable event.

Control System Operation Example Answer

Answer: C. This is a non-reportable event.

Explanation: A sudden pressure relay is not responding to electrical quantities and therefore does not qualify as a protection system operation or misoperation.

Operations during Maintenance or Testing

- Operations caused by personnel that occur during maintenance or testing should not be reported.
  - This also applies to personnel accidentally operating other equipment during their testing. The maintenance/testing is considered ongoing until the equipment is released for service, so an operation on energization as part of the testing is not reportable.
  - This follows the general philosophy that if an incorrect operation would not be a reportable Misoperation, it should not be included as an operation.

Voltage Class for Operations

- If the Element is a transformer, the operation should be classified according to the high-side voltage.
- If the Element is a generator, the operation should be classified according to the GSU transformer high-side voltage.
- If the Element is a dispersed generation source, such as wind or solar generation, it should be reported based on the voltage at the common point of connection as described in Chapter 4 of the Bulk Electric System Definition Reference Document.
- If the Element is a reactive device connected to the tertiary of a transformer:
  - The tertiary voltage class shall be reported if the tertiary breaker opens, de-energizing only the reactive device.
  - The transformer high-side voltage shall be reported if the transformer breaker opens, de-energizing the transformer.

Reporting on Tie-Lines – 1/N Method

- Entities can report correct operations on an Element with shared ownership based on the fraction of terminals of the Element that the entity owns.
- Fractional operations are rounded to the closest whole number for reporting.
- The entity should round fractional operations in such a way that the total number of operations reported over several time periods is an accurate representation of the actual number of operations (e.g., round up first quarter, round down next quarter, etc).

Reporting on Tie-Lines – 1/N Method

- Line 1: 3-Terminal Line owned by Entities A, B, and C.
  - Faults 1 and 2: Correct Operations
  - Fault 3: Unnecessary trip at Entity B Terminal for a fault on Line 2
- Line 2: 2-Terminal Line owned by Entity A only
  - Fault 3: Correct Operation during which Line 1 Entity B Terminal also operates
  - Fault 4: Correct Operation
- 5 Composite Protection System Operations (3 on Line 1, 2 on Line 2), 1 Misoperation (on Line 1)

Reporting on Tie-Lines – 1/N Method

- Entity A
  - Line 1: 2/3 Correct Operations
  - Line 2: 2 Correct Operations
  - Total – Rounds up to 3 Total Operations, No Misoperations
- Entity B
  - Line 1: 2/3 Correct Operations, 1 Misoperation
  - Total – Round up to 2 Total Operations, 1 Misoperation
- Entity C
  - Line 1: 2/3 Correct Operations
  - Total: Round down to 0 Operations
- Totals:
  - 5 Operations, 1 Misoperation

Misoperations

Misoperation - Categories

Failure to Trip – During Fault

- A failure of a Composite Protection System to operate for a Fault condition for which it is designed. The failure of a Protection System component is not a Misoperation as long as the performance of the Composite Protection System is correct.
- Example: A line Fault occurs and breaker failure operates due to a failed trip coil. The trip coil is considered to be part of the station dc control circuitry for protective functions, therefore this is reported as a “Failure to Trip – During Fault” Misoperation. This means that two Composite Protection System operations and one Misoperation should be reported.

Failure to Trip – Other than Fault

- A failure of a Composite Protection System to operate for a non-Fault condition for which it is designed, such as a power swing, undervoltage, overexcitation, or loss of excitation. The failure of a Protection System component is not a Misoperation as long as the performance of the Composite Protection System is correct.
- Example: A generator breaker of a BES generator was closed energizing the unit while at a standstill and offline. The Protection System inadvertent energization did not recognize the condition and failed to operate. The generator breaker was immediately tripped by manual intervention in response to its Protection System failure to operate.

Slow Trip – During Fault

- A Composite Protection System operation that is slower than required for a Fault condition if the duration of its operating time resulted in the operation of at least one other Element's Composite Protection System.
- Example: A high-impedance phase-ground fault occurs on a two-terminal line that is protected by ground-overcurrent relays. Due to the low level and varying nature of the current, the overcurrent relay operates, but does so more slowly than expected. Because of slower than expected operation, the protection system on an adjacent line also operates.

Slow Trip – Other than Fault

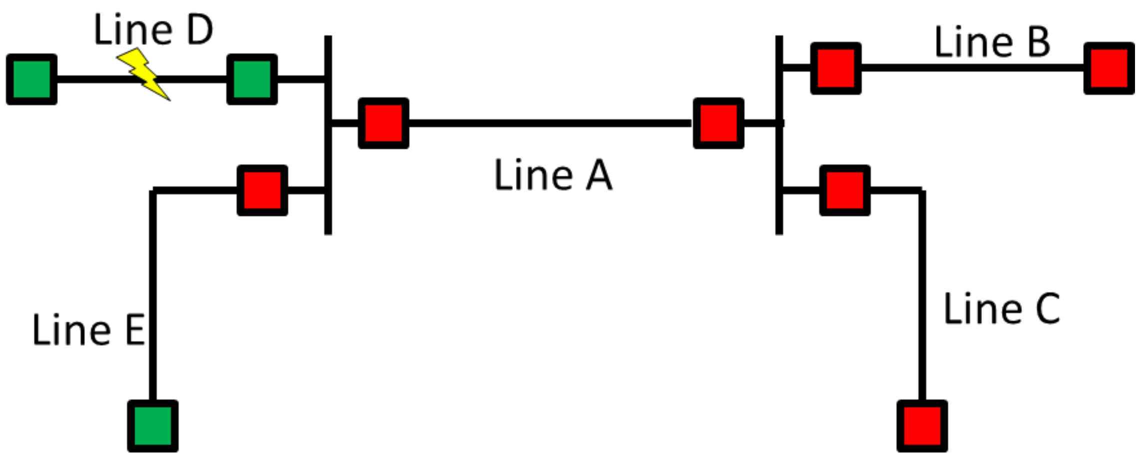
- A Composite Protection System operation that is slower than required for a non-Fault condition, such as a power swing, undervoltage, overexcitation, or loss of excitation, if the duration of its operating time resulted in the operation of at least one other Element's Composite Protection System.
- Example: Combustion Turbine Generator Units A and B at Power Station AB share a common generator bus and GSU. The exciter controller failed on Unit A and went into full boost mode. Both units A and B tripped for 24 V/Hz. Investigation revealed that the primary protection on Unit A, the rotor overcurrent protection, was set with an incorrect time delay. This caused the 24 V/Hz relays to operate on both units and the unnecessary tripping of Unit B.

Unnecessary Trip – During Fault

- An unnecessary Composite Protection System operation for a Fault condition on another Element.
- Example: An operation of a transformer's Composite Protection System which trips (i.e., over-trips) for a properly cleared line Fault is a Misoperation. The Fault is cleared properly by the faulted equipment's Composite Protection System (i.e., line relaying) without the need for an external Protection System operation resulting in an unnecessary trip of the transformer protection; therefore, the transformer Protection System operation is a Misoperation.

Unnecessary Trip – During Fault

- A permanent fault occurs on Line D. The Line D breakers trip, but a breaker on Line E overreaches and trips incorrectly. How many operations and misoperations should be reported?



A. *Three operations, one of which is a reportable misoperation.*
B. *One operation, this operation is a reportable misoperation.*
C. *Two operations, one of which is a reportable misoperation.*
D. *Two operations, no misoperation to report.*

Unnecessary Trip – During Fault

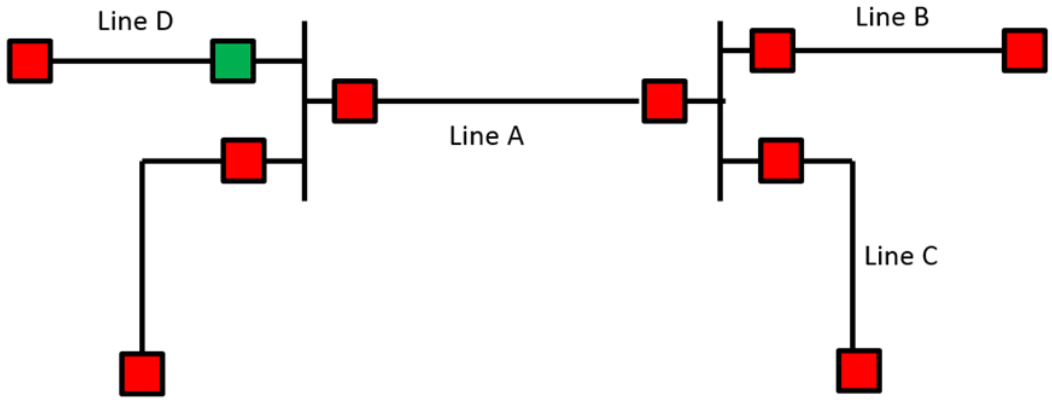
- Answer: C. Two operations, one of which is a reportable misoperation.
- Explanation: The unintended operation of a protection system for a fault outside the zone it is designed to protect is an operation. This unintended operation is a misoperation that must be reported to the MIDAS Portal.
- Reference: MIDAS Reporting Template – Tab 4 - Definition of Operation.

Unnecessary Trip – Other than Fault

- An unnecessary Composite Protection System operation for a non-Fault condition. A Composite Protection System operation that is caused by personnel during onsite maintenance, testing, inspection, construction, or commissioning activities is not a Misoperation.
- An impedance line relay trip for a power swing that entered the relay's characteristic is a Misoperation if the power swing was stable and the relay operated because power swing blocking was enabled and should have prevented the trip, but did not.

Unnecessary Trip – Other than Fault

- A breaker on Line D trips due to a failed protection system relay with no fault. How many operations and misoperations should be reported?



A. *No operation, one reportable misoperation.*

B. *One operation, no misoperations to report.*

C. *One operation. This operation is a reportable misoperation.*

D. *None of the above.*

Unnecessary Trip – Other than Fault

- Answer: C. One operation. This operation is a reportable misoperation. This misoperation would be categorized as Relay Failure/Malfunction.
- Explanation: This category includes Misoperations due to improper operation of the relays themselves. These may be due to component failures, physical damage to a device, firmware problems, or manufacturer errors. Examples would include Misoperations caused by changes in relay characteristic due to capacitor aging, misfiring thyristors, relay power supply failure, or internal wiring/logic error. Failures of auxiliary tripping relays fall under this category.
- Reference: MIDAS Reporting Template – Tab 4 - Definition of Relay failure/Malfunction misoperation.

Misoperation - Causes

AC System

- This cause includes Misoperations due to problems in the ac inputs to the Composite Protection System. Examples would include Misoperations associated with current transformer (CT) saturation, loss of potential or damaged wiring in a voltage or current circuit.
- *Example: One of the redundant reactor protection relays operated while there was no fault on the system. Cause of the misoperation was found to be a defective CT cable to one of the reactor protection relays.*

As-Left Personnel Error

- This cause includes Misoperations due to the as-left condition of the Composite Protection System following maintenance or construction procedures. These include test switches left open, wiring errors not associated with incorrect drawings, carrier grounds left in place, settings placed in the wrong relay, or settings left in the relay that do not match engineering intended and approved settings. This includes personnel activation of an incorrect settings group.
- *Example: The Substation A to Substation B line primary relay incorrectly operated for a Substation A Breaker failure condition due to an incorrect relay setting left in the relay after relay testing.*

Communication Failure

- This cause includes Misoperations due to failures in the communication systems associated with protection schemes, inclusive of transmitters and receivers. Examples would include Misoperations caused by loss of carrier, spurious transfer trips associated with noise, communications provider errors resulting in malperformance of communications over leased lines, loss of fiber optic communication equipment, or microwave problems associated with signal loss or degradation.
- *Example: A free standing Current Transformer failed at Substation A. The bus protection operated properly, but a remote end line breaker also operated unnecessarily. Investigation revealed a trip of the overreaching Directional Comparison Blocking zone due to faulty drain coil at Substation B, which prevented the block signal from being received.*

DC System

- This cause includes Misoperations due to problems in the dc control circuits. These include problems in the battery or charging systems, trip wiring to breakers, or loss of dc power to a relay or communication device. Please refer to Figure for additional clarification.
- *Example: The Substation A relays operated, causing an outage of Substation A and Generator 1. It was determined that the cause of the operation was due to a faulty neon indicating bulb in the DC tripping circuitry. The bulb socket shorted, causing the tripping relay to operate.*

Incorrect Settings

- This cause includes Misoperations due to errors in issued setting, including those associated with electromechanical or solid-state relays and the protection element settings in microprocessor-based relays (excluding logic errors discussed in the Logic Error cause code). This includes setting errors caused by inaccurate modeling.
- *Example: The transformer differential operated under load and an unusual amount of standing differential was noticed in the relay event reports. Upon settings inspection, it was revealed the winding 2 nominal voltage was set incorrectly by the protection engineer and was the culprit of the operation.*

Logic Errors

- This cause includes Misoperations due to issued logic setting errors associated with programming microprocessor relay inputs, outputs, custom user logic, or protection function mapping to communication or physical output points.
- *Example: There was a trip of 115kV bus at the same time as an event on the 345kV system. Investigation revealed primary and backup bus relaying did not operate as expected. Investigation determined that the breaker failure relay had an incorrect logic equation on an output contact that was in the design to trip the primary bus lockout relays. Revised relay settings issued to correct the error.*

Design Errors

- This cause includes Misoperations due to incorrect physical design. Examples would include incorrect configuration on ac or dc schematic or wiring drawings, or incorrectly applied protective equipment.
- *Example: There was a trip of the 115kV bus at Substation A. Backup bus differential relay targets reported from the field. No relay targets on primary bus relayed. Backup relaying was recently installed. Review and investigation of issued prints identified a rolled current transformer wiring of a new Aux current transformer installed to provide secondary currents to the new backup bus relay.*

Relay Failures/Malfunctions

- This cause includes Misoperations due to improper operation of the relays themselves. These may be due to component failures, physical damage to a device, firmware problems, or manufacturer errors. Examples would include Misoperations caused by loss of calibration, component degradation, misfiring thyristors, relay power supply failure, or internal wiring/logic error. Failures of auxiliary tripping relays fall under this category.
- *Example: Terminal A only of Line A-B operated under no fault conditions. Investigation revealed that the primary relay at Terminal A had a fault Analog to Digital Converter on the A phase current input leading to an incorrect operation of the ground overcurrent element.*

Other/Explainable

- This cause includes Misoperations that were determined to have an identified cause but they do not fit into any of the above categories.
- For example, temporary changes in network topology that, because of their low probability of occurrence, are not accounted for in the design of the Protection System, 61850 errors, or environmental issues such as damage due to water from a leaking roof or animal intrusion.

Unknown/Unexplainable

- This cause includes Misoperations where no clear cause can be determined. Use this cause code if the analysis is still in progress. Ensure that cause code is updated, if necessary, once analysis is complete. If this cause code is selected following final analysis, description of extensive investigative actions should be included in the Corrective Action Plan.

Misoperation – Key Concepts

Multiple Misoperations on a Single Element

- If multiple Misoperations occur on a single Element's Composite Protection System during the same event within 24 hours then it should be reported as a single Misoperation. The Misoperation would also be counted as a single CPSOP, in addition to any other Composite Protection Systems that operated as expected to clear the fault. The record should be populated based upon the most critical Misoperation.
  - Any additional Misoperations beyond the most critical within the same Composite Protection System should be detailed as part of the event description.

NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Multiple Misoperations on a Single Element

- *Example: A Fault occurred on Line AB and a relay at terminal C on Line BC operated. Simultaneously, the terminal C main bus was cleared by the breaker failure lockout relay. Upon investigation, the line relay incorrectly had a zero time delay and its breaker failure initiate contact was incorrectly wired to trip the breaker failure lockout directly.*
- *Report the breaker failure relay operation since its Misoperation was more critical, but describe the circumstances that led to the lockout operation, i. e., the incorrect time delay that allowed the line relay to operate too quickly.*

Non-Interrupting Misoperations

- Misoperations of BES Composite Protection Systems that trip a BES breaker but do not interrupt BES paths or service are still considered reportable. For example BES breakers, as part of a ring bus, tripping but not interrupting service.

Breaker Trip Coil Failure

- A breaker trip coil is considered to be part of the Composite Protection System and should be reported if it causes a Misoperation. Investigation should be made to determine if a mechanical problem (i.e. stuck breaker) is the cause of the trip coil failure; if so it is not a Misoperation. If a defective trip coil is found during maintenance, testing, or through control operations nothing should be reported.
- *Example: Lockout properly requested the generator breaker to open. Breaker did not open due to an aux relay coil failure. The generator breaker did not open due to a failed relay coil. The breaker was opened with proper functionality. The relay was repaired and tested.*

Breaker Mechanism Malfunction

- Breaker mechanism malfunction is considered a mechanical failure, not an electrical failure, and should not be reported
- Note that a mechanical failure can cause a breaker trip coil failure, leading to the incorrect conclusion that a Protection System Misoperation occurred but is really a mechanical failure.
- *Example: The 100kV breaker tripped for a non-fault event. During restoration, multiple defects including a DC ground, failure of an undervoltage timer, pole disagreement trip were observed. Investigation concluded the cause was a ground on the DC System on the breaker mechanism trip coil. DC ground was located on the side of the trip coil in the A phase mechanism cabinet.*

Detected Relay Settings Errors

- In cases where a relay settings error is detected without a Misoperation having occurred, nothing should be reported.

Misoperations on De-Energized Elements

- In cases where a breaker trips when the protected Element is already deenergized and no in-service BES interrupting devices tripped, nothing should be reported.
- In cases where the Composite Protection System on a de-energized Element trips and causes the operation of an in-service BES interrupting device, this is a reportable Misoperation, unless otherwise excluded.

UFLS/UVLS

- Underfrequency load shedding (UFLS) and undervoltage load shedding (UVLS) system(s) that are intended to trip one or more BES elements should be reported if a system fails to shed load when expected or if a system sheds load inadvertently.
- *Example: Voltage reading high on one phase, resulting in average voltage reading higher than actual Lead to desensitization of UnderVoltage relay to show 90% and in turn failed to trip.*

Reverse Power Relays

- An entity intentionally uses reverse power relays during normal unit shutdown. If the operation of these relays is part of a controlled shutdown, no operations should be reported to MIDAS.

FACTS Devices

- Failure of a FACTS device Composite Protection System to operate as intended for protection purposes should be reported as a misoperation.

Environmental Issues

- If a Composite Protection System misoperates due to environmental issues such as induced vibration (excluding onsite personnel), excessive temperature, or water intrusion it should be reported as a Misoperation. These would generally fall under the “Other/Explainable” cause.

Voltage Class

- If the Element is a transformer, the operation should be classified according to the high-side voltage.
- If the Element is a generator, the operation should be classified according to the GSU transformer high-side voltage.
- If the Element is a reactive device connected to the tertiary of a transformer:
  - The tertiary voltage class shall be reported if the tertiary breaker opens, de-energizing only the reactive device.
  - The transformer high-side voltage shall be reported if the transformer breaker opens, de-energizing the transformer.

Control Functions

- Operations that are initiated by control functions, such as those associated with generator controls, turbine/boiler controls, SVC controls, FACTS controls, HVdc transmission system controls, or other facility control functions are not Misoperations.

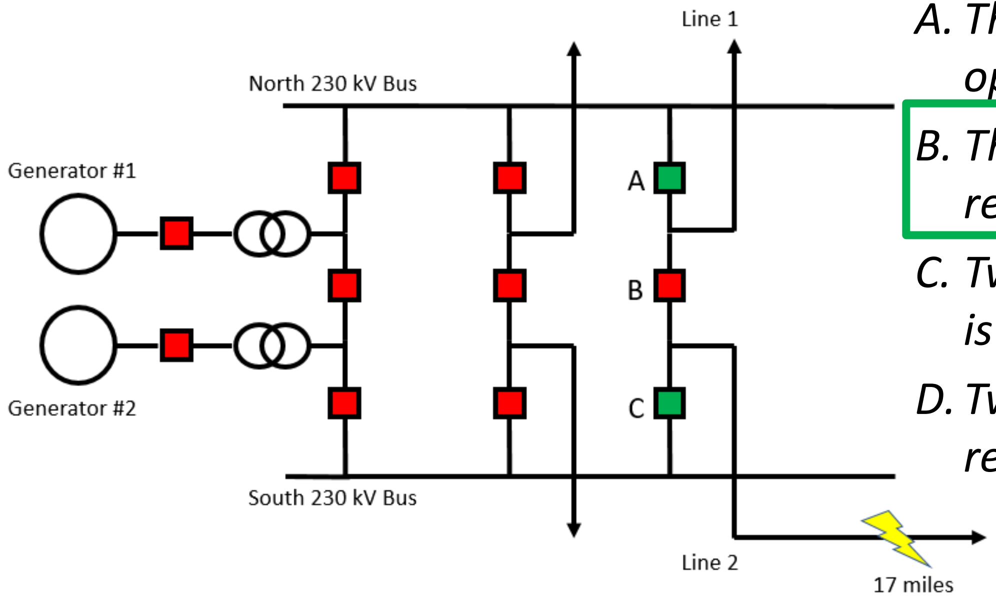
Failure to Automatically Reclose

- Failure to automatically reclose after a fault is not considered a reportable Misoperation.

Quiz Questions

Example 1

- Permanent line fault occurs 17 miles out on Line 2. Line 2 relaying operates as intended; however, Breaker B fails to clear the fault because of a failed breaker mechanism. The breaker failure scheme provides local tripping, but no transfer tripping of the remote end of line 1. Remote relaying on line 1 operates to clear fault from system. How many operations and how many misoperations should be reported?



A. Three operations, one of these operations is a reportable misoperation.

B. Three operations, no misoperations to report.

C. Two operations, one of these operations is a reportable misoperation.

D. Two operations, no misoperations to report.

Example 2

- Which is the correct cause for the following scenario?
- A Bus PT failed, leading to an imbalanced voltage being detected on the Generator Bus 59N relay, which tripped Unit 1 and GSI #1 offline.

A. Incorrect Settings

B. As-Left Personnel

C. AC System

D. Relay Failures/Malfunctions

NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Example 3:

- Which is the correct cause for the following scenario?
- Terminal A of line A-B overtripped for a fault on Line B-C. Investigation revealed that the settings engineer had placed Z2 (overreaching zone) into the unconditional trip equation instead of the time-delayed Z2T.

A. Logic Errors

B. As-Left Personnel

C. AC System

D. Incorrect Settings

Example 4:

- Which is the correct cause for the following scenario?
- A lightning strike created a three-phase fault on a 115kV transmission line. The line is protected by primary and backup transmission line relays, which saw the fault with zone two and three-phase distance elements, but were blocked from initiating a trip by their loss of potential settings. The fault on the line was cleared by a system backup protection element. Investigation revealed that the voltage threshold settings for Loss of Potential were set too tight, allowing the Loss of Potential condition to be asserted during minimal load imbalances that occur under normal conditions.

A. Design Errors

B. As-Left Personnel

C. AC System

D. Incorrect Settings

Example 5

- Which is the correct cause for the following scenario?
- There was a fault on the Substation A to Substation B line. Primary and secondary relays at Substation A initiated a trip, but Breaker 1 failed to open. Substation A is a ring bus with local breaker failure on the generator bay. The fault self cleared after approximately 1.15 seconds. Due to technician wiring error, Substation A Breaker 2 inadvertently tripped in addition to the correct breaker, Breaker 3, for a breaker fail on Breaker 1.

A. Logic Errors

$\boxed{\textit{B. As-Left Personnel}}$

C. Relay Failures/Malfunctions

D. Incorrect Settings

NERC
NORTH AMERICAN ELECTRIC
RELIABILITY CORPORATION

Example 6

- Which is the correct cause for the following scenario?
- Terminal A of Line A-B operated slowly via time-delayed Zone 2 for a fault on the line near Terminal B. This caused miscoordination at Terminal C of Line C-A. Investigation revealed that the Directional Comparison Unblocking Scheme was in alarm due to a failed receiver at Terminal A, which prevented high speed tripping and led to miscoordination with Line C-A relaying.

A. Communication Failure

B. As-Left Personnel

C. Relay Failures/Malfunctions

D. DC System

Example 7

- Which is the correct cause for the following scenario?
- During the initial unit startup following a scheduled maintenance outage, in which the generator protection relays were tested and the maintenance personnel had left the site, the unit tripped on the Generator Differential. Due to a technician wiring error, the A-Phase wiring of the differential circuit was reversed, which resulted in the Generator Differential operating to trip the unit.

A. Incorrect Settings

B. As-Left Personnel

C. Relay Failures/Malfunctions

D. AC System

Example 8

- Which is the correct category for the following scenario?
- Breaker Failure tripped even though breaker had opened. Breaker opened due to a ground fault on a Generator Step-up Unit. Breaker opened, but due to the fault event, DC current remained for the Breaker Failure relay to see.

A. *Unnecessary Trip – Other than Fault*

B. *Failure to Trip – During Fault*

C. *Unnecessary Trip – During Fault*

D. *Slow Trip – During Fault*

Example 9

- Which is the correct category for the following scenario?
- The breaker tripped for no fault on the system. It was found that the relay had a defective I/O module and the trip coil monitor was leaking enough current to trip the breaker.

A. Unnecessary Trip – During Fault

B. Unnecessary Trip – Other than Fault

C. Failure to Trip – Other than Fault

D. Slow Trip – During Fault

Example 10

- Which is the correct category for the following scenario?
- A generator breaker of a BES generator was closed energizing the unit while at a standstill and offline. The Protection System inadvertent energization did not recognize the condition and failed to operate. The generator breaker was immediately tripped by manual intervention in response to its Protection System failure to operate.

A. Unnecessary Trip – Other than Fault

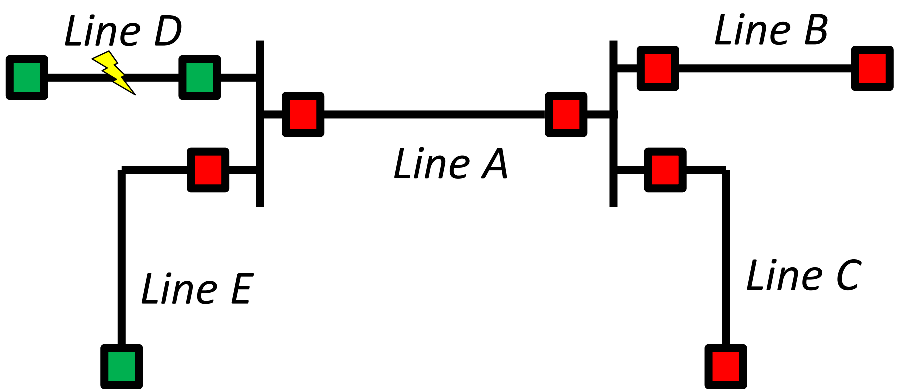
B. Failure to Trip – Other than Fault

C. Failure to Trip – During Fault

D. Slow Trip – Other than Fault

Example 11

- Which is the correct category for the following scenario?
- A permanent fault occurs on Line D. The Line D breakers trip, but a breaker on Line E overreaches and trips incorrectly.



A. Unnecessary Trip – Other than Fault

B. Failure to Trip – During Fault

C. Unnecessary Trip – During Fault

D. Slow Trip – During Fault

NERC
NORTH AMERICAN ELECTRIC
RELIABILITY CORPORATION

Example 12

- Which is the correct category for the following scenario?
- Electromechanical bus differential relay correctly detected a fault on the 115kV bus and sent trip signals to two bus differential lockout relays that trip the 115kV bus breakers. Lockout that trips Breaker 1 and Breaker 2 was slow to operate and took approximately 15 cycles to roll. This caused relays at the remote terminals protecting the 115kV lines to trip on zone 2 timing.

  A. *Unnecessary Trip – Other than Fault*

  B. *Failure to Trip – During Fault*

  C. *Unnecessary Trip – During Fault*

  D. *Slow Trip – During Fault*

Example 13

- Which is the correct category for the following scenario?
- Relay should have tripped to clear a bird contacting the buswork fault but did not. The root cause of the incident was that the element was turned off, accidentally disabling any protection that has a directional element assigned to it.

A. Unnecessary Trip – Other than Fault

B. Failure to Trip – During Fault

C. Unnecessary Trip – During Fault

D. Slow Trip – During Fault

Example 14

- Which is the correct category for the following scenario?
- There was a fault on a 161kV transformer on the bushing and was slow to clear by the transformer differential scheme. The generator breaker failure relay operated as a result.

A. Slow Trip – Other than Fault

B. Failure to Trip – Other than Fault

C. Unnecessary Trip – During Fault

$\boxed{\textit{D. Slow Trip – During Fault}}$

Questions and Answers