

NERC

NORTH AMERICAN ELECTRIC
RELIABILITY CORPORATION

Fault Types

November 2021

RELIABILITY | RESILIENCE | SECURITY



- The descriptor of the fault, if any, associated with each Automatic Outage of an Element.
 1. No fault
 2. Phase-to-phase fault (P-P)
 3. Single phase-to-ground fault (P-G)
 4. Phase-to-phase-to-ground (P-P-G), 3P, or 3P-G fault
 5. Unknown fault type
 - NOTE for TADS purposes the Fault Type chosen should:
 - Be based on TO best judgment of what occurred
- Represent the worst impact on system dynamic stability

- If an Element has an Automatic Outage and its Outage Initiation Code is:
 - Element-Initiated - report Fault Type 1-5 as appropriate.
 - Other Element-Initiated - report Fault Type 1, No fault
 - the Fault Type will be reported for the other Element that initiated the outage
 - AC Substation-Initiated or AC/DC Terminal Initiated -
 - If fault occurred on BES AC equipment report Fault Type 2-5 as appropriate.
 - If a fault did not occur OR if a fault occurred on non-BES AC equipment report type 1, No fault.
 - Other Facility-Initiated or Protection System-Initiated - report Fault Type 1, No fault.

- No Fault: An outage occurs and no electrical short circuit was present to cause the outage **on the element being reported.**
 - Over/Under voltage, overload, RAS schemes, Dependent Mode outages, Protection System component failures would be coded as no fault.
- A BES 500kV line tripped because of incorrect relay settings during a 3 phase fault on a 230kV line a bus away. The outage record for the 500kV line would be selected as no fault.

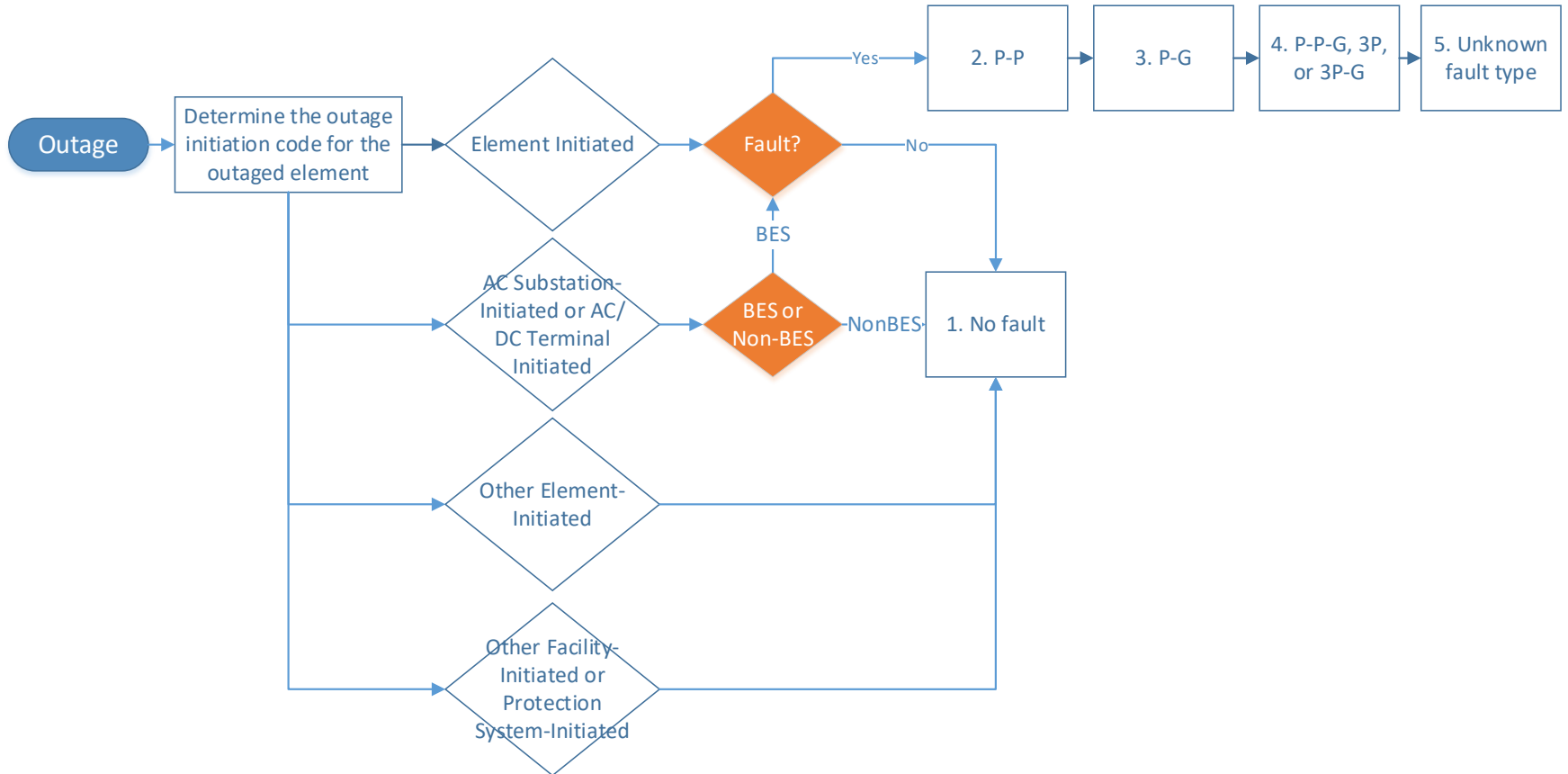
- This fault occurs when a single phase conductor short circuits to the earth (ground) neutral point.
 - Typical targets would include Ground, Neutral, Ground Inst, Z1 G, Carrier Ground, Z2 G, Ground Time, etc. However if any multi-phase or phase pair targets are indicated this would not be a single phase to ground fault.
- Bird contamination on a bottom phase of a vertical constructed circuit causes a flash from the bottom line conductor to tower. Relay targets were Ground Inst and Carrier Ground.

- This fault type occurs when any two phase wires short circuit to each other without contacting the earth ground plain or the third phase in the circuit.
 - Typical targets could be AB, BC, CA, Zone 1 Phase, Zone 2 Phase, A and B Time, B and C Time, C and A Time. If any ground targets are indicated, it is not a Phase to Phase fault.
- A tree branch breaks cleanly from the tree and falls into two phase wires on a horizontal circuit.

- This fault type occurs when any two phase wires short circuit to each other and earth neutral or ground at the same time. Or when all three phase wires short to each other by themselves or with ground contact.
- A transmission crossarm breaks and drops all three phase wires to the ground. All three phase wires make contact with the earth at the same time causing a 3 phase fault.

- In instances where the fault type changes over the duration of the fault, the fault type should be reported as the most egregious option.
- As an example; a fault initiates as a single phase to ground then evolves into a two phase to ground fault. The fault should be reported as a two phase to ground fault.

- Fault recorder/Digital Relay records
 - While not always available, records from remote stations could indicate which phases were involved and provide the best information for determining fault type.
- Relay Targets
 - While usually available, may be cumbersome to evaluate when multiple events have occurred before the targets are obtained from a station.
- Patrol Results
 - When relay targets or fault records are not available, patrol results can tell what the fault type was based on damage reports or repairs made.



- Lightning causes a single phase to ground fault on a 500kV AC Circuit which causes an outage to the circuit. A BES 500/230kV transformer is connected to the circuit at one of the circuit's terminals. When an outage occurs on the 500kV line, the transformer must also be outaged.

Element	Fault Type
500kV Line	<i>Single Phase to Ground Fault</i>
500/230kV Transformer	<i>No Fault</i>

- A 230kV wooden crossarm breaks and drops all three wires to the ground. One wire makes contact first and the line protection trips the circuit breakers, outaging the line before the other two phase wires make contact with the earth or each other. When the line recloses the breakers, all three phase wires are making contact with the earth.

Element	Fault Type
230kV line	<i>Phase-to-phase-to-ground (P-P-G), 3P, or 3P-G fault</i>

- A Non BES 345/23kV transformer is connected to a BES 345kV line. The protection on the non BES transformer misoperates and sends a trip signal to outage the BES 345kV line.

Element	Fault Type
345kV Line	<i>No Fault</i>

- A 500kV line has an A-G fault and trips out the A phase portion of the circuit, however the remaining phase B and C remained energized. The A phase pole successfully reclosed after 10 seconds. This only pertains to single pole tripping.

Element	Fault Type
<i>Single pole outages are not reportable.</i>	

A stylized map of North America is centered on the page. The map is divided into three horizontal color bands: a light purple band at the top covering Canada, a dark blue band in the middle covering the United States, and a light grey band at the bottom covering Mexico. The text "Questions and Answers" is overlaid on the dark blue band.

Questions and Answers

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