North American Transmission Forum

NATF Equipment-related Outage Cause and Sub-cause Code Definitions

Version 1.0

- **Failed AC Circuit Equipment -** Automatic Outages related to the failure of AC Circuit equipment, i.e., overhead or underground equipment "outside the substation fence." Includes failures of equipment during weather or environmental events where conditions do not exceed the equipment's design criteria.
    - **Arrester**
    - **Cables**
    - **Circuit Switcher -** this is not just a switch. Reference IEEE definition (A mechanical switching device with an integral interrupter, suitable for making, carrying, and interrupting currents under normal circuit conditions. It is also suitable for interrupting specified primary-bus fault current and transformer-limited fault current that may be less than its rated short-circuit making current and rated short-time withstand current.) This sub-cause code also includes line-rupter.
    - **Conductor** - Use if failed jumper or if the conductor is broken (for failure of splices and sleeves reference new sub-cause code of Splice)
    - **Crossarm**
    - **Foundations**
    - **Guy Wire –** includes anchor
    - **Hardware** - Use for failed hardware including clamps, ground wire connections, mounting assemblies, spacers, spacer dampeners, vibration dampeners, etc.
    - **Insulator**
    - **Pole/Structure/Tower**
    - **Series Compensation Devices** - Use for series capacitors or series reactors that are within the boundaries of the AC Circuit even if these "in-line" devices are within an AC Substation
    - **Splice –** includes sleeve
    - **Static Wire**
    - **Structure Grounds** - Use when grounds are present but degraded. If grounds have been stolen, use the Vandalism cause and Theft sub-cause
    - **Switch** - Includes in-line switches that are within the boundaries of the AC Circuit even if these "in-line" devices are within an AC Substation
    - **UG/OH Transition Equipment** - Use for failed equipment in the transition between underground and overheard transmission lines including potheads and terminators
    - **Other AC Circuit Equipment** - Use when failed circuit equipment is known but cannot be categorized using above list
- **Failed AC Substation Equipment -** Automatic Outages caused by the failure of AC Substation; i.e., equipment "inside the substation fence" including Transformers and circuit breakers but excluding Protection System equipment. Includes failures of equipment during weather or environmental events where conditions do not exceed the equipment's design criteria. Note:

Series compensation (capacitors and reactors) is part of the AC Substation if it is not part of the AC Circuit.

- **Arrester**
- **Breaker**: If the failure point on the breaker is the bushing, use the "Bushing – Breaker" code instead of this "Breaker" code.
- **Bus**
- **Bushing – Breaker**: When a breaker failure is attributed to the bushing specifically, use this code.
- **Bushing – Transformer**: When a transformer failure is attributed to the bushing specifically, use this code.
- **Bushing – Other**: When failure of equipment (other than breakers and transformers) is attributed to the bushing specifically, use this code.
- **Capacitor Bank**
- **Circuit Switcher -** this is not just a switch. Reference IEEE definition (A mechanical switching device with an integral interrupter, suitable for making, carrying, and interrupting currents under normal circuit conditions. It is also suitable for interrupting specified primary-bus fault current and transformer-limited fault current that may be less than its rated short-circuit making current and rated short-time withstand current.) This sub-cause code also includes line-rupter.
- **CCVT/Coupling Capacitor**
- **CT/PT Combo**
- **Current Transformer**
- **Fuse**
- **Grounds**: Use when grounds are present but degraded. If grounds have been stolen, use the Vandalism cause and Theft sub-cause
- **Insulator**
- **Potential Transformer**
- **Power Transformer**: Includes Auto Transformers; If the failure point on the transformer is the bushing, use the "Bushing – Transformer" code instead of this "Power Transformer" code.
- **Reactor Bank** - includes shunt reactor banks
- **Reclosing Scheme -** includes recloser switch, reclosing relay, reclosing circuitry between relay and the device
- **Regulator**
- **Series Compensation Devices -** Use for series capacitors or series reactors that are within the boundaries of the AC Substation
- **Switch** - Includes disconnect switches located inside the substation, arcing horn

- **Wave Trap**
- **Underground Cable Equipment** - use for failed equipment in the underground cable system (i.e., pump house)
- **Other AC Sub Equipment** - Use when failed substation equipment is known but cannot be categorized using above list

- **Failed AC/DC Terminal Equipment -** Automatic Outages caused by the failure of AC/DC Terminal equipment; i.e., equipment "inside the terminal fence" including PLC (power-line carrier) filters, AC filters, reactors and capacitors, Transformers, DC valves, smoothing reactors, and DC filters but excluding Protection System equipment. Includes failures of equipment during weather or environmental events where conditions do not exceed the equipment's design criteria.
  - **AC and Auxiliary Equipment** – Use for AC terminal equipment failures at the substation. This includes everything from the incoming AC connection to the converter transformer connection such as AC filters, shunt compensation, PLC filters, AC control equipment, converter transformer, synchronous compensator, auxiliary equipment (e.g. auxiliary transformers, battery chargers, low voltage switchgear, or fire protection), and AC substation equipment (e.g. breakers, switches, arresters, bus, and insulators).
  - **Valves** – Use for electrical valve failures and cooling valve failures. The valve is the complete operative array forming an arm, or part of an arm of the convertor bridge. It includes all auxiliaries and components integral with the valve.
  - **DC Control and Protection Equipment** - Use for failures in equipment that is used to control the overall HVDC system and for control, monitoring and protection of the HVDC substation excluding the conventional protection system equipment which is covered in Protection System equipment.
  - **Primary DC Equipment** - Use for DC equipment failures at the substation. This includes DC filters, DC smoothing reactors, DC switching equipment (e.g. DC breakers, DC switches), DC ground electrode, DC ground electrode line, and other DC substation or Valve Hall equipment (e.g. valve and dc-side arresters, overcurrent diverters, bus, insulators and wall bushings).
  - **Other AC/DC Terminal Equipment** - Use when failed AC/DC terminal equipment is known but cannot be categorized using above list.

- **Failed DC Circuit Equipment -** Automatic Outages related to the failure of DC Circuit equipment, i.e., overhead or underground equipment "outside the terminal fence." However, include the failure of a connecting DC bus within an AC/DC Back-to-Back Converter in this category. Includes failures of equipment during weather or environmental events where conditions do not exceed the equipment's design criteria.
  - **Arrester**
  - **Cables** - includes underground or submarine cables
  - **Conductor** - Use if the conductor is broken (for failure of splices and sleeves reference new sub-cause code of Splice)
  - **Crossarm**

- **DC Bus within BTB Converter**
- **Foundations**
- **Guy Wire** – includes anchor
- **Hardware** - Use for failed hardware including clamps, ground wire connections, mounting assemblies, spacers, spacer dampeners, vibration dampeners, etc.
- **Insulator**
- **Pole/Structure/Tower**
- **Splice –** includes sleeve
- **Static Wire**
- **Structure Grounds** - Use when grounds are present but degraded. If grounds have been stolen, use the Vandalism cause and Theft sub-cause
- **Switch** - Includes in-line switches that are within the boundaries of the DC Circuit even if these "in-line" devices are within a DC Substation
- **UG/OH Transition Equipment** - Use for failed equipment in the transition between underground and overheard transmission lines including potheads and terminators
- **Other DC Circuit Equipment** - Use when failed circuit equipment is known but cannot be categorized using above list

- **Failed Protection System Equipment -** Automatic Outages caused by the failure of Protection System equipment to operate, the Protection System equipment operates slower than planned, or an unnecessary operation of the Protection System equipment. Includes any relay and/or control misoperations *except* those that are caused by incorrect relay or control settings that do not coordinate with other protective devices. Categorize these as "Human Error". Protection System Equipment includes protective relays, associated communication systems, voltage and current sensing devices, station batteries and DC control circuitry. It does not include components of an AC Circuit or AC Substation equipment that are inputs to the protection system (e.g. a b-switch or b-finger of a breaker, the primary insulation side of a PT or CT). Includes failures of the Protection System equipment during weather or environmental events where conditions do not exceed the equipment's design criteria.
    - **AC System** - Use for problems in the AC inputs to the protection system
    - **Communication Failure** - Use for problems with the communication systems associated with protection schemes inclusive of transmitters and receivers
    - **DC System** - Use for problems in the DC control circuitry. This includes problems in battery or charging systems, trip wiring to breakers, or loss of DC power to a relay or communication device.
    - **Relay/Malfunction** - Improper operation of relays due to component failures, physical damage, firmware problems, and vendor design issues, or manufacturer errors. Failure of auxiliary tripping relays fall under this category.
    - **Other Protection System Equipment** - Use when failed protection equipment is known but cannot be categorized using above list