

Appendix E

Conditions That May Trigger Direct Transfer Trip (DTT)

The following conditions and configurations may result in the need for generation DTT and can be used as a general guide of when DTT is required. This is not an exhaustive list; detailed studies are required to finalize DTT requirements.

Transmission Interconnections

Transmission interconnections do not enable active anti-islanding therefore will require DTT in many cases. Refer to the following figures for typical DTT interconnections listed under Configurations.

Note: The DTT configurations are specifying distribution interconnections but can also apply to transmission interconnections.

Distribution Interconnections requiring transmission DTT

Distribution interconnections may require DTT under the following conditions, refer to [Distributed Generation Protection Requirements Engineering Document 094681](#) for specific requirements.

- Existing aggregate generation > 50% of minimum gen to load ratio.
- Mix of certified (UL1741SA/SB) and uncertified generation (synchronous machines and wind-turbine generation)
- Distribution Substation Transmission Source configuration.
 - Radial – Generation is tied to a bus via a dedicated transmission line, there is only one source.
 - Loop station with one source or two sources (for contingencies assume one source is out of service)
 - Station with three sources (DTT would not be required from the transmission sources)

Distribution Generation Protection Requirements Engineering Document (094681) is linked to PG&E's [Distribution Interconnection Handbook \(DIH\)](#) and is updated to include any changes to the evaluation screens or protection requirements.

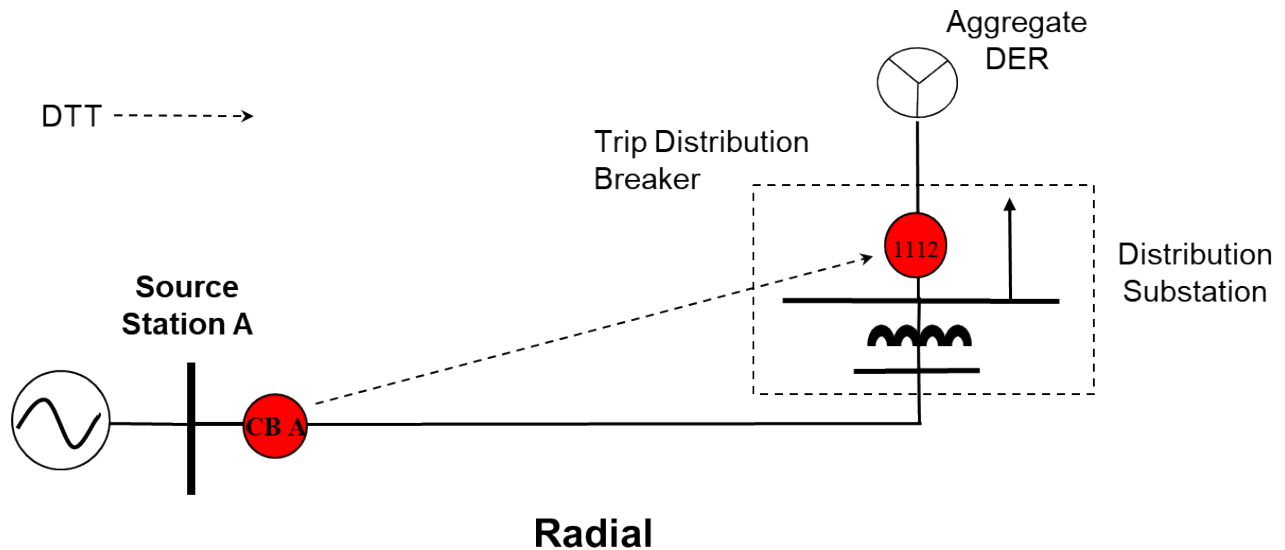
Configurations

Radial

In this configuration, the generator will island the Distribution Substation if Circuit Breaker (CB) A is opened. Mitigation could consist of DTT initiated from CB A open status, Station A bus differential, and line protection relays. A CB Maintenance switch is not required in this case since it's the only source; if the breaker is open the generator should be off-line.

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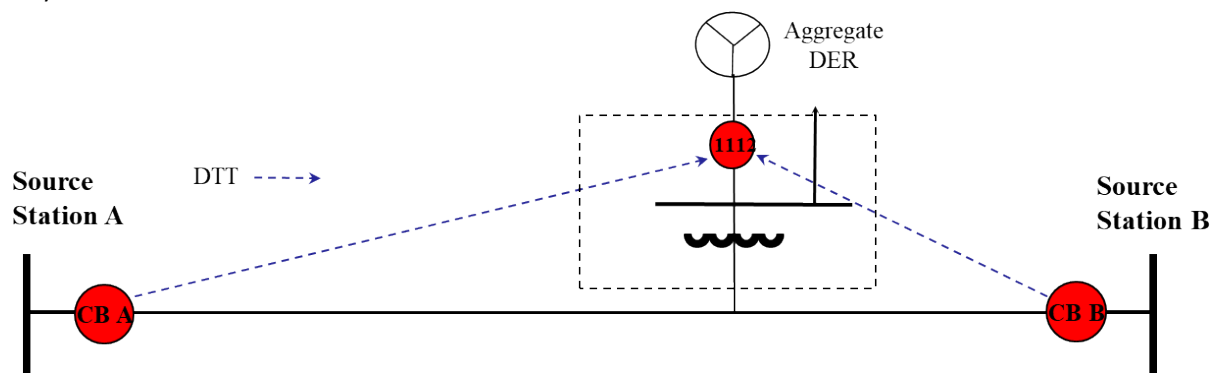


Two Terminal

In this configuration the generator is tripped from the line relays on either end. Station A or B bus differential tripping and CB Open status could be included with a separate Relay Cut-Out (RCO) to allow gen tripping when the opposite terminal CB is open. RCO is a two positions selector switch. When RCO is operated to "Cut-In" position, then DTT would be enabled from bus differential tripping and when RCO is operated to "Cut-Out" position, then DTT would be disabled from bus differential tripping.

Each of the source stations can have three or more sources. If the source station has two sources only, then source station will be considered as a loop station and additional condition for loop with one source open (discussed later in the section) has to be considered. If the source station has only one source, then it would be considered radial and radial configuration conditions (discussed above) would apply.

Source station can have any bus configuration (such as double bus, breaker and a half, ring bus etc.)



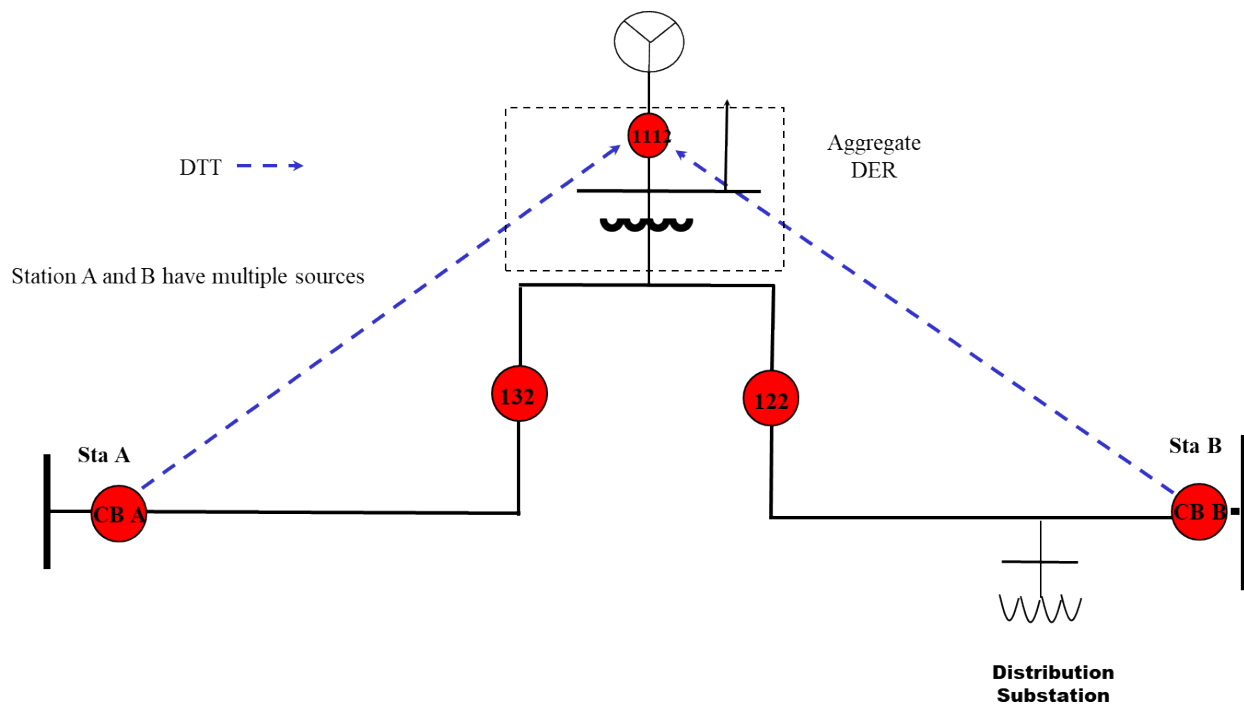
Two Terminal

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Loop Station Configuration

In this configuration the generator could island the Distribution Substation if CB A or CB132 is open and then CB B is opened. The generator is tripped via DTT which is initiated from either the CB status, bus differential or line protection relays from either side. In this configuration DTT is only required if one of the sources from Station A or Station B is unavailable. In order to simplify the DTT scheme, the DTT can remain cutout until either the Station A or Station B sources is opened at which point the in-service source terminal DTT is cut-in.



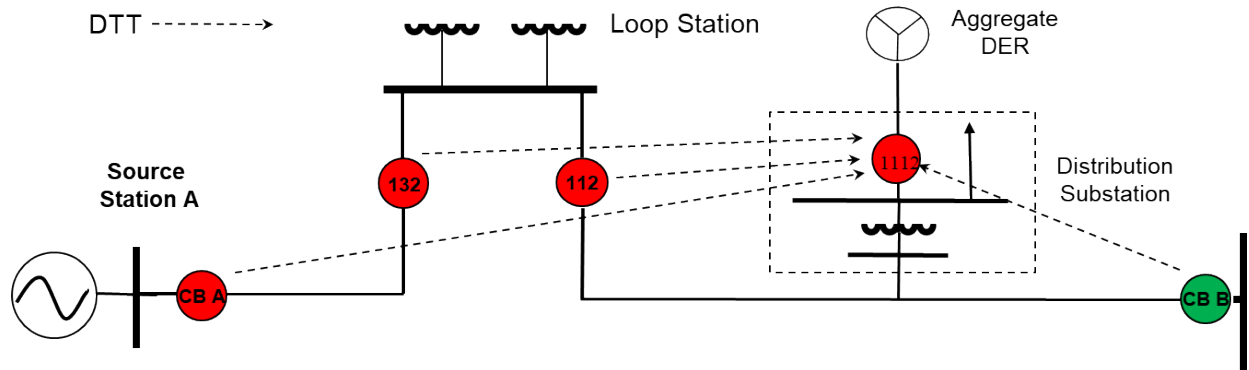
Loop Station Configuration

Loop with one Source

In this type of loop configuration, the generator could island the connected load if the path from the generator to the system is opened. This can occur if Station A, CB A or either CB 132 or CB 112 is opened. To prevent an island under these conditions DTT can be initiated from the CB open status, the bus differential and line protection relays from each of the breakers. It should be noted that when CB B is closed and has a source behind it, DTT from CB A, and CB 132 will be cut-out.

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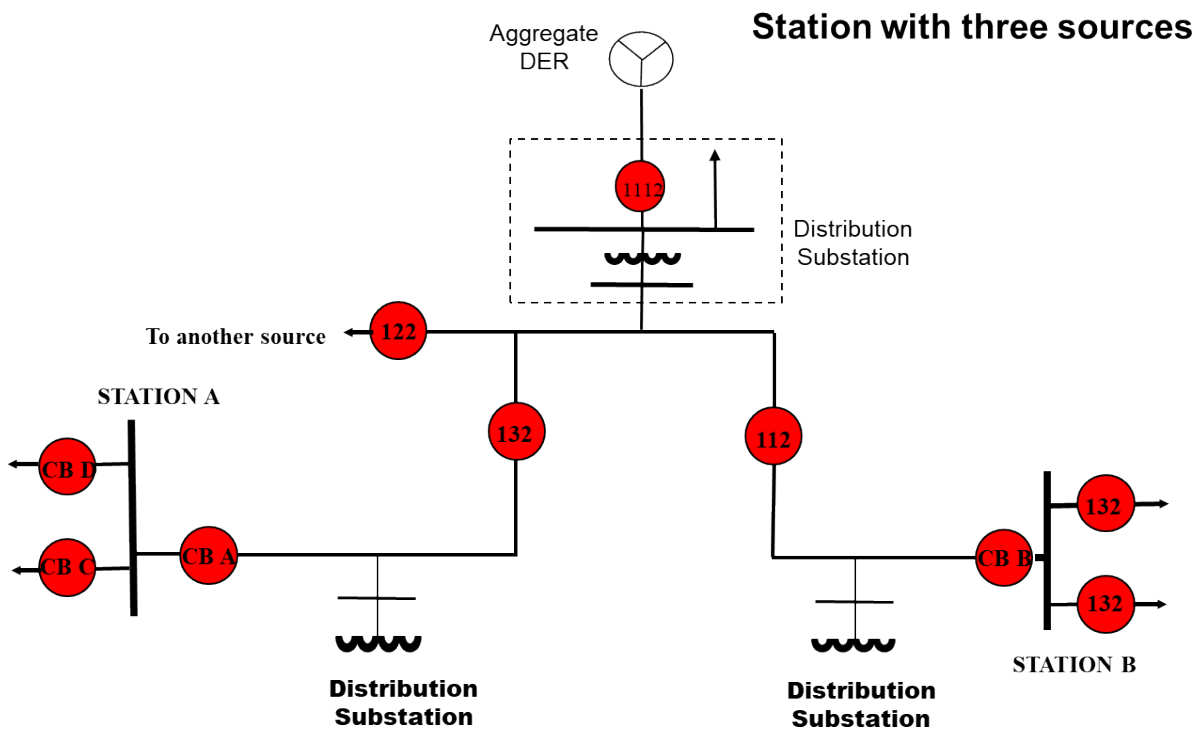
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Loop with one source

Station with Three Sources

For interconnection with three sources DTT would not be required from the transmission terminals, however, hardware DTT may be required at the interconnection station.



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Substitute Breakers

If a breaker is substituted for above configurations, then the substitute breaker should provide the same DTT trip functions as the original breaker.

Approved Communication mediums

The signal can be carried via various means sorted by viability.

- Digital Telephone lease line
 - Pros – Rely on local telco infrastructure
 - Cons –Communication circuit may not be protection grade, may not operate during a fault., Installation of costly equipment, reoccurring monthly lease line cost can be expensive. Installation can take six months or more.
 - Unit costs – For single DTT application, unit cost is \$300k per terminal. Communication medium for DTT application may include T-1 lease or equivalent communication medium (like Multiprotocol Label Switching (MPLS)). The cost does not include T-1 lease or equivalent cost that can vary widely.
 - The cost is based on 2022 unit-cost and could vary based upon yearly inflation.
- Wireless Spread spectrum
 - Pros – Cost effective installation, no external communication channel required.
 - Cons – Line of sight for transmitter and receiver required. Limited effective distance.
 - Unit costs - For a single DTT application, unit cost is \$400k for substation and \$150k for the generation facility. For each repeater station unit cost is \$100k.
 - The cost is based on 2022 unit-cost and could vary based upon yearly inflation
- Fiber Optic
 - Pros – Reliable fast communications.
 - Cons – Fiber and equipment installation can be costly and expensive.
 - Unit costs – Underground or Overhead costs \$1.5 million up to 1 Mile. Each additional mile is an extra \$1 million.
 - The cost does not include ageing pole replacement to run fiber

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- The cost is based on 2022 unit-cost and could vary based upon yearly inflation.
- Microwave
 - Pros – Fast communications
 - Cons – Equipment and installation can be costly and time consuming.
 - Unit costs – Microwave Tower: \$500k, Each Additional Dish: \$300k
 - The cost is based on 2022 unit-cost and could vary based upon yearly inflation.