



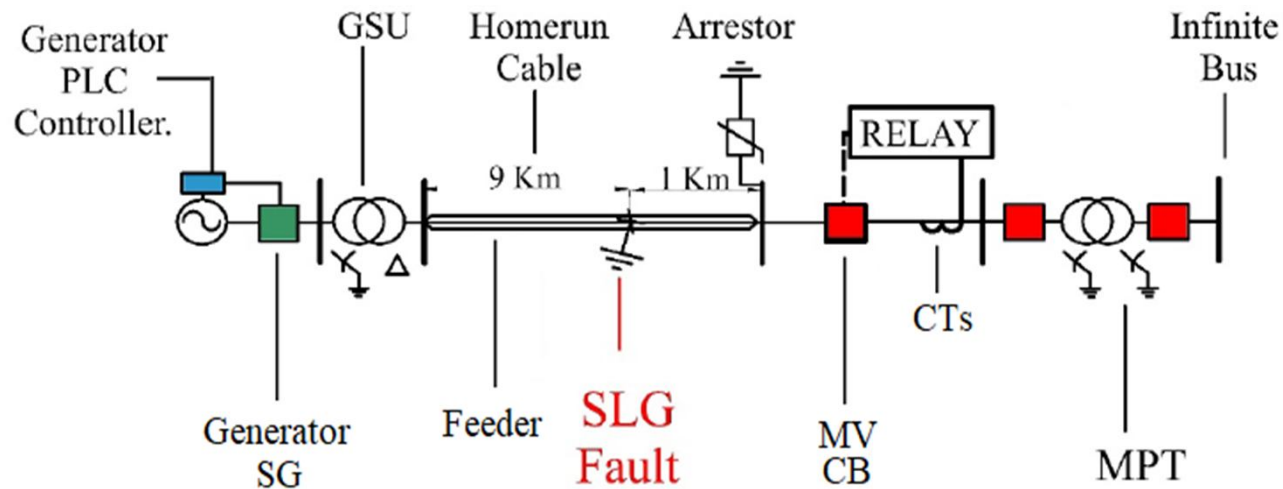
Abstract from White Paper

**“VDH/GSMI Provides Better Safety and Reliability for
Wind and Solar Power Plants and Their Personnel than
Remote Transfer Trip”**

November 2017

INTRODUCTION: SINGLE LINE TO GROUND FAULT (SLG)

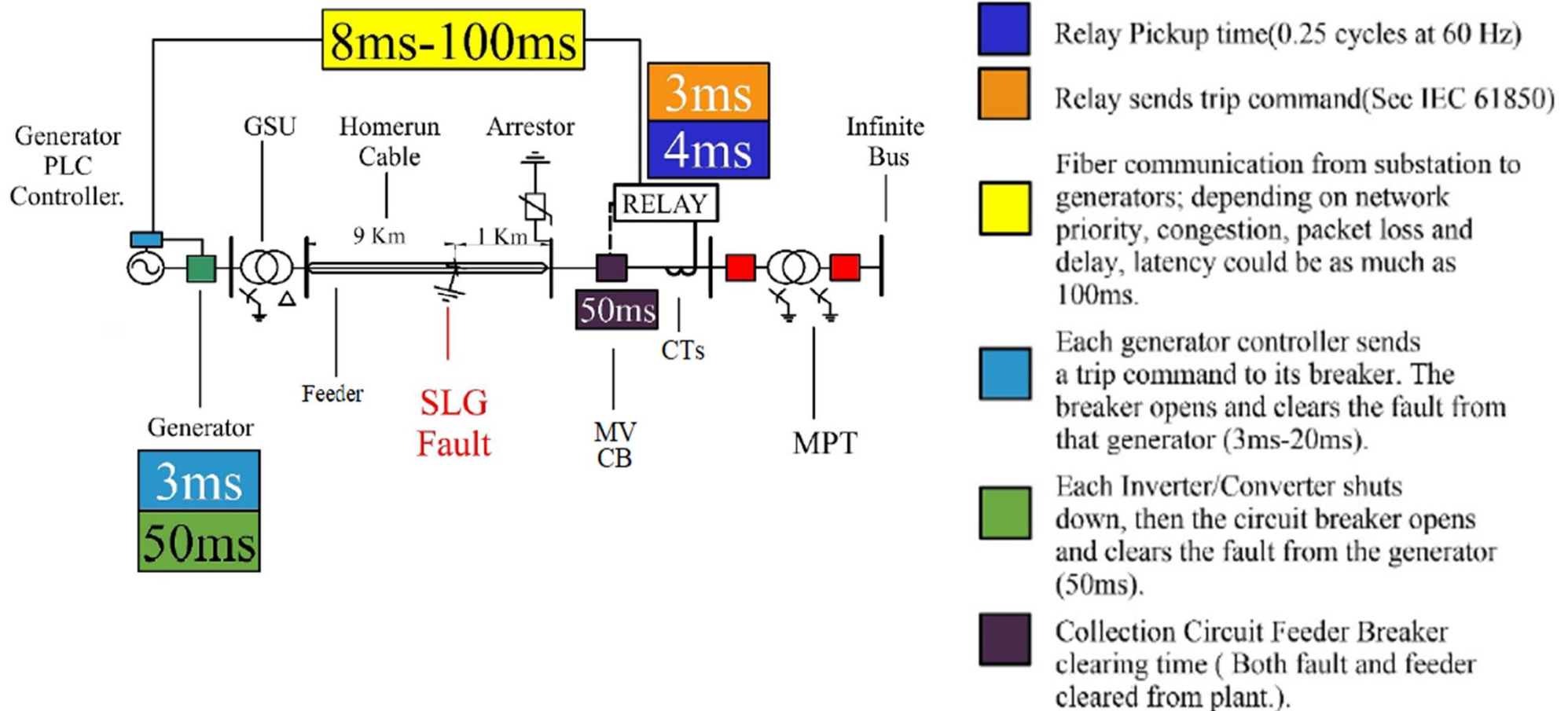
- Faults in collection circuit happen and, the longer a fault keeps on, the more damages it will cause. Although communication systems are fast, they do not process information instantaneously. Therefore communication plays a very important role in protecting the collection circuit.
- A signal over a dedicated communication channel, such as fiber, takes time to complete, this delay is called **latency**. Delays from the initiation of a fault on the collection circuit to the time when the equipment is separated or isolated from the fault is called the **clearing time**.
- When protecting a collection circuit, among the objectives to be accomplished, it is necessary to: (a) clear the fault from the grid and (b) clear the fault from the individual generators. The use of the Transfer Trip tool could be a possibility.
- Transfer Trip means the opening of a circuit breaker or recloser from a remote location by means of a signal over a communication channel.
- When using Transfer Trip, if (a) the fault is cleared from the grid by **tripping the feeder breaker as fast as possible and, for any reason, WTGs breakers take longer** then that, the whole MV collection circuit is **exposed to TOV (> 1.73 p.u.)**.
- If (b) the **feeder breaker is intentionally delayed** in order to match the opening of the feeder breaker and WTGs breakers, the feeder is exposed to incident energy (> 15,000 Amps) and eventually TOV if the delay is not enough.



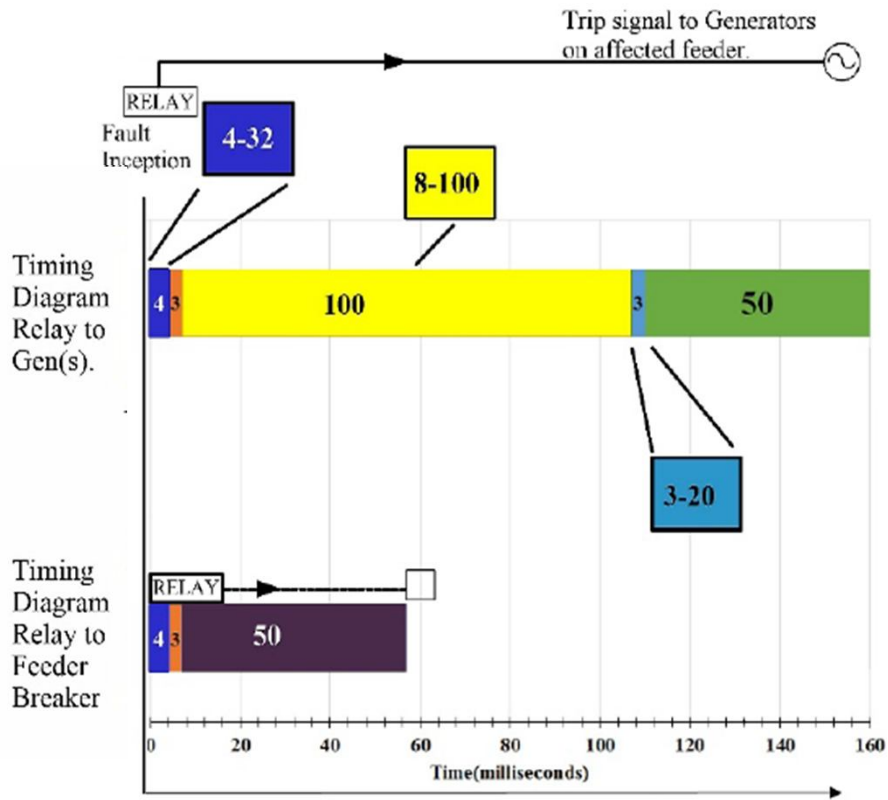
Neither the (a) Transfer Trip tool nor (b) the feeder breaker delay are reliable solutions.

SIMULATION - SINGLE LINE TO GROUND FAULT (SLG) WITH TRANSFER TRIP

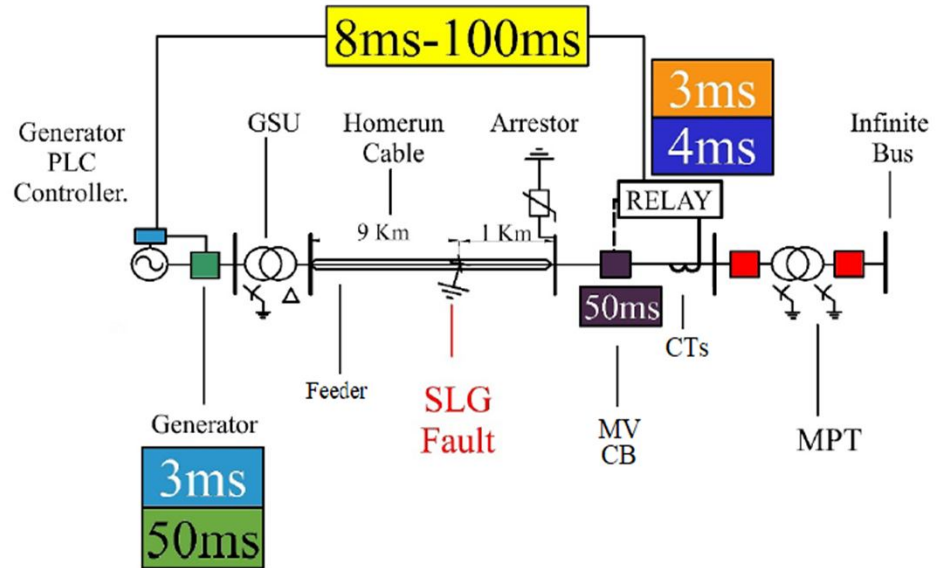
Time and Topology



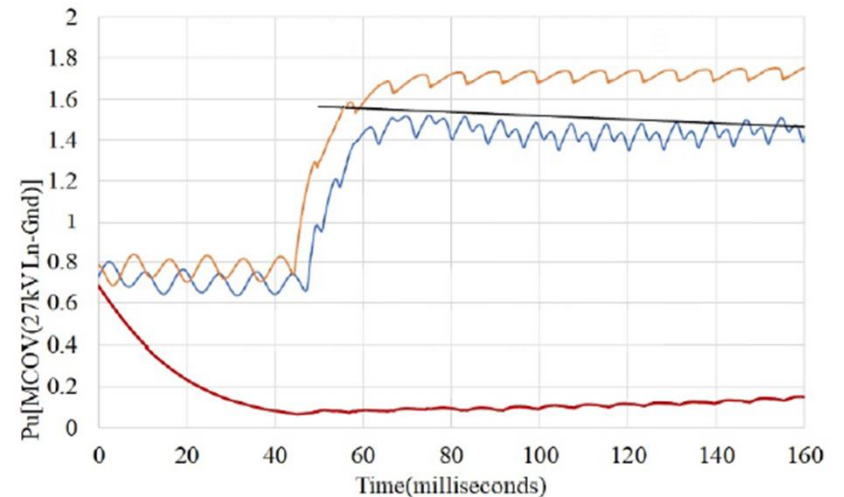
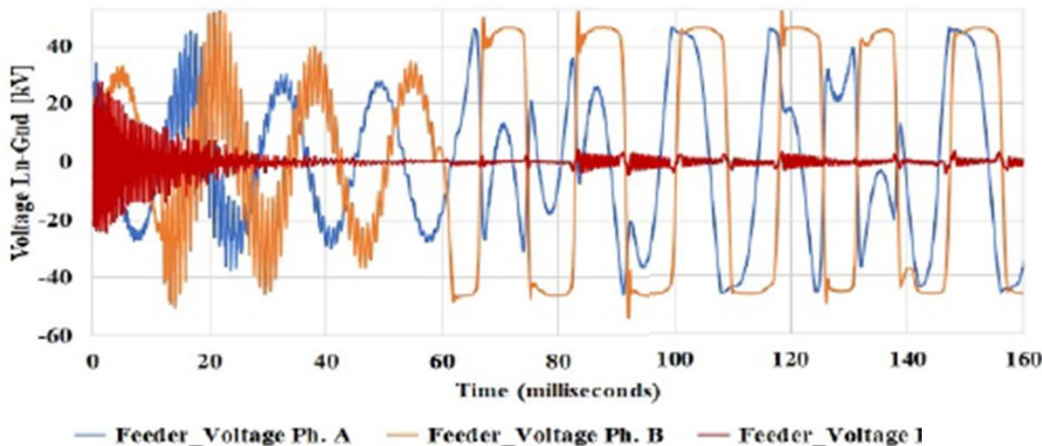
SIMULATION (a) - SINGLE LINE TO GROUND FAULT (SLG) WITH TRANSFER TRIP



Feeder CB opened first than all WTG CB causes islanding and TOV.

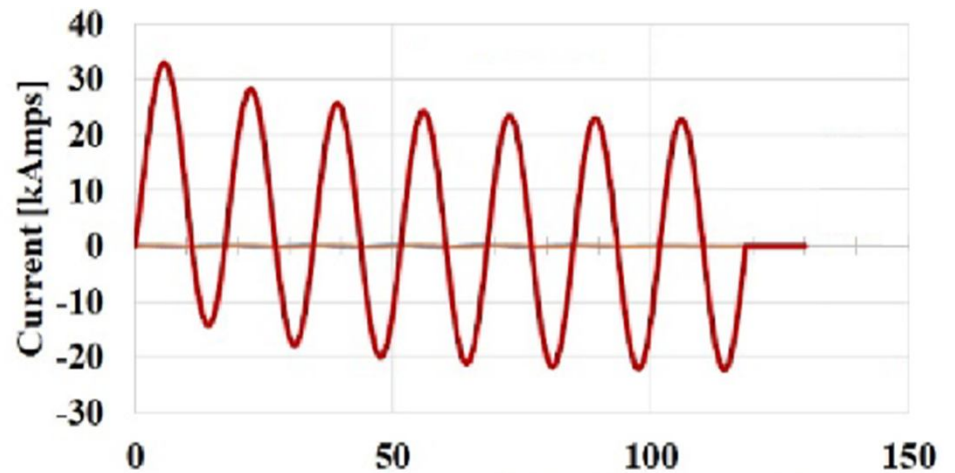
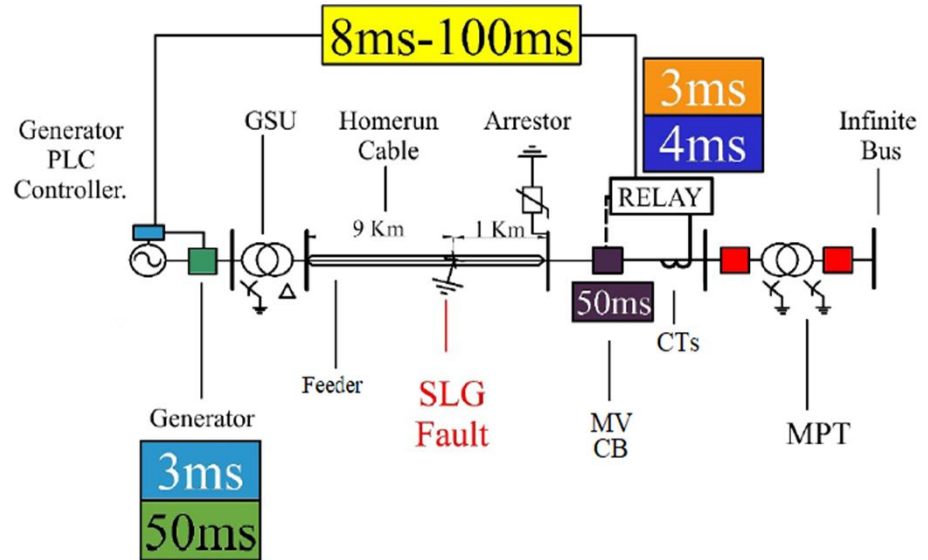
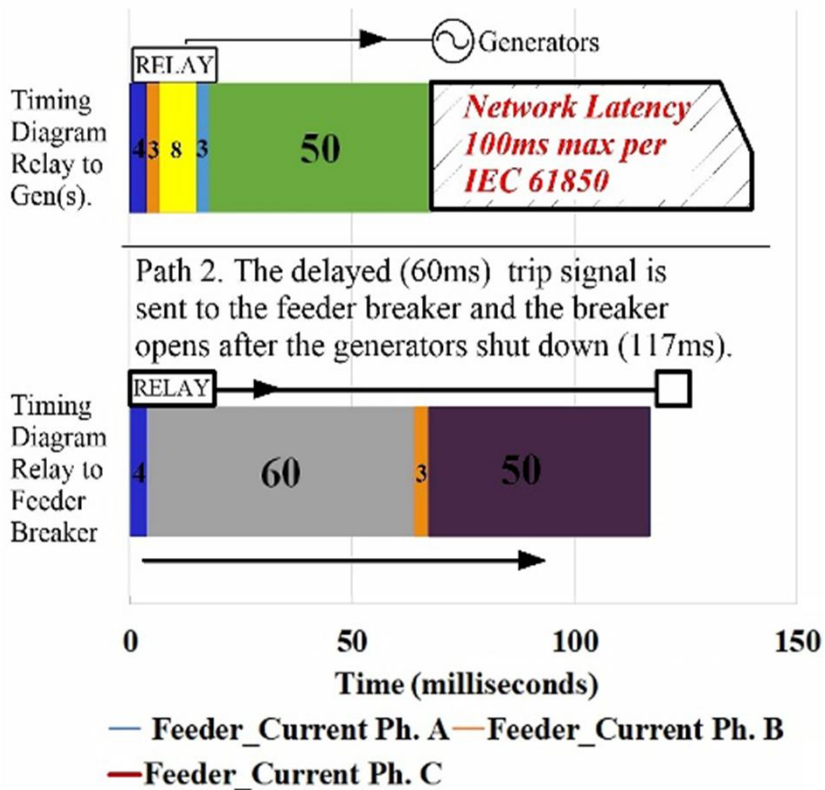


Severe islanding combined with the latency of the transfer trip command causes TOV on the separated feeders and surge arrestors are damaged.



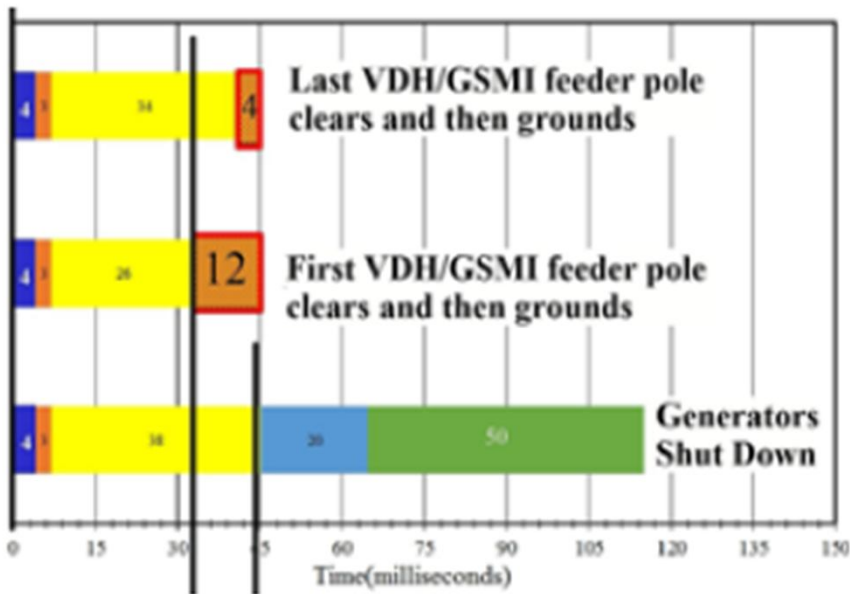
SIMULATION (b) - SINGLE LINE TO GROUND FAULT (SLG) WITH TRANSFER TRIP

Adding delay increases incident energy and in case feeder CB and WTGs CB do not match at the opening time, feeder is also exposed to TOV.

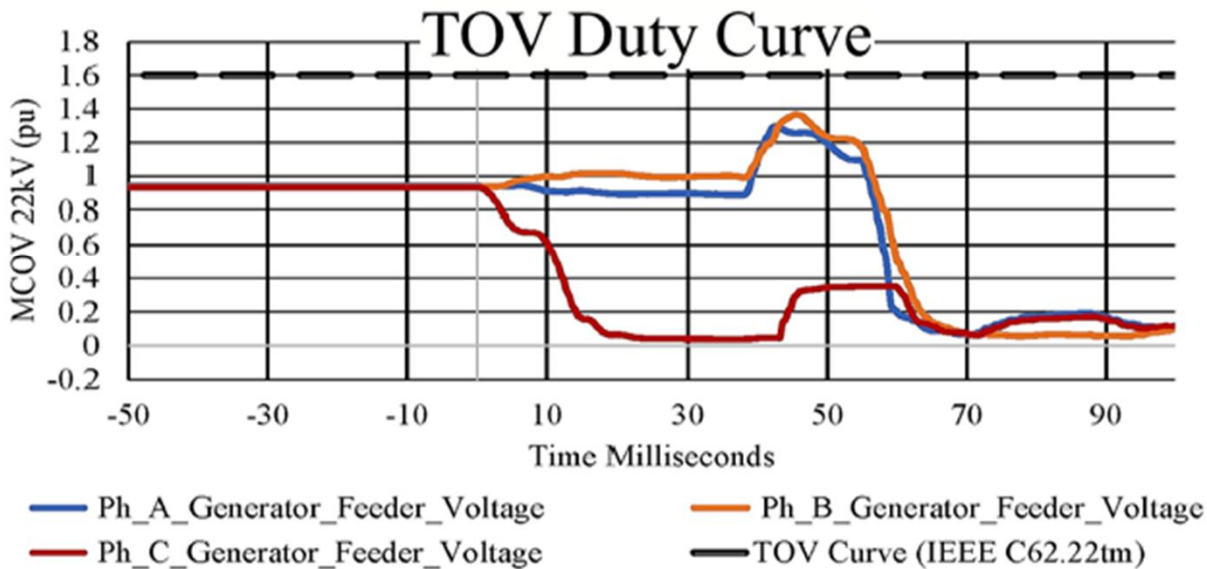
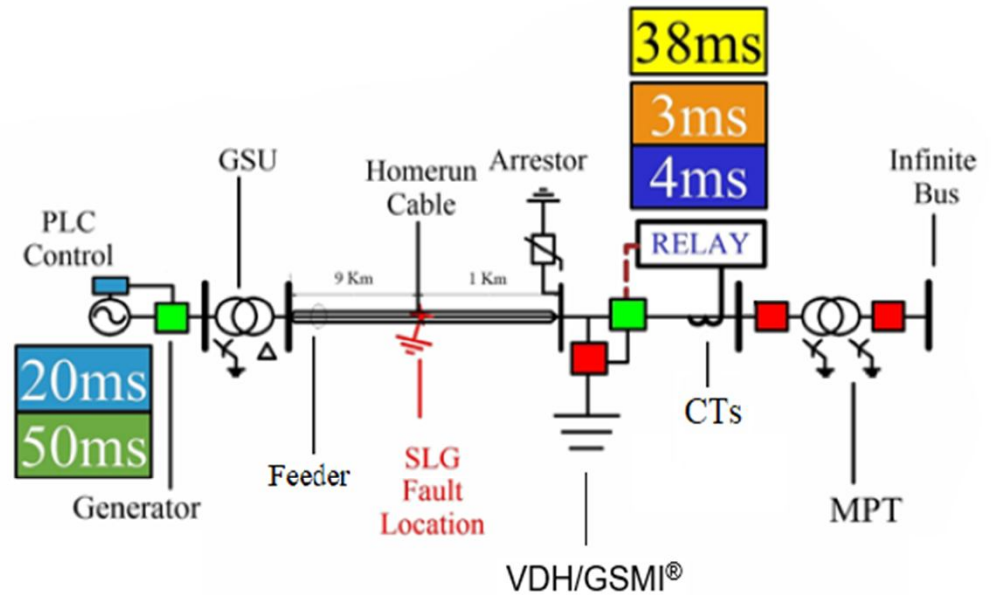


7 cycles or more to clear the fault from de grid, adding incident energy, arc flash and arc blast which could be fatal for personnel.

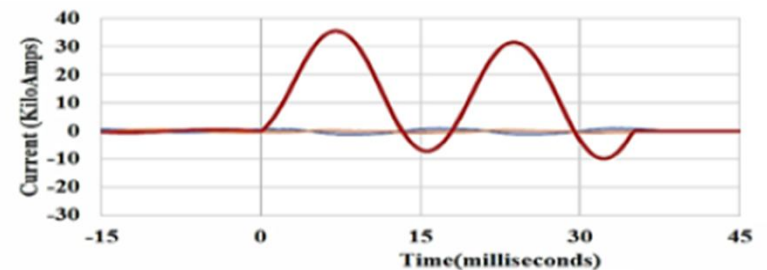
VDH/GSMI® SIMULATION - SINGLE LINE TO GROUND FAULT (SLG)



The VDH/GSMI prevents TOV and acts quickly to collapse the voltage on the grounded feeder.



The VDH/GSMI minimizes incident energy acts quickly to clear the fault from the grid and the feeder.



CONCLUSIONS

- **Transfer Trip does not ensure a perfect synchronization** between the feeder breaker and the Generators breakers, because of the latency on the communication system.
- Once the breakers synchronization is not a possible solution, there is **a high probability that the feeder breaker opens first and one or more Generators remain connected** for a couple of cycles, feeding the faulted MV collection circuit and creating TOV on it.
- The VDH/GSMI protects solar / wind power plants by **reducing incident energy and eliminating TOV.**
- The continues **exposure of the MV collection circuit to TOV may causes damage**, such as the **aging of the of surge arrestors**. The aging **changes the I-V characteristics of the surge arrestors**, becoming an open circuit or destroying it.
- Elimination of TOV is an important feature of the VDH/GSMI. When TOV, the lightning **arrestors are operated below their prior duty curve, insulation coordination of the feeder circuit is maintained**, and the equipment is more reliable.
- **Anti-island functionality** is an important advantage of the VDH/GSMI.
- **VDH/GSMI overcomes such problems** to provide superior protection compared with Transfer Trip.
- VDH/GSMI constitutes **a best practice concerning protection of personnel and equipment that work with collection feeder circuits** within wind / solar power plants.
- When the **collection circuit is grounded, the voltage at the mains of the generator is low enough, working this as a fast and clear signal** to the generators to go offline.
- The VDH/GSMI clearly can protect and make it easier for engineers to perform an **insulation coordination study and feel comfortable** about their assumptions.



*Medium Voltage Vacuum Circuit Breaker with
Mechanically Interlocked Grounding Switch
(VDH/GSMI) Provides Better Safety and Reliability
for Wind and Solar Power Plants and Their
Personnel than Remote Transfer Trip*

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VDH/GSMI Provides Better Reliability than Remote Transfer Trip, Page 1 of 29

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