



Very Fast Transient Overvoltages Mitigation System

Speed controlled Disconnecter

CONTEXT

Switching of Bus-charging currents are common operations in HV substations normally performed by the disconnectors (DS), it consists on the switching operation of an AC voltage source from an unloaded section of busbar and it causes several dielectric breakdowns to occur across the gap during the switching process.

These breakdowns produce the so called Very Fast Transient Overvoltages (VFTO) phenomena that travels towards all of the connected equipment. VFTOs are of special concern in UHV-Gas Insulated Substations because they reach voltages values close or higher than the rated Lightning Impulse Withstand Voltage putting the phase-to-earth insulation systems of the disconnector and adjacent equipment in jeopardy.

As VFTOs are proportional to the breakdown voltage across the disconnector, limiting its value will slightly limit VFTO peak voltage.

TECHNOLOGY DESCRIPTION

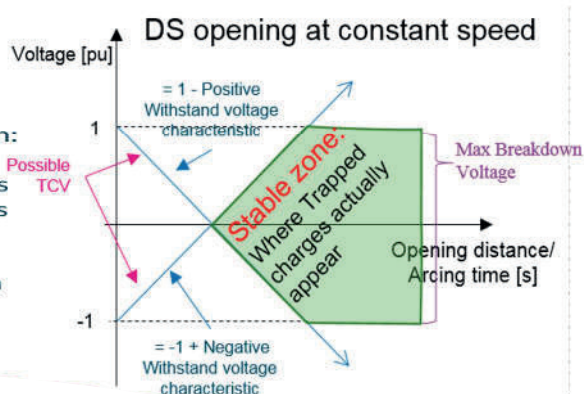
During a breaking operation, the last strike will leave a random trapped charge voltage (TCV) on the floating busbar section equals to the voltage on the AC source side at the moment of the breakdown. During the next making operation, the first breakdown will occur at the peak of the AC voltage leading to a breakdown voltage across the gas gap of $1 \text{ p.u.} + \text{TCV}$. Limiting TCV will reduce VFTO during making operations and limiting breakdown voltage will do the same during breaking operations.

From in-depth analysis of trapped charge behavior after opening processes during tests, it has been proven that TCV is proportional to the disconnector's opening speed and can be predicted from the characteristic Breakdown voltage vs gap length of the DS with a so called "stable zone". It corresponds to the relative position of arc contacts where TCVs are more likely to appear. If the disconnector stops at the beginning of this stable zone, TCV is minimized to its lower possible possible value.

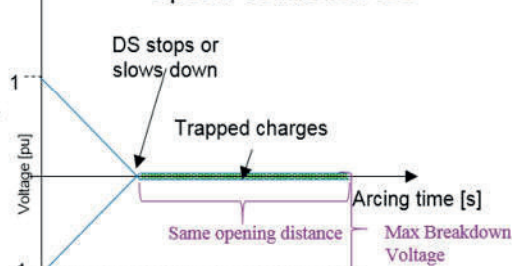
Principle illustration:

Breakdown Voltage vs intercontact distances

In green the trapped charge existence area



Speed controlled DS



Maximum Breakdown is strongly reduced
VFTO level is reduced

APPLICATION DOMAIN

UHV -AC Substations
Transients Overvoltage Protection
for Disconnectors

ADVANTAGES

As the only needed modification concerns the speed control of the disconnector, this solution is:

- *Cost-Effective
- *Easy to Implement
- *Fully compatible with existing GIS

TRL SCALE



Control strategy tested by EMTP-ATP simulations

DELIVERABLES

Patent WO2017 103355
Technical reports