NAME : Andrea VALANT, Dario POLINELLI (*), Francesco PALONE, Luca BUONO, Roberto SPEZIE
COUNTRY : Italy
REGISTRATION NUMBER : 7097

GROUP REF. : Group 3
PREF. SUBJECT : PS3 B2
QUESTION N° : 3.20

Pole-mounted Switchgears to increase HV tapped Line Resilience

This contribution describes a solution to increase resilience of a tapped HV overhead Line against extreme weather events.

Let us consider a user connected to an HV Line with a "T" junction; pole-mounted manually-operated disconnectors were usually installed across the junction to guarantee a faster power supply recovery. In case of fault, circuit breakers placed in the Substations at the ends open the Line, clearing the fault. Then, by operating the pole-mounted disconnector, the faulted branch can be excluded from the grid topology and the user supplied again from the other Line side.

The installation of disconnectors close to the junction improves the system resilience against harsh weather conditions in terms of system recovery time: in case of a "rigid" T junction, TSO operators would have to climb an anchoring tower close to the junction to its top, remove conductors' jumpers and exclude the faulted branch. These operations could be performed only when weather conditions allow a safe intervention. With pole-mounted manually-operated disconnectors, grid reconfiguration is faster: the operators only have to reach the disconnector command rods, usually at mid tower height, and easily accessible with pre-mounted ladders.

Paper B2-10776 presents a solution that, starting from the pole-mounted disconnector concept further improves the system resilience by mounting SF6 insulated equipment on HV transmission towers.

The solution, conceived and patented by the Italian TSO Terna under the name "Organo di Manovra su Palo – OMP" i.e. "Pole-Mounted Switchgears", detects automatically the fault condition and its location thanks to the Instrument transformers of the GIS equipment and a Telecommunication, Control and Protection System equivalent to those of HV Substations. Then, the circuit braker of the SF6 equipment clears the fault with no power supply interruption for the user. System resilience results to be highly improved, being only the faulted branch excluded from the grid and not the whole tapped Line.

Moving to the equipment, the use of SF6 insulation increases its resilience: all moving parts are shielded inside the gas tank, therefore, they are protected against snow and ice formations that could clog them as sometimes occurs with manual disconnectors. On top of that, SF6 equipment has a lower failure frequency compared to air-insulated equivalent.

To increase the resilience of the OMP LV power supply, the equipment and the Telecommunication, Control and Protection System are fed through an Inductive Power Transformer directly from the HV Line, hence for a Network that has a higher capability to withstand harsh weather conditions than LV and MV grids.

All LV circuits, the local control cubicle and the Telecommunication, Control and Protection System are mounted on the tower, starting from 3,5 m above the ground hence continuous and safe operation is guaranteed even if flooding occurs.

Concerning the tower, instead of installing the new equipment on cantilevers, a traditional "delta" shape trellis has been reviewed to allow the insertion of the GIS equipment inside the top hamper, in a more barycentric position.
The tower static design has been performed considering extra loads according to CEI EN 50341-2-13, although not being mandatory by the Italian law. In accordance with the standard, wind and ice loads with a 50-year return period and 3-year when considering the effects on the Line section have been introduced in the calculations. To quantify these loads IEC 80826 has also been consulted. Seismic calculation has been performed considering the heaviest seismic condition of the Italian territory (Zone 1) in combination with standard soil mechanical parameters. The OMP can therefore be installed in the majority of the Italian installation sites.
The combination of the overmentioned design criteria makes the OMP tower highly resilient from the static point of view.

Resilience against lighting has been pursued. An innovative grounding system with micropoles covered by a compound of marconite, bentonite and concrete pushes the ground resistance below 5 Ω. Back flashover overvoltages are avoided for 98% of lightning. HV surge arresters protect SF6 equipment and a combination of LV surge arresters, shielding cable ducts and reinforced insultations protects LV circuits and connected electronic devices in case of lightning.

The refurbishment of sectionalizing posts with pole-mounted SF6-insulated switchgears results to be a resilient solution in extreme weather conditions. On top of that, the installation of two OMPs across an overhead Line "T" junction provides a high level of operational flexibility, with a great soil reduction, an easy authorization process (according to the Italian law) and overall costs similar to that of two gas-insulated bays of a same voltage level traditional Substation.