Study Committee B2
Overhead lines
10776_2022

Refurbishment of sectionalizing posts on 245 kV towers for a reduced visual impact and an increased line resilience

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Motivation

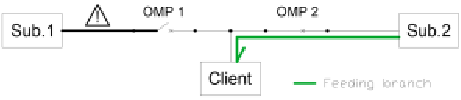
- Improve grid flexibility and resilience of existing HV "T" junctions
- Quickly connect new users and producers to the HV grid
- Automatically identify and cleare faults on tapped lines

From existing manual sectionalizing posts… … to pole-mounted SF6 insulated Circuit Breakers (OMP)

Discussion

Installation of 2 OMPs across a "T" junction guarantees continuity of supply to user both in case of maintenance and fault:

- ✓ Higher power supply quality and lower penalties for the TSO;
- ✓ Line maintenance schedule independent from user needs.

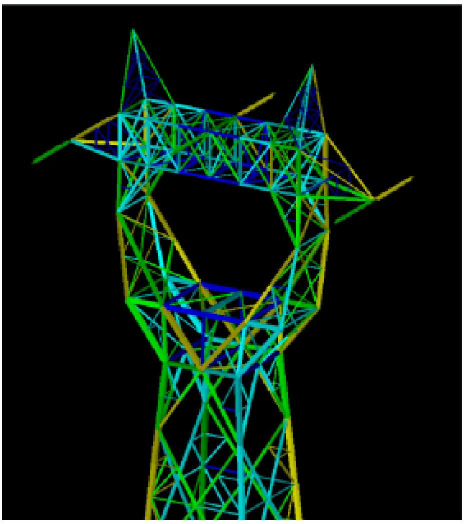


Objects of investigation & methods

- Trellis and GIS equipment design to fit clearing distances (CEI EN 50341-1, CEI EN 61936)
- Tower static calculation and design
- Lightning protection (CEI EN 62305-4, ITU-T K.97) and grounding (CEI EN 50522, CEI EN 61936)
- Vibrations and acoustic emission
- Telecommunication, Control and Protection System optimization
- Tools and procedures to face operator emergencies
- Camouflage for an environmentally friendly insertion in installation sites

Experimental setup

- 3D tower modelling and F.E.M. static calculations
- ATP-EMTP Transient lightning simulation
- PEEC SW grounding design and simulation
- GIS vibration and acoustic characterization
- 3D software sound pressure simulation
- Study of the environment dominant colors and camouflage definition



Conclusion

The OMP can support the Energy Transition:

- ✓ Grid flexibility and availability
- ✓ Quick connection of new RES to the HV Network

Meanwhile being:

- ✓ Resilient in extreme weather conditions
- ✓ Environmentally sustainable
- ✓ Compliant with National and International standards for OHL and electric power installations

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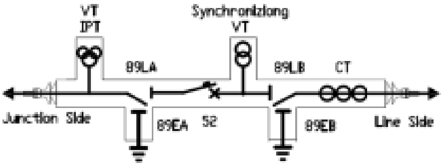
SF6 equipment line diagram definition and realization

- VT, CT, CB and the Telecommunication, Control and Protection System allow to auto-detect and clear line faults.



Acoustic and vibration dumping

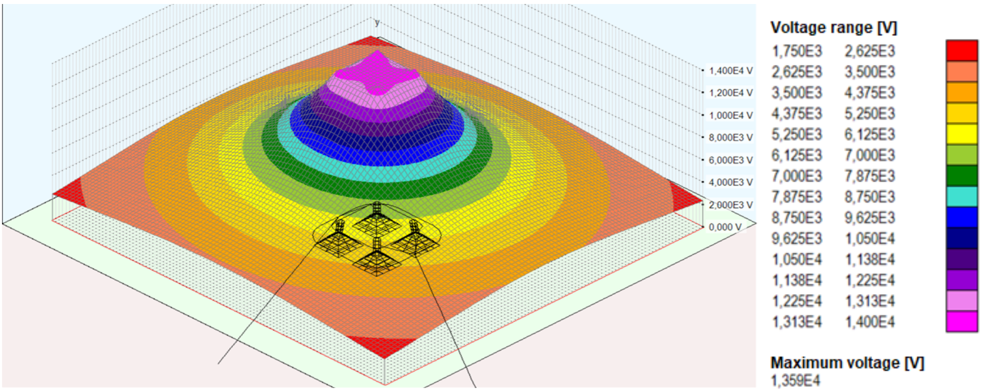
- SF6 equipment vibrations measured during O/C
- FFT identification of most important contributions
- Selection of dumping system and characteristics: tearproof, durable, 10 Hz natural frequency

Lightning transient overvoltages

- Protection against both lightning strike on the tower and on conductors (shieling failure)
- Inductive overvoltages on LV circuits calculated as from CEI EN 62305-4, ITU-T K.97 std.
- Tower and grounding system modelled for transient simulation on ATP-EMTP
- HV surge arresters (LAs) protect GIS equipment in case of shielding failure back-flashover
- Simulations proved lower overvoltages with direct connection of HV LAs to the tower
- LV circuits and connected electronic devices protected through LV LAs, reinforced cables insulations, double-end shields grounding, shielding effect of cable metallic ducts.

Grounding system

- Equipment installation requires grounding system according to CEI EN 50522 std
- Touch voltage requirements dictate the grounding system design due to high short circuit currents
- 5 Ω grounding resistance obtained with micropoles covered by a compound of marconite, bentonite and concrete
- Micropoles and a superficial insulating layer guarantee touch voltages lower than 220 V (permissible touch voltage with 0.5 s fault clearing time) with a 2,8 kA short circuit current.



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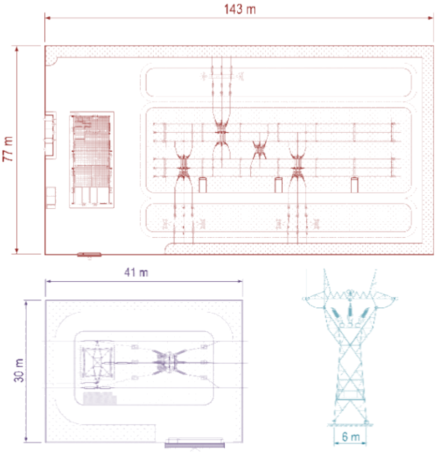
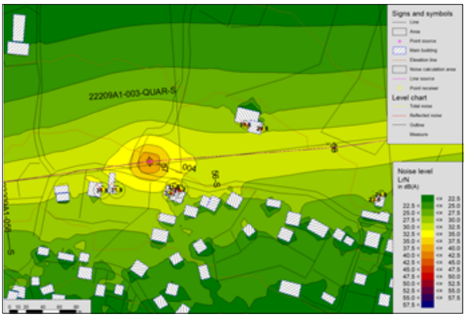
Environment

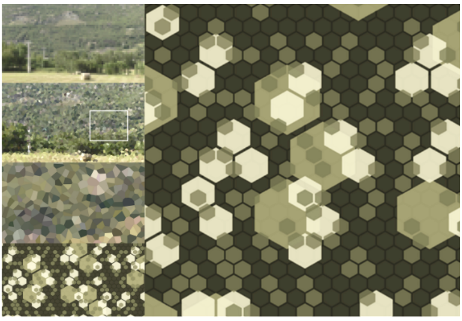
- ✓ 2x36 m^2 soil occupation vs 11.000 m^2 of a standard 245 kV double busbar substation.
- ✓ -97% vs ground-mounted SF6 equipment.



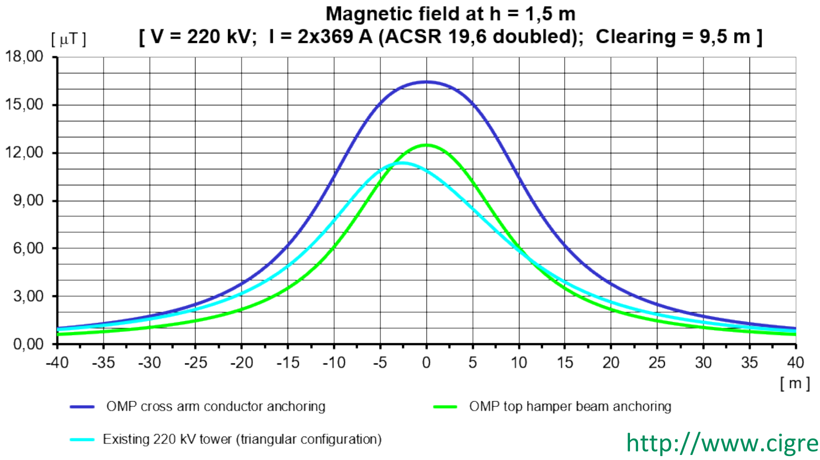
- ✓ Acoustic 3D simulation proved the respect of Italian law limits.



- ✓ Smooth visual insertion obtained from background color studies and camouflage of planar surfaces.



- ✓ External conductors anchored to the top hamper beam reduce magnetic fields generated by the OMP to values close to traditional triangular configuration HV tower.



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