Cable installation in mountainous areas, example of a successful installation and service

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ABSTRACT

In the well known touristical area of Carinthia in Austria, near Mühldorf a hydro power plant was extended (Reisseck II).

As the energy generating turbine is situated on the mountain site at a level of ~1600 m above ground, produced energy has to be transmitted downwards to the bottom of the valley, where a substation is distributing the power to the Austrian distribution network.

The mountainous site gave rise a lot of challenges for the installation of a HV cable system, which were successfully solved and are described within this paper.

KEYWORDS

hydro power, high slope, HV cable system, hydro power transmission

INTRODUCTION

Hydro power plants are usually built in mountainous and remote areas, where the natural water resources are used to generate energy. Often the transmission of the generated energy is difficult, no matter if overhead lines or cables are considered.

Due to the increasing ratio of regenerative energy on the energy mix, coming from wind farms and solar plants, pumped storage hydropower gains more and more importance as it is needed to level out the inconstancy of the renewables by storing energy.

If the location of a hydro power plant is also an area of touristic interest, the impact of the transmission system has to be minimized to reduce the economic effects for the tourism and to increase the acceptance of the population.

This has also been the case for the expansion of the pumped-storage hydropower plant Reisseck II in Austria. Two turbine segments in a new cavern were added resulting in energy of 480 MVA that has to be transmitted to the substation in the valley.

In the following text the measures that have to been taken to design and install such a cable system are described.

CABLE ROUTE

Starting from the cavern it was planned to lead the cable through an energy distribution tunnel towards the valley with a slope of up to 48 °(= 107 %) as shown in Fig. 1.

After leaving the tunnel the cable route had to pass several hindrances, a huge rock, the serpentine construction route which serves also the construction sites for the cavern, the switch gear and the turbines and a train track of the Austrian Railway.

TECHNICAL CONSIDERATIONS

To find an optimal cable route the following aspects have to be taken into account:

- cable laying
- transportation
- joint bays and positions
- thermomechanical aspects
- magnetic field emission
- environmental aspects

The standard cable trench was carried out in concrete troughs.
Due to the high slopes of the route, the cable laying had to be done in situ, meaning that after pulling of the cable the final position of the cable had to be attained and no further positioning would be possible.

The only way to succeed this was by lowering each cable section separately towards the valley. For the laying process the accessibility of the cable route was important. From the construction routes where the cable drums could be transported to cable reels had to be laid out and special construction scaffolds to lead the cable directly into the troughs.

The thermo-mechanical effects caused by the load of the cable in service had to be considered. Hence the cable was fixed applying a vertical snaking. This snaking had to be obtained during the lowering of the cable. Additional to this the forces had to be levelled out in the joint positions.
Usually the joint positions are resulting from the electrical design of the circuit as the cable losses should be reduced by a cross-bonding system. In this case since the terrain is also passing routes, rocks and the railway tracks additional considerations had to be done to comply with the electrical, the geological and the thermo-mechanical aspects of the cable route.
The joint bays were implemented in concrete manholes, one of the joints is installed in a gallery under a new built serpentine construction route.

An additional aspect was the reduction of the magnetic field emission. The required value was 10µT in the areas