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Experience with 2nd generation gas-insulated transmission lines GIL

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The Gas-insulated Transmission Lines (GIL) of the second generation are now in services since more than 2 years, with very good service experiences. The 2nd generation GIL is insulated with N_2/SF_6 gas mixtures and the design and laying technique is primary dedicated to long distance transmission lines.

The N_2/SF_6 gas mixtures are used since many years in extreme low temperature regions around the world with very positive experiences. The design criteria for the gas mixture to find an optimum between gas pressure, dimensioning and N_2/SF_6 mixture percentages.

In this paper the focus is given to the experiences made with the installation and laying of two projects: PALEXPO, Switzerland, and Sai Noi, Thailand.

PALEXPO is a typical future application where an existing 300 kV overhead line was replaced by an underground GIL laid in a tunnel to give space for expansion of a PALEXPO exhibition hall. The GIL in this case is only used for power transmission as part of an important overhead line connecting France with Switzerland.

The complete manufacturing, laying and on-site testing process has been carried out in the same way as it is planned to do with long distances GIL. The experiences in all steps of the process are very positive including the management of obstacles and unforeseen situations.

Sai Noi Substation in Thailand close to Bangkok is typical for the very high power transmission capability of the GIL with a rated current of 4000 A. At a rated voltage of 550 kV this allows a transmitted power of 3800 MVA with one three-phase system.

The extreme external conditions of very high ambient temperature, the extreme sun radiation and the high rated current of this important power supply line of Bangkok make this GIL application special. It shows that with the GIL technology high power rating can be transmitted reliable even under extreme conditions.

In both cases laying technologies were used which are developed to install long lengths of GIL lines at economical cost levels for high power ratings.

These laying techniques are derived from the oil and gas pipeline technology. The experience of oil and gas pipelines was used to improve the laying speed at the same time with keeping the quality level high. Especially for directly buried laid GIL the situation of laying is very similar. A very positive experience was made with handling the cleanliness needed for high voltage systems. This was proven by the high voltage tests on site where no test failure was recorded. This success could also be demonstrated with partial discharge measurements (pd) based on the VHF method.

The paper gives examples of the key experiences for long distances applications and shows future possibilities where GIL is the best technical solution. New applications of GIL as a high power transmission line used together with public accessible tunnels like train or street tunnels will be explained. Also the application of special energy tunnels over long distances will be explained.