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Future Needs of High Power Transmission by Gas Insulated Transmission Line

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Abstract **—A new and latest technology used world-wide level from many decades, Known as Gas Insulated Transmission System. Normally air as an insulated medium used in overhead transmission line, but these line replaced by GITL. GITL as underground, directly buried, under tunnel connected lines in power system. In last 45 years of GITL history, it will know for high power transmission capabilities. In world-wide level, very first time the GITL installed in Switzerland at Geneva airport and similarly at Bangkok, Thailand within substations. As the advancement of GITL, next generation of GITL installed over a very long distances as good alternative of overhead transmission line. In second generation many countries adopted gas insulated transmission line technology like China, Germany etc. This paper discuss with how GITL technology fulfill the future needs of high power transmission.**

Keywords-component; GIS: **Gas Insulated Substations,** ***GITL: Gas Insulated Transmission Line,***

INTRODUCTION

Last 45 years' experience of first-generation gas-insulated technology is an excellent basis for using GIL as a high-power transmission system underground. The gas-insulated technology was introduced to substations in the late 1960s and is widely used today with high reliability. The introduction of second-generation GIL in 2001 using N2/SF6 gas mixtures and pipeline laying methods to reduce costs makes the GIL a long-distance, high-power underground transmission system with high reliability and availability for the future [1].

GITL system adopted by world wide, change the real scenario of high voltage overhead transmission lines. GITL many merits for high capacity power transmission lines as;

I. Small Transmission Losses

As GITL having larger cross-section area of conductor and enclosure, then the resistive losses are low. Normally resistance of GIL are 6–8 m/km depend upon the outer diameter of enclosure (500.00 mm or 600.00 mm) and the thickness of wall of the enclosure and conductor pipe (6.0 mm to 15.0 mm). The losses on transmission line are proportional to the square of the transmitted current as $P_v = I^2 \cdot R$ (i.e. I = current, R = resistance). As high current rating such as 3000 amps –this will affect high transmission losses. The very small losses takes place in the insulating gas[2].

II. Very Low Capacitive Load

As the lengths are not too much long and the electric phase-angle compensation is only needed at very long lengths, so the capacity of the Gas Insulated Line is low, Normally 55 µF/km. Therefore, there are no or low compensation coils are required under most network conditions for transmission lengths of approximately 100 km. This will also decreases the thermal operation losses.

III. Power Rating Like an Overhead Transmission Line

The GITL is the good alternative and supplement to overhead transmission lines. The higher capability power transmission line of the GITL (which is up to 3000.0 MVA per system at 550.0 kV rated voltage) allowing to go directly underground in series with an overhead transmission line without power depresses. The GITL also allows the use of protective system and advance control systems in the same way as with overhead transmission lines. Any differential protection is not required for failure location when a GITL is combined with overhead transmission lines. In the GITL, there are very low inrush current because it has a low capacitance[3].

IV. Highest Personnel Safety

As there are two pipes, outer enclosure pipe and inner pipe. The outer enclosure pipes are solid grounded and no access to high-voltage parts, because of gas-tight enclosure. Guarantee of personnel safety is also in case the GITL, because it has to carry a short-circuit current of (50.0 , 63.0 or 80 kA up to 1.0 or 3.0 s). There are no external impact occurs on the surroundings even when an internal failure occurs and an arc developed between the enclosure and conductor pipes.

3.1. Electromagnetic Fields in GITL

From protection point of view, international regulations are require for electromagnetic field limitations to protect the public and the operational personnel. These rules and regulations may vary across regions and countries depending on their laws and regional regulations. As it seen worldwide level, that reduces the values and getting lower and the restrictions harder. In highly populated areas and countries these electromagnetic field requirements are defining the allowed design of transmission lines. The operation of GITL as a solid grounded installation and the closed inductive loop through the ground connection. The factor of coupling is about 95.0%. which means that two reverse current of superposition reduces the outside magnetic field by 95.0%, and only 5.0% of the magnetic field of the conductor current, which effective outside the GITL. Because of the low induction, the conductor current will induce a current in the enclosure of the same size and with phase shift of 180◦. Both the electromagnetic fields of superposition is close to zero. In the surrounding environment, magnetic field have limitation, Whenever needed very low magnetic field, this solid grounded GITL may fulfill that requirements. As a current rating near of 3000 A, A magnetic field of strength 1 µT can be reached within a few meters' distance (this is needed in some countries).

Whenever installation of the transmission line is near to residential areas, the advantage of a low magnetic field is important. For the sensitive instruments of airports, sensitive imagining systems of hospitals, or all kinds of sensitive electronic equipment in private or business use. For example in Italy, the electromagnetic field requirements for latest installations is low to the magnetic flux values of only 0.2 µT. The GITL can reach such a low values over a distance of a few meters whenever populated residential areas are involved[4].

V. Conclusion

This network change needs new solutions. Besides the existing technologies of overhead lines and solid insulated cables, the GIL offers an additional solution for high-power transmission. The GIL offers an opportunity to transmit large amounts of electrical energy over long distances directly buried, underground or installed in a tunnel.

In Europe, long-distance transmission lines are under development and planning. With the driver of renewable energy generation of large wind farms in the north and large solar power generation in the south of Europe and North Africa, the intercontinental level 5 is under development. Most of these long-distance transmission lines will be built as overhead lines because this is the lowest-cost solution. But in some densely populated areas or areas under environmental protection, underground solutions are necessary. The GIL offers an alternative solution for these high voltages and current ratings [6, 7].

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