5 Conclusion & Recommendation

There are no voltage fluctuations are observed (with respect to neutral point) in the 33KV bus at the grounding transformer. In the Auxiliary winding however there are some fluctuations of voltages in the event of an earth fault. General theory of transformers does not explain this directly. At an earth fault a current (fault current) is injected from the neutral point of the zigzag winding and this current produces the voltage fluctuations in the auxiliary winding.

The total fault current to earth divides up when reaching the earthing transformer (ZigZag winding) neutral point into approximately equal parts in each phase. The current distribution under fault conditions, assuming equal currents in all windings and it will be seen that the currents in the halves of the windings on the same limb flow in opposite directions in equal magnitude so that they introduce no choking effect, thus permitting a free flow of current from the earthing transformer neutral to each line wire.

It is expected to cancels out the flux on the each limb as the current in the halves of the windings on the limb flows in equal and opposite. But it is not further valid if the two halves of the windings on the same limb are not arranged in identical manner. That is due to the fact that the magnitude of the flux on the limb is depending on the distance from the core to the centre of the winding. Based on this, it can be concluded that the winding arrangement in the existing earthing and auxiliary transformer would produce an additional single-phase magnetic flux in each limb at an earth fault

As the solutions to the problem, the following proposals can be recommended.

1. Splitting of existing Grounding Transformer
2. Re-arrangement of Windings in the Grounding Transformer
3. Proposals for Earthing and Auxiliary Transformer Tests

5.1 Splitting of Grounding Transformer

As this report explained there are two main functions integrated to the particular grounding transformer. The main function is grounding the 33kV side of the GSS and the other is the providing the auxiliary and control supply for the GSS. This integration of these two functions has created a negative impact on the auxiliary and control supply. The influence of the fault current in the zigzag winding has caused voltage fluctuation problem in the auxiliary supply. As a solution it can be proposed to split the functions, and use two separate transformers for grounding and auxiliary supply. Then there will be no influence on the auxiliary supply what ever the winding arrangement in earthing transformer since it is totally isolated from the core of the earthing transformer.

5.2 Re-arrangement of Windings in the Grounding Transformer

As explained in previous chapters, the net additional flux in the core at an earth fault is due to non-identical sections of zigzag winding and the influence of the leakage fluxes. If it is possible to re-arrange the windings of the two halves of the zigzag winding in such a way that the above two factors are eliminated there will be no problem of surges in auxiliary and control supply. Therefore, in the process of designing the earthing and auxiliary transformer, it important to consider this additional fact of "Elimination of non-identical halves of windings" for zigzag arrangement

5.3 Proposals for Earthing and Auxiliary Transformer tests

The existing test procedures do not test the earthing and auxiliary transformers for full functionality, most importantly the output of the auxiliary winding in extreme cases like earth fault, which is common in the GSS environment. Especially the earthing transformers should be type tested under earth fault conditions as the transformer gets fully functioned only under a neutral current injection. Proper test procedures have been proposed in this report to identify the mal-functionality of the transformer before connecting to the GSS.

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