Fault Characteristic of a Power Transformer in Bangladesh Power Grid

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***Abstract*—Faults in an electric power system hinder the sustainability and longevity of power system components. Protective devices should be well coordinated for rapid removal of fault. Transformers are expensive and critical equipment and requires full-fledge protection to ensure operational reliability. Grid transformer failure may result in a brownout of an area. This paper focuses on a power transformer fault that occurred in the Bangladesh power grid, analyses characteristics of the fault, and suggests modifications to the existing protection scheme.**

Keywords– Fault characteristic, Transformer protection, Fault analysis.

I. INTRODUCTION

Power transformers are considered as one of the most vital components in a grid substation [1]. They play a fundamental role in electrical power systems, in addition to representing significant investments involved in the implementation of these systems. Transformer failures are sometimes catastrophic and usually results in irreversible internal damage [2]. This is heavy-duty equipment which substitution is expensive and involves a lengthy process [3]. Research and development of new technologies, new predictive maintenance techniques and condition based monitoring have greatly contributed to reduce unscheduled, thereby ensuring improved reliability of energy supply [4]. Several studies highlight the importance of optimizing maintenance processes and diagnoses of substation equipment such as transformers [5]. To reduce the costs associated with a transformer's life cycle and to guarantee its reliability and durability, it is essential to monitor its operating conditions, its insulation system, and the working conditions of its accessories and other components [6].

In this context, the purpose of the research presented in the paper is to study and analyse the detail characteristic of a fault that occurred in a 132/33 kV, 80/120 MVA mineral oil immersed power transformer at Khulshi grid substation in Chottogram.

We have also analysed the existing protection scheme that slows down the removal of fault and the possible solution. Figure 1 shows the two transformers, Tr-1 and Tr-2, that are operating in parallel to serve the load at the at Khulshi grid. Both the transformers have the same vector group of Dyn1. The fault is being studied in this research occurred in the vicinity of Tr-1 transformer.

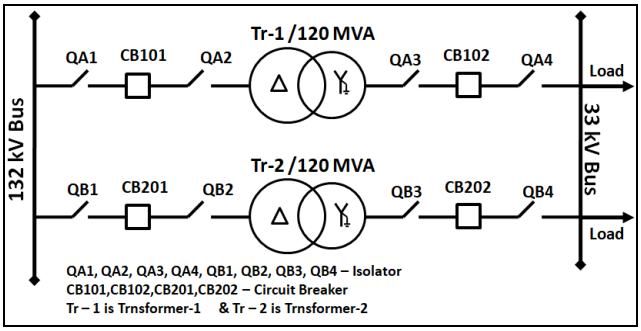

Fig. 1. Parallel operation of transformer at Khulshi grid substation

This paper is organized as follows: Fault characteristics analysis is given in section II whereas the introductory information is given in section I. In section III, Improved protection scheme is discussed. The total research work is concluded in section IV.

II. FAULT CHARACTERISTICS ANALYSIS

Comprehensive analysis of fault characteristics is performed in several steps to dig out what really happened.

A. Identification of Phase to Phase Fault

Figure 2 shows 132 kV and 33 kV phase currents of Tr-1 transformer right after the fault happened. The maximum fault current was 9.03 kA. Figure 2 is collected from Micom P643 numerical protective relay installed at site, which has an integrated disturbance recorder. As soon as a fault occurs, the disturbance recorder is triggered to record the current waves. In this case, the disturbance recorder is connected only with the bushing current transformers (CTs) of both sides of Tr-1 transformer.

Figure 3 shows the current waves of 132 kV phase-A and 33 kV phase-A and C. From Figs. 2 and 3 we observe that phase-C current waves on 132 kV and 33 kV sides of Tr-1 transformer is exactly opposite to each other for about 54 ms. It implies that, the fault current is going into the primary side (132 kV side) and going out from secondary side (33 kV side) during the period. We also observe from Fig. 3 that current waves of phases -A and -C on the 33 kV side of Tr-1 transformer is also exactly opposite to each other up to 54 ms.

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