Diagnosis of a Gassing Transformer using DGA

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INTRODUCTION

This paper present the detection and analysis of faults on the Leseding (**Leseding No1 Trfr Bay 400kV - 132kV - 22kV Trfr**). This paper should be used in conjunction with the presentation slides that will hand in with this paper.

1. DISSOLVED GAS ANALYSIS

1.1. Fault Detection

For fault detection of the transformer, the *key-gas* method and *individual & total dissolved key-gas concentration* method are used to detect if the transformer has faults. The conditions required to apply this aforementioned methods are detailed explained in the presentation slide.

1.2. Fault Analysis

Rogers ratio method and *Duval triangle* method are used to fully analyze the type of fault that is occurring inside the transformer and also shows the severity of the problem. These methods are not used for detecting faults thus they should only be used for analyzing the faults only if the existence of fault in the transformer has been detected by the detection methods aforementioned. Success criteria required to use this method has been stipulated in the presentation slides as well as how to apply them.

2. RESULTS

2.1. Fault Detection

It was challenging to detect the faults inside the transformer using the *key-gas* method. Since the method uses 4 charts to detect faults, all the charts plotted for every sample did not match any of the standard charts by the *key-gas* method.

Using *individual & total dissolved key-gas concentration* method, it was possible to detect for all the samples as either positive or negative. No fault was identified on the first sample. The 2nd sample until 8th sample showed that the transformer to be on condition 1 which shows that the transformer is operating satisfactorily but there were gas that were beyond their limits thus the method suggested that further investigation is done on those gases. The 9th and 10th

sample showed the transformer to be on condition 2 which shows that fault may be present since the total dissolve combustible (TDCG) exceed the specified limit, it also suggested that the individual gases exceeding their limits have further investigation as well.

2.2. Fault Analysis

All the rules required to perform the Rogers ratio analysis were applied correctly considering its requirements as well. The 1st sample was not tested since it was detected to be normal. The method showed the 2nd and 3rd samples to have no faults. The 4th until 10th samples were analyzed to be thermal faults with the temperatures of 150°C-300°C. The method further suggested that the problem is with the cellulose insulation, which will release CO_2 and CO.

Analyzing the Duval triangle method, the 2nd sample was not tested as it did meet the requirement of the method. The 3rd - 6th, 8th and 9th samples were found to be thermal faults within the temperatures of 300°C-700°C. The 7th and 10th samples were found to be thermal faults with temperatures greater than 700°C.

The ratio of the CO_2/CO was also used to check support the other methods. IEC 60599-2007 state that if the ratio is less than the value of 3 then there is excessive paper degradation due to the overheating of the conductor, it further states that if the overheating involves the oil, then the ratio will be greater than 10. The results shows CO_2/CO ratio of the 1st and 2nd samples to be 1.581 and 0.804 respectively. The 10th sample is found to have the ratio of 1.858.

The level of oxygen and the moisture reading were also studied. It was observed from the samples data that level of dissolved oxygen within the oil was decreasing as the samples were taken every 6 months. The level of moisture was found to increasing inside the transformer.

3. DISCUSSION AND ANALYSIS

Both the Rogers ratio and Duval triangle method diagnosed the transformer to be experiencing thermal fault, therefore it can be concluded that the transformer is under thermal stress. Since the thermal fault can occur on oil/cellulose the Rogers ratio method suggested that the faults are within the cellulose. This suggestion by the Rogers method tally with the result CO_2/CO ratio were it was observed that ratio only went below 3 in some samples and never went beyond 10 thus the using IEC 60599-2007 it shows that the fault is due to cellulose overheating caused by the overheating conductor. When the cellulose is overheated, it release hydroxide (OH^-) that combines with oxygen to form moisture. The level of oxygen was witnessed depreciating from the samples which moisture was increasing thus this shows the aforementioned behavior was taking place.

It has been proven that the presence of high concentration of dissolved oxygen within the oil halves the life of the cellulose insulation and that the level of oxygen should not exceed 3000ppm. The level of oxygen was exceeding the limit at the beginning, thus this oxygen actual increases the oxidation of the cellulose as well and speed up the aging of the cellulose insulation.

4. RECOMMENDATIONS

- The transformer can continue operation under exercised caution.
- The root cause of the problem should be found and eliminated
- The samples of the transformer for testing should be taken quarterly since the TDCG shows the system to be at condition 2 with TDCG generation rate (ppm/day) less 10.

5. CONCLUSION

Detection of the faults on the transformer was performed. After faults were detected, the analyzing of the faults was performed. The transformer was found to be experiencing thermal faults. It was recommended that the transformer continue service under exercised caution and increase the sampling frequency of the transformer.