NERC Lessons Learned

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Moisture Intrusion in Hermetically Sealed Metering Current Transformers

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Problem Statement

- Three 138kV metering CTs were retrieved from a long term outdoor utility storage and tested as per manufacturer guidelines
- All testing yielded satisfactory results and the CTs were placed back into service
- Oil samples were not taken from the units as it was advised against doing so in the manufacturer's manual
- After five weeks, a catastrophic failure at C-phase, interrupting the transmission service to the utility’s entire service territory
- Ten weeks later while awaiting the results A-phase CT experienced a failure, interrupting the transmission service of the entire service utility again

Figure 1: Three hermetically sealed oil-filled current transformers [1]

Details

- The initial oil and lab inspection revealed no concerns except for a higher moisture content above acceptable levels
- The root cause from the lab reports was analyzed to be the seal design that allowed moisture to enter the metering CT
- The design allowed moisture at the rim of the two sections of the tank to be pulled in by internal pressure changes caused by the daily cycling of temperature
- Over time, the atmospheric moisture contaminated the CT's kraft paper insulation
- The corrective measures included the design with a bolted gasket system and purchase of spare parts stored in a climate-controlled dry, indoor environment

Figure 2: C-phase CT failure [1]

Lessons Learned

- CTs may fail without warning and spare units must be on hand
- Spare units must be stored in temp/humidity controlled environment
- Moisture sampling is recommended prior to use - if advised against by the manufactures, contact them and ship back if needed
- Normal hi-pot testing in the field may not indicate a high moisture content
- A Doble test (insulation power factor) may provide a better indication of moisture if an original baseline test was performed for comparison later
- Perfect-looking metering data provided no early warning signs or guarantee of avoidance of catastrophic failure

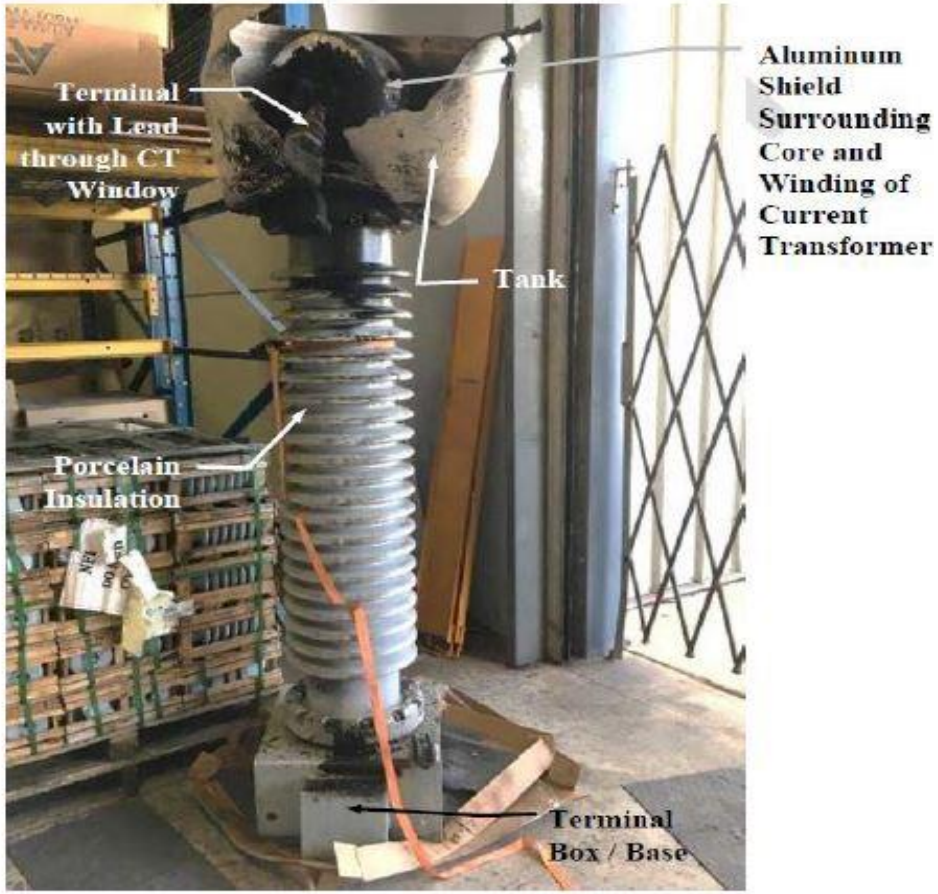

Figure 3: A labelled diagram of a failed CT [1]

References

1. Moisture Intrusion in Hermetically Sealed Metering Current Transformers

   https://www.nerc.com/pa/rrm/ea/Lessons%20Learned%20Document%20Library/20191201_Moisture_Intrusion_in_Hermetically_Sealed_Metering_CTs.pdf