CASE STUDY
DISTRIBUTION TRANSFORMER AND PD DETECTION

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INFORMAL RELIABILITY SURVEY

How old is your facility?
  Less than 5 years old?  10 years?  20 years?  Greater than 20 years?

Is your facility configured with single transformers supplying production critical loads?

Are your distribution transformers typically oil-filled or dry?
Which technologies does your facility use to determine health of your distribution transformers?

- Dissolved Gas Analysis of Oil
- Off-line insulation quality measurements
- Infrared Scan
- On-line partial discharge detection
- Other?

Are you confident that someone in your facility understands the condition of your distribution transformers?
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1 MVA oil-filled transformer

2400 volt primary  480 volt secondary

Sole power supply for refinery Nitrogen production plant

Installation date August 2008

First indication of problem June 2010 in DGA
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JUNE 2010 DGA RESULTS
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JUNE 2010 DGA RESULTS
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#1 Suspect – Tap Changer
1. Electrical field service contractor was on-site for TAR
2. Took transformer off-line
3. Opened upper inspection port and found a loose tap changer connection that showed signs of overheating
4. Fixed connection and placed transformer back into service
5. Problem solved - We thought
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JUNE 2011 DGA RESULTS
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JUNE 2011 DGA RESULTS
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Tested a new technology (new to the refinery):

In-Service Partial Discharge Tester

Uses a High Frequency Current Transformer clamped around the tank ground connection to detect PD

Test setup took about 10 minutes at the transformer

Immediately detected a waveform indicating arcing, not PD
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Electrical field services contractor re-inspection two months later in October

Testing and a thorough visual inspection (included borescope) – nothing found

December DGA testing results were inconsistent
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DEC 2011 DGA RESULTS
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DEC 2011 DGA RESULTS

![Acetylene Graph]
However, PD tests immediately following the inspection clearly detected the problem.
Conversations with the manufacturer were un-productive. They were unfamiliar with field PD testing. The gas levels did not yet concern them.

Refinery personnel disagreed with them, and purchased a new transformer as an ‘insurance policy’.

No drop-in spare on site, and lead time a few months.
Subsequent DGA testing several months later also indicated the problem was still present.
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JUNE 2012 DGA RESULTS
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JUNE 2012 DGA RESULTS

Acetylene

Acetylene
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The new transformer arrived on site

A down-time window for the Nitrogen plant was a few months away.

The transformer was replaced and sent back to the manufacturer for autopsy and possible repair.
Factory Findings

“multiple core ground points created different potentials, resulting in arcing between the core and frame, and from core to core across its insulation”
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Black marks from arcing between outer loop of core and inside segment of U-frame
Black marks on the Insulation between the cores
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Black marks from arcing on the insulation paper between core loops
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Lessons Learned

Being newer does not guarantee a transformer’s health

No one else is as concerned about our equipment as we are

A robust transformer inspection program should include on-line Partial Discharge testing