

Transformer noise



February-22-2018

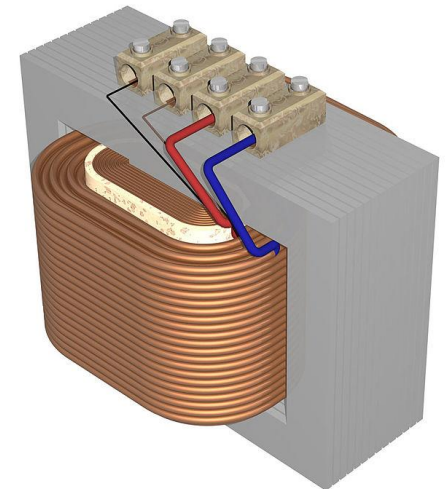
Rob Ross

Transformer noise



Ageing transformers produce noise

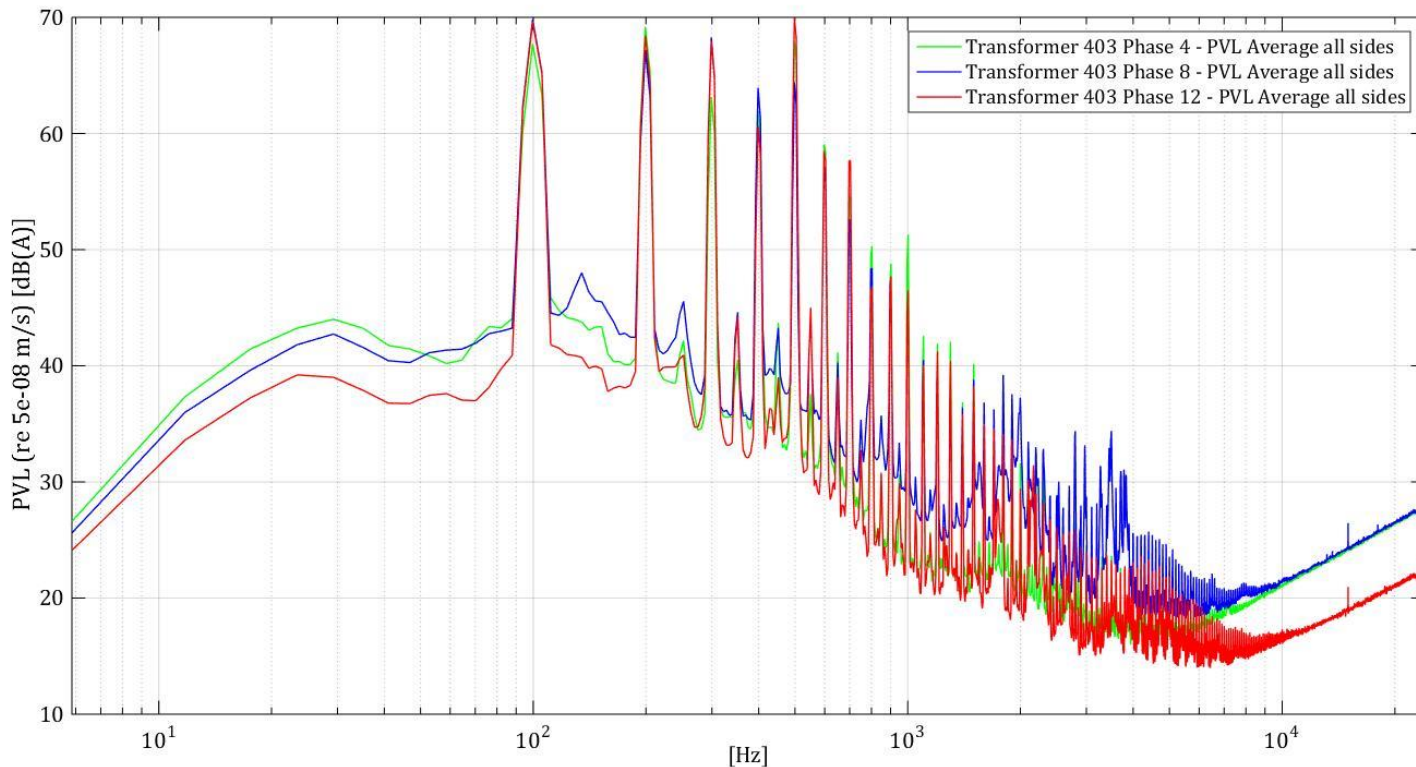
- 50 Hz current through copper conductors
- Magnetic flux 100 Hz + harmonics from core
- Magnetostriction and release cause noise
- External influence under investigation



How does the noise look like?



- Voltage and current both 50 Hz (i.e. 50x/sec plus and min)
- Current produces AC magnetic flux → AC contraction of lamellae pack
- Both maximum + or – current give maximum magnetic flux → 100 Hz
- Not a nice sine, but clipped signal → also harmonics 200, 300, .. Hz



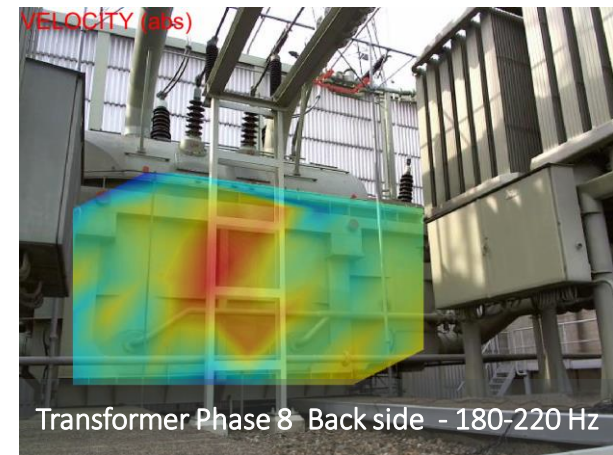
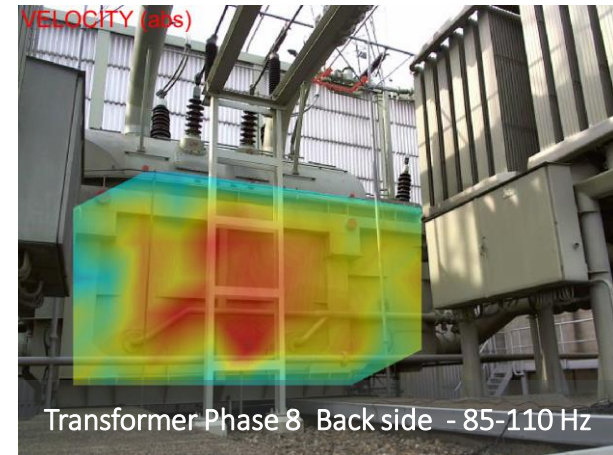
Why care?



What has been done so far?



- Investigation into Active Noise Reduction ('Anti noise'). Long way.
- Noise source imaging
- Investment decision for replacement finished
- Project started, but takes **3 years** to complete:
 - permits
 - trafo design & construction
 - substation design & reconstruction
- Meanwhile there is a call for a:
 - **Resolution for the years in between**
 - **Resolution for future cases**
- Half year monitoring and data collection for research to reduce noise



Purpose



Findings:

- Weak correlation with power flow and load on the transformers: power flow cannot explain the noise production
- Noise can increase considerably in hours or day without explanation
- Literature study indicates importance of voltage and current wave shape
- Half year monitoring of 250 Gb of data:
 - Noise of each transformer and compensation coil: spectra & intensity
 - Noise in community mixed with background (traffic, planes, ...): idem
 - Weather station: temperature, precipitation, wind speed and direction
 - Switching operations in nearby grid of potential DC/harmonic disturbance
 - Harmonic disturbance on the grid voltage

Purpose:

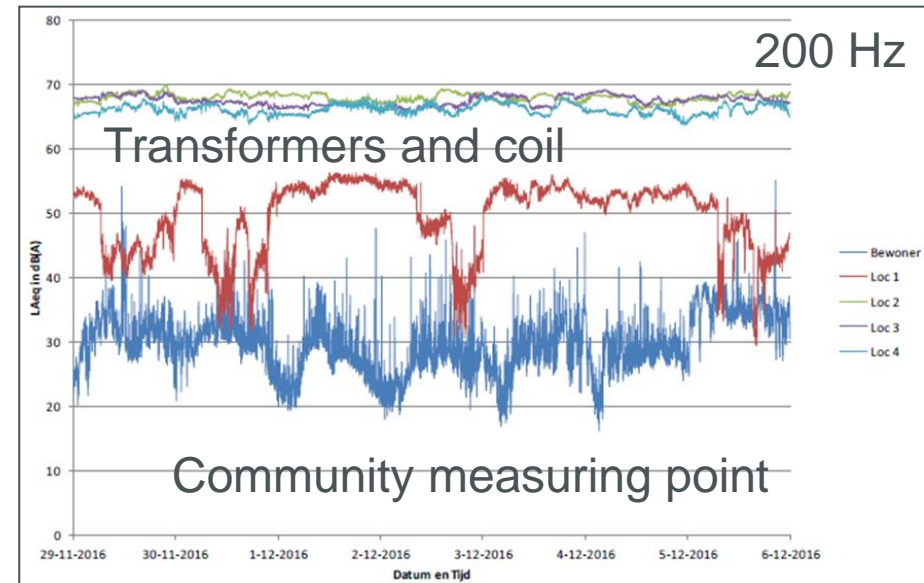
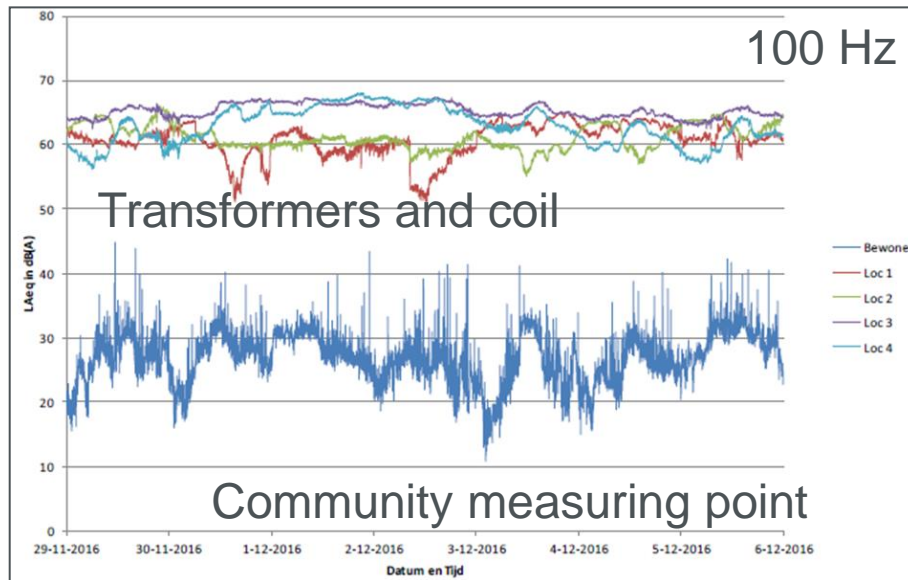
Correlations of community noise with transformer and coil noise

Correlations with external parameters that can help to reduce noise

Assignment



1. Discriminate transformer noise from background
 - a) Is that feasible? By shape, spectrum, envelop etc. (pulses often planes flying over, fire works, ...).
 - b) Alternatively select data when transformers dominate noise (night)



Assignment



2. Correlation with weather
 - a) Could influence noise transmission, reflection, production
 - b) Could influence interference pattern
3. Correlation with switching operations in nearby grid
 - a) Could trigger start of entering DC and increase of noise
 - b) Possibly accumulation with a certain delay
 - c) Specific sources would be targeted
4. Correlation with harmonic disturbance on grid voltage
 - a) Certain correlation with point 3 possible
 - b) More general voltage disturbance



16-11-2016	9:09:45	GI	SP401	VS	OFF
16-11-2016	9:10:37	GI	SP401	VS	IN
16-11-2016	9:11:02	GI	SP401	VS	OFF
16-11-2016	9:12:07	GI	SP401	VS	IN
16-11-2016	9:12:17	GI	SP401	VS	OFF
16-11-2016	9:12:38	GI	SP401	VS	IN
16-11-2016	9:12:52	GI	SP401	VS	OFF
16-11-2016	11:06:47	GI	SP401	VS	IN
16-11-2016	11:09:07	GI	SP401	VS	OFF
17-11-2016	0:15:55	GI	SP401	VS	IN
17-11-2016	5:41:23	GI	SP401	VS	OFF
19-11-2016	0:24:16	GI	SP401	VS	IN
19-11-2016	9:01:20	GI	SP401	VS	OFF
19-11-2016	22:09:52	GI	SP401	VS	IN
20-11-2016	8:34:25	GI	SP401	VS	OFF
21-11-2016	1:11:38	GI	SP401	VS	IN
21-11-2016	6:31:31	GI	SP401	VS	OFF
23-11-2016	23:16:40	GI	SP401	VS	IN

The final goal



1. Finding the clues for presently unexplained phenomena and enabling finding adequate mitigation.
2. Helping a community to regain undisturbed night rest even before the replacement project is finished.
3. Be prepared how to handle likely future incidents, because transformers will age and will produce noise at some point.

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