Amorphous distribution transformers trial test campaign

ERDF - EDF R&D – EnBW project

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- ERDF considers reducing no-load losses thanks to AMDT.

- Aim of the study :

  To perform investigations on prototypes for evaluating the technology for 3-phase needs according to ERDF / EnBW requirements (short-circuit withstand, dimensionning, TOC approach ...)

A trial test campaign of prototypes will be the study outcome.

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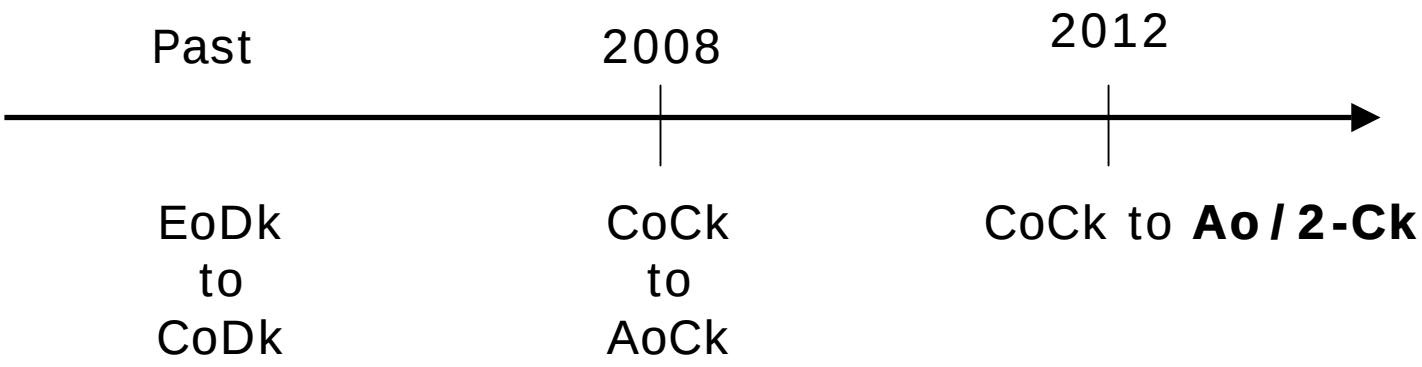
- Brief historical or losses reduction at EDF/ERDF



- 2006 : ERDF incentive to investigate in AMDT
- 2009 : First AM prototypes to be tested
- 2010 : First units in operation on French distribution grid

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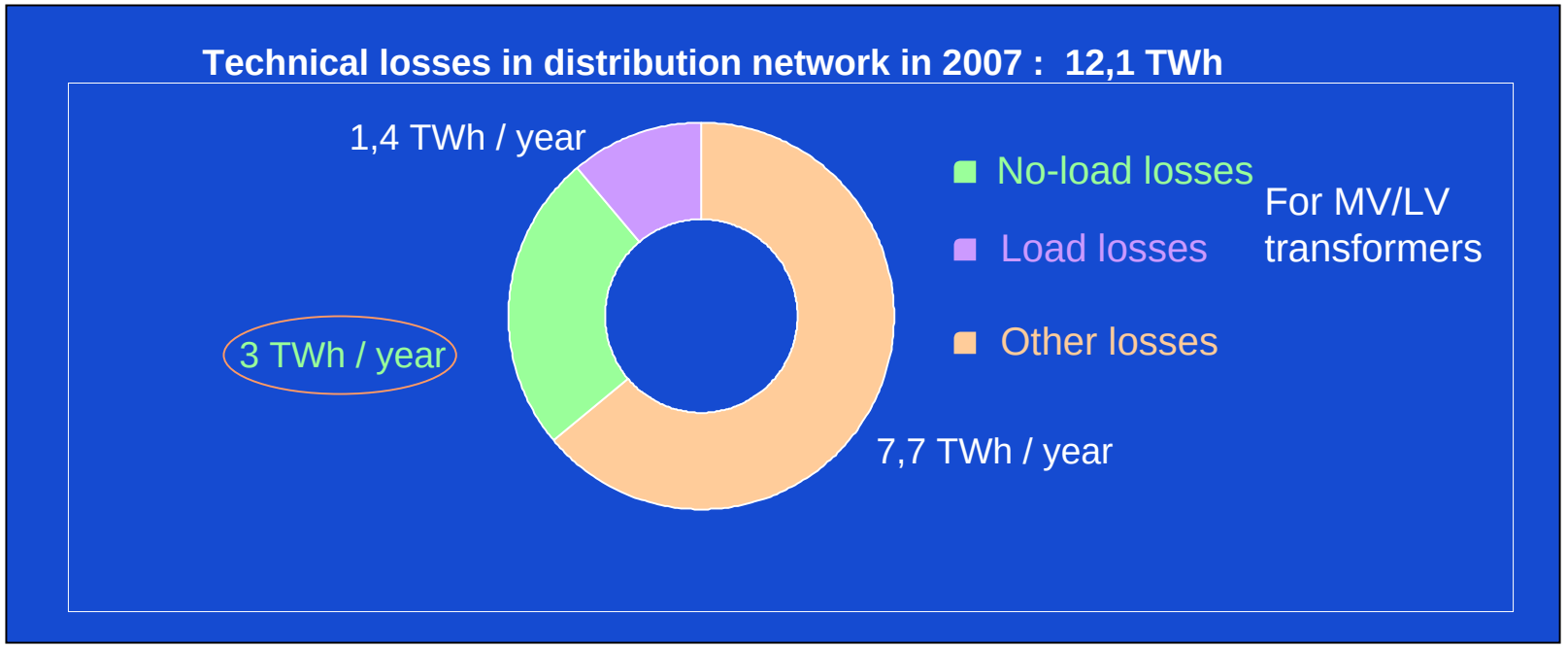
- French network losses overview



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- AMDT well-known for low no-load losses level
- On-going investigations with 20 units
- A PhD Program in progress with ENS Cachan
- ERDF Subsidiary of EDF in charge of the French Distribution Grid.

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- First 3-phase AMDT prototypes (20kV / 410V)

Rated power	250 kVA	400 kVA
Noise level	C_0 (55 dBA)	C_0 (58 dBA)
P_0 (W)	$A_0/2$ (150 W)	$A_0/2$ (210 W)
P_K (W)	C_K (3250 W)	C_K (4600 W)
Weight (kg)	1500	2500

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- ERDF and EnBW requirements

ERDF	EnBW
Ao/2 - Ck – Co Po – Pk - Lwa	Ao/2 – Bk – Bo Po – Pk - Lwa
Spec HN 52 –S-27 +Amendment	

- A weight limit may be reached for the 630 kVA and above

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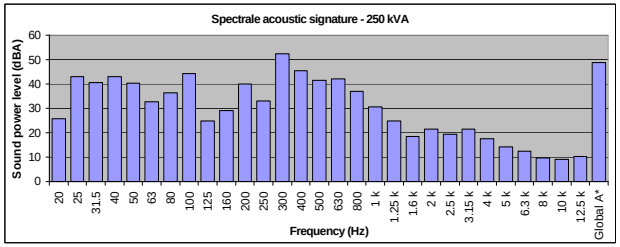
Example of spectral acoustic signature of AMDT

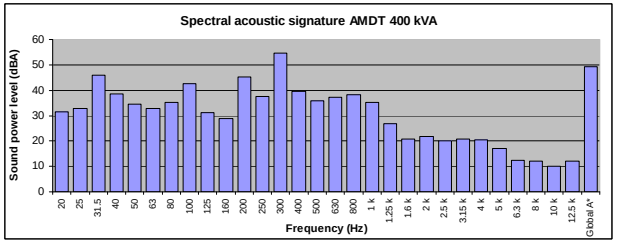
Acoustic signature : even if prototypes comply with the need a singular point is noticed at 300 and 500 Hz. (a question of resonance tank/core)

AMDT are satisfying with respect to the noise, Here 50 dBA (Bo) for a 400 kVA.

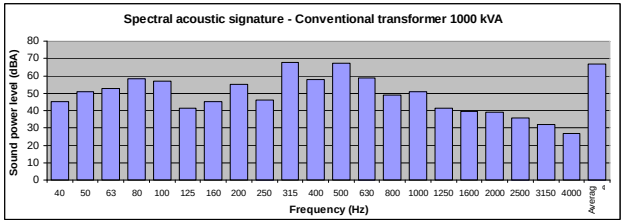
AMDT rated 250 kVA



AMDT rated 400 kVA



Conventional transformer rated 1000 kVA



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- Short circuit withstand tests

Manufacturers	Year	Rated power	Max. deviation on each phase (A/B/C)	Results after SC test
M1 – Tr1	1997	400 kVA	6 %	NS
M2 – Tr1	2008	400 kVA	0,2% / 0,5% / 0,5%	S
M3 – Tr1	2009	400 kVA	1,4% / 0,9% / 0,9%	S
M3 – Tr2	2009	630 kVA	1,8% / 3% / 2,3%	S
M4 – Tr1	2010	250 kVA	1,6% / 1,5% / 1,5%	S
M4 – Tr2	2010	400 kVA	4,5% / 5% / 6,5%	NS
M5 – Tr1	2009	400 kVA	5% / 4,6% / 2,9%	NS
M5 – Tr2	2010	400 kVA	5,9% / 2,5% / 2,9%	NS

- Brand new developments have shown promissing behaviors

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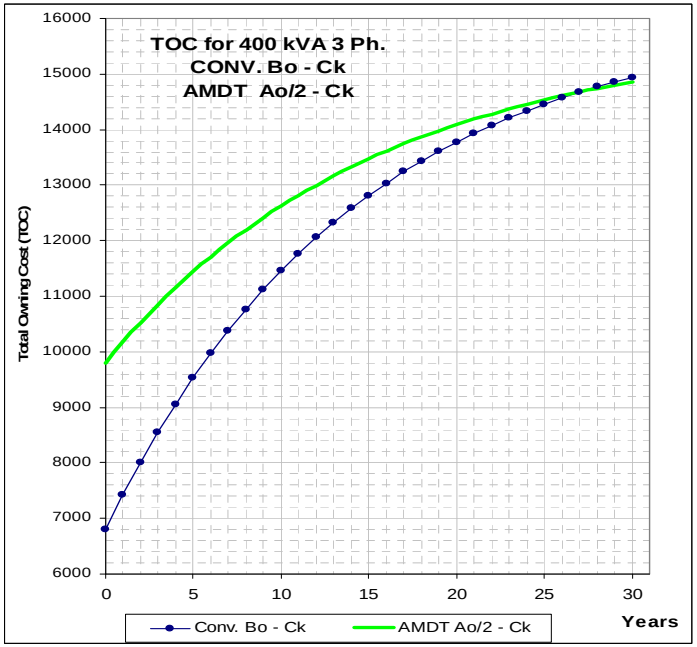
- Total Owning Cost evaluation

An example of economical compairison study between a 400 kVA Conv / AMDT

$$TOC = C_{purchage} + \sum_{0}^{n} (A \times P_o + B \times P_k) \times \frac{1}{(1+i)^n}$$

Costs capitalization of AMDT must be more competitive than conventional units.



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- Feed back – July 2010

2 first AMDT 400 kVA

installed on ERDF Grid

in Tissans Substation near Paris.

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Conclusions

With these experimental results, ERDF is confident regarding the know-how of manufacturers to develop 3-phase amorphous transformers matching ERDF and EnBW requirements.

A bid for tender for marketing will be launched by July 2012.

Thank you for your attention.