LOW LOSS DISTRIBUTION TRANSFORMERS: IN A SOUTH AFRICAN CONTEXT

Powertech Transformers

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Introduction: Why reduce loss?

- Eskom generation shortage
- Cost of electricity
- Reduction of CO2 emissions
- Green energy tariffs
- Finite reserve of fossil fuel
- Time to market of generation

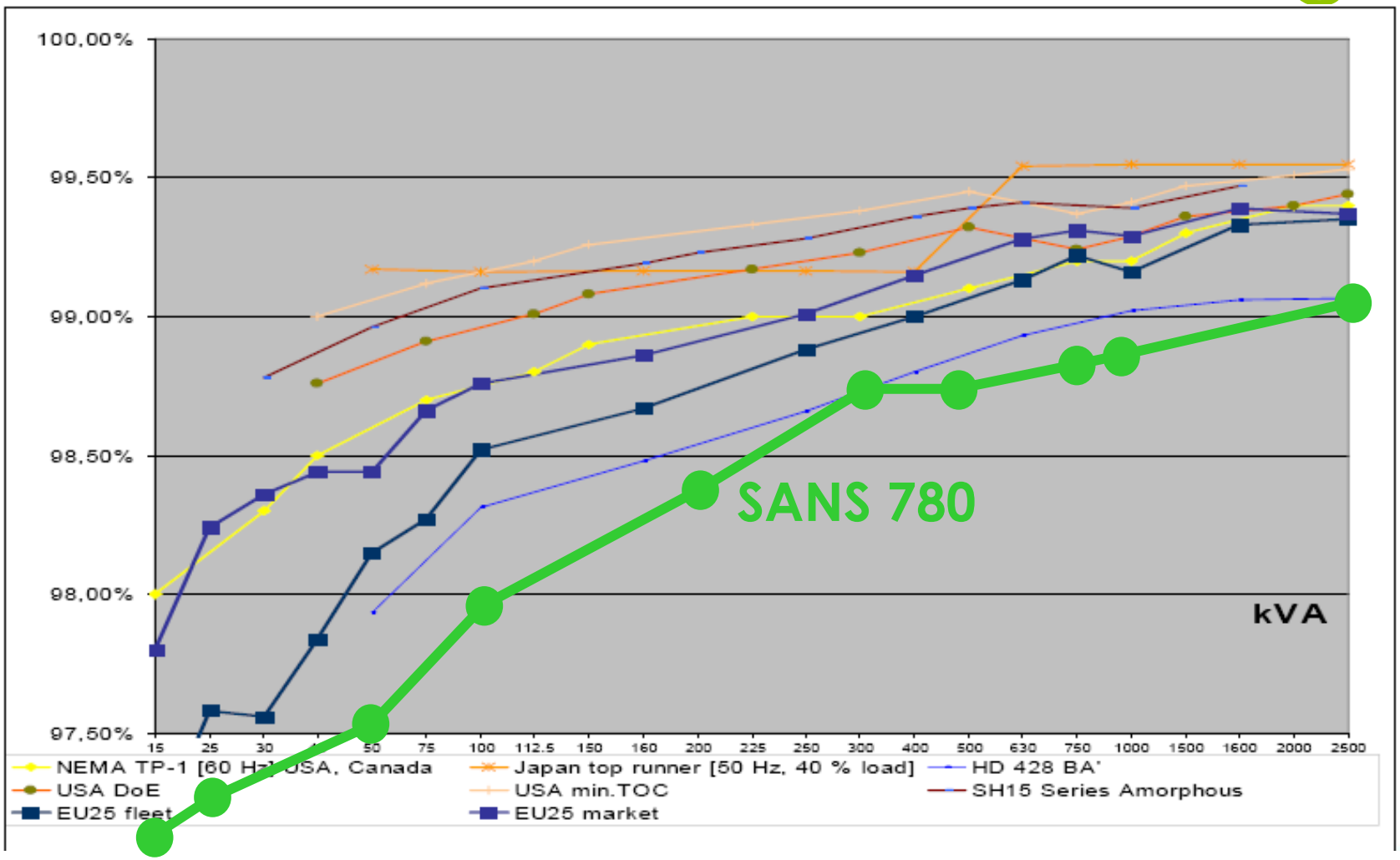
Distribution Transformer Specifications

- Most users specify
  SABS 780:2009
- No Load Loss
- Load Loss

Table 1 — Standard power ratings and standard component losses of dual-ratio transformers (other than auto-transformers)

1	2	3	4	5	6
Rated no-load secondary voltage	Rated power	Component losses			
		No-load loss W			Load loss
V	kVA	Up to 12 kV	24 kV	36 kV	W
121 or 242, single-phase	5	40	–	–	160
	16	80	100	–	400
	25	110	140	160	530
	50	180	220	250	900
420 or 550, three-phase	16	95	120	–	410
	25	120	150	170	570
	50	180	220	250	1 000
	100	300	360	400	1 700
	200	520	600	650	2 700
	315	720	840	890	3 800
	500	1 100	1 180	1 230	5 400
	630	1 300	1 400	1 450	6 400
	800	1 600	1 650	1 700	8 000
	1 000	1 900	1 950	2 000	9 500
	1 250	2 250	2 300	2 350	11 000
	1 600	2 750	2 770	2 820	13 500
	2 000	3 250	3 250	3 300	16 000
3 300 or 3 450, three-phase	2 500	3 800	3 800	3 800	19 000
	3 150	4 500	4 500	4 500	22 000

International Benchmarking



Geldenhuys, H. (2009). Build Power Stations or Avoid Losses? *SANS 780 working group meeting April 2009*, (p. 24). Pretoria.

Are Cap Formulas the answer?

- Cap cost = Total cost of ownership
- Costs factors depend on cost of energy & life span
- Total cost = Price + No load loss cost + Load Loss cost

	≤ 200 kVA	315 kVA	500 kVA	≥ 800 kVA
Utility 1	F_{NL} = 31 200 R/kW F_L = 6 700 R/kW			
Utility 2	FNL = 56 430 R/kW FL = 11 789 R/kW			
Utility 3	F_{NL} = 58 062 R/kW F_L = 12 529 R/kW			
Utility 4 (R/kW)	FNL=91104 FL = 27331	FNL = 91104 FL = 36441	FNL = 113880 FL = 45552	FNL = 113880 FL = 68328

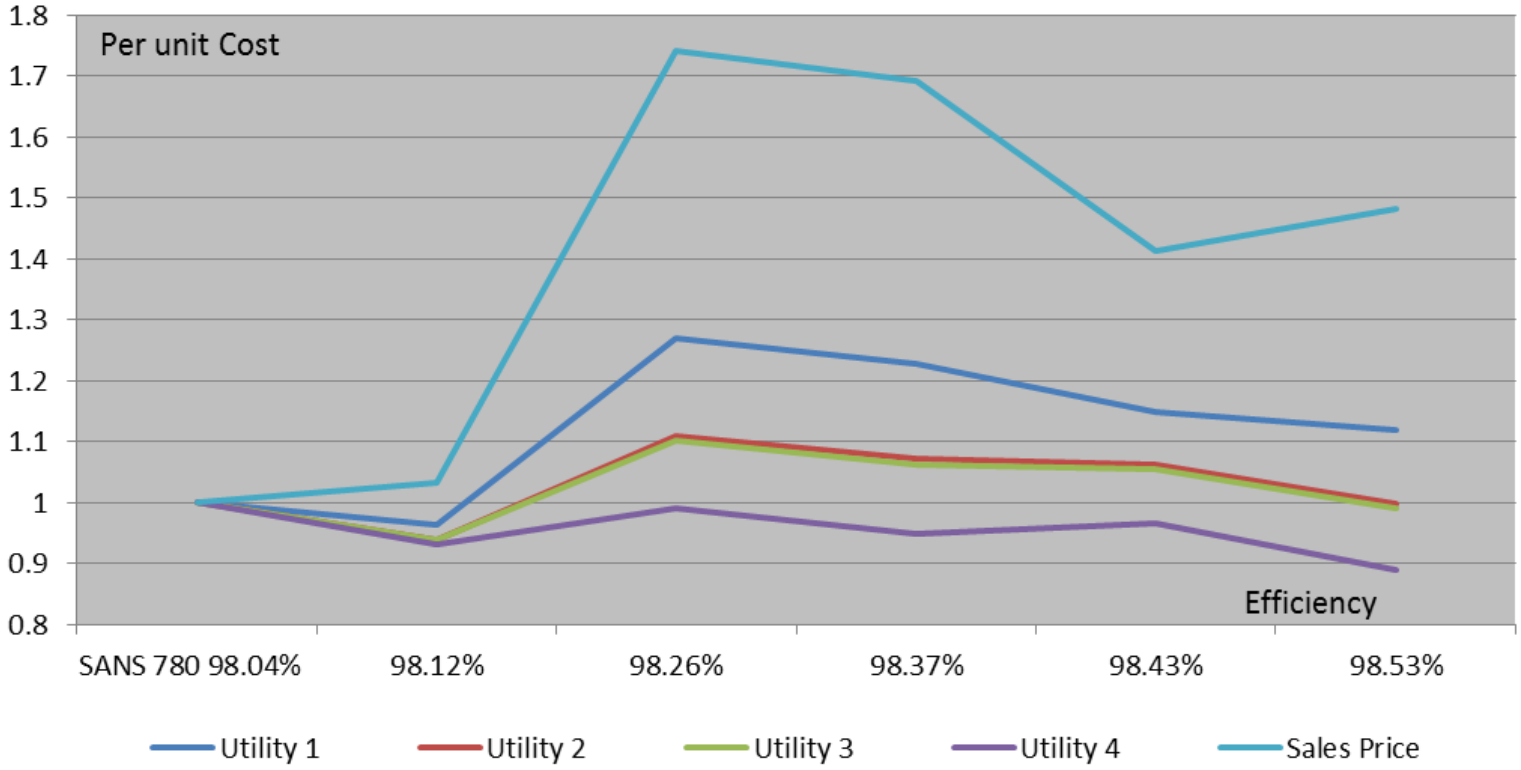
Transformer evaluation

- 100 kVA 11 kV transformers
- Convert to per unit using SANS a base value.

Transformer data					Utility 1	Utility 2	Utility 3	Utility 4
Design	Transformer Efficiency	NLL kW	LL kW	Sales	TCO	TCO	TCO	TCO
SANS 780	98.04%	0.3	1.7	1	1	1	1	1
Reduced Loss GO1	98.12%	0.22	1.7	1.03	0.9635	0.939	0.939	0.932
Low Loss AM1	98.26%	0.07	1.7	1.74	1.2686	1.11	1.101	0.991
High Efficiency AM2	98.37%	0.08	1.6	1.69	1.2272	1.071	1.062	0.949
High Efficiency GO2	98.43%	0.25	1.4	1.41	1.1488	1.062	1.055	0.966
Extra Low Loss GO3	98.53%	0.14	1.4	1.48	1.119	0.998	0.99	0.89

Evaluation Results

- Sales price increases as efficiency improves.
- Long term saving assumes finances are available for the increase in sale price.



Further loss improvement

- Reduction losses ≈ increased materials
  ≈ bigger transformer
  ≈ heavier transformer
  ≈ expensive transformer
  ≈ expensive installation

- Ideal transformer ≈ reduced loss
  ≈ reduced materials

- Capitalisation formula allows Cost verses Benefit analysis as technology improves.
- Allowing an incremental approach to reducing losses

Questions?

Thank you.