Environmental Product Declaration

Power transformer TrafoStar 500 MVA.

CERTIFIED ENVIRONMENTAL PRODUCT DECLARATION
S-P 00020
http://www.environdec.com

ABB Power Transmission

Organizational framework

Manufacturer:
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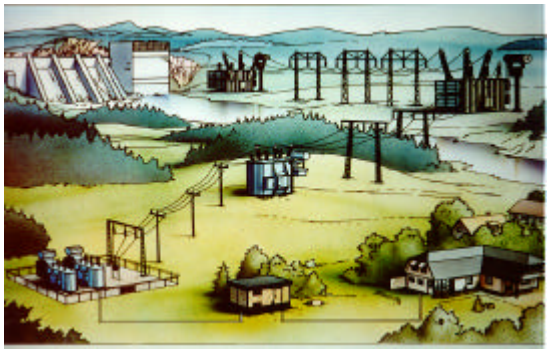
ABB Transformers AB belongs to Business Area BA Power Transformers (a part of ABB Transmission Segment), which consists of 27 main manufacturing sites all over the world.

Environmental management:
The process of implementing environmental management system (EMS) according to international standard ISO 14001 started four years ago. ABB Transformers AB received the certificate in May 1999.

Product description:
Power transformers transform voltage and current in power systems for transmission and distribution of electric power.



The picture shows transformers in typical operation from electric power generation to the final consumer.

TrafoStar is the common ABB concept for the design and manufacture of power transformers. A TrafoStar transformer is built of standardized, service-proven components and modules, ensuring flexible, reliable and tailor-made transformer designs. ABB has developed a completely new concept based on the best knowledge and experience of our facilities worldwide.
TrafoStar design is based on the core type technology. It has a circular shaped core limb surrounded by concentrically arranged, cylinder- shaped windings.

This transformer concept gives the most efficient use of the active material, while allowing short, competitive assembly times in the factory. Our core type technology with cylindrical windings has an excellent capability to withstand short- circuits even under the most demanding fault conditions. The high voltage windings are normally built as ordinary, interleaved or shielded disc windings, while the low voltage windings typically are of helical or layer design. The tapped portion of the winding is normally arranged as a separate physical winding shell. This design allows a balanced ampere turn distribution, avoiding excessive short-circuit forces and additional losses.

Products range

Type	Power transformer TrafoStar
Apparent power	30 MVA ÷ 1200 MVA
Voltage	up to 600 kV

with radiators, coolers or heat exchangers.

Environmental performance

The data and calculations are in accordance with Product Specific Requirements (PSR 2000:6) for Liquid- or gas-filled and dry type transformers within the range of 16 kVA – 1000 MVA, dated December 2000, which applying rules included in ISO 14040÷43, specifies the following baselines for the LCA calculation.

Functional unit has been set to 1MVA of the system apparent power.

System boundaries
The life cycle assessment covers all environmental aspects for extraction and production of raw materials, manufacturing of main parts, assembly of the transformer, transportation and use of the product and dismantling after end of life. It includes consumption of material and energy resources as well as emissions and waste generation.
Calculations are based upon an estimated lifetime of 35 years and average load assumed as 50%. Swedish mix of energy has been used for calculating energy consumption during manufacturing and an OECD mix of energy for calculating energy losses during use. No energy

consumed by auxiliary equipment has been taken into account. Even in case of air forced cooling, electrical energy consumed by those components stand for less than 2% of total energy losses (in all atmospheric conditions except for polar). The TrafoStar 500MVA with coolers has been chosen for the LCA.
This EPD is also valid for similar transformers, provided that the range of variations within each impact category does not exceed + - 5%.

Allocation unit
The factor for allocation of common environmental aspects during manufacturing is calculated as the ratio of apparent power (functional unit) to the sum of apparent power (MVA) of all products produced annually in the relevant part of the production unit.

Resource utilized

Inventory	Manufac-turing	Use phase
Use of non-renewable resources	kg/MVA	kg/MVA
Al (material resource)	1,25	0,00
Coal (energy resource)	416,09	104633,2
Cr (material resource)	0,01	0,00
Cu (material resource)	80,52	0,00
Fe (material resource)	263,45	0,00
Gas (energy resource)	87,38	8947,93
Lignite (energy resource)	2,66	0,00
Mn (material resource)	0,50	0,00
Ni (material resource)	0,00	0,00
Oil (energy resource)	307,65	8550,76
Pb (material resource)	0,00	0,00
S (material resource)	0,08	0,00
Si (material resource)	7,13	0,00
Sn (material resource)	0,01	0,00
U (uranium energy res.)	0,02	2,43
W (material resource)	0,00	0,00
Zn (material resource)	0,30	0,00
Limestone (material res.)	10,46	0,00
Nitrogen (material resource)	0,09	0,00
Use of renewable resources		
Wood	24,14	0,00
Hydro power (MJ/MVA)	62,36	0,00

Materials used

Summary of materials	kg / trafo	kg / MVA
Transformer oil	63000	126
Cooper	39960	80
Insulation materials	6500	13
Wood	15000	30
Porcelain	2650	5
Electrical steel	99640	199
Construction steel	53618	107
Paint	2200	4
Other	8300	17

Waste generated

Waste	kg / MVA
Hazardous waste	
During manufacturing	5,14
During usage	0,25
At end of life	126,00
Regular waste	
During manufacturing	13896,21
During usage	0,00
End of life total waste	558,00
End of life waste to recycling	70200

The average Swedish electricity mix is defined as 0.5% gas, 52% hydro, 44% nuclear, 1.7% oil and 1.8% coal. The OECD electricity mix, is based on official IEA statistics 1997 and is defined as being: biomass & waste 1.51%, gas 13.23%, hard coal 32.54%, hydro 15.67%, lignite 5.96%, nuclear 23.21%, oil 7.28%. The resultant resource utilization is shown in the table blow.

Energy net consumption and losses	kWh / transformer		kWh / MVA	
	Manufacturing	Use	Manufacturing	Use
Electrical energy	750000	177206000	1500	354412
Heat energy	300000	0,00	600	0,00

The classification data for emissions, based upon the indexes specified in Requirements for Environmental Product Declarations, EPD (MSR 1999:2) published 2000-03-27 by the Swedish Environmental Management Council, are the following:

Category of impact	Equivalent unit per MVA	Manufacturing	Usage phase	Total life cycle
Global warming (GWP)	kg CO_2	2190,04	212226,65	214416,69
Acidification (AP)	kmol H^+	1518,15	38104,83	39622,98
Ozone depletion (ODP)	kg CFC-11	0,00	0,00	0,00
Photochemical oxidant formation (POCP)	kg ethylene	1,81	38,21	40,03
Eutrophication (EP)	kg O_2	161,41	2835,96	2997,38

Additional qualifying factors

Recycling and disposal

The transformers consist of large metals parts (construction steel, copper) relatively easy to dismantle and recycle. The description of decommissioning can be found in the LCA report (see references).

Noise levels

Achievable if requested	typical	high
dB(A)	dB(A)	dB(A)
500 MVA		
80	95	105

Surface coating

The tanks are coated with two components solvent-based paint.

Usage phase in relation to the total life cycle

It is to be observed that the environmental impact during the usage phase is the most important one.

Category of impact	Usage in % of total
Global warming GWP	99
Acidification	96
Photochemical oxidants POCP	96
Eutrophication	95

Third party certification

This EPD has been reviewed and found to comply with the Product Specific Requirement, PSR 2000:6 for Liquid- or gas-filled and dry type transformers within the range of 16 kVA – 1000 MVA, dated December 2000, with the Swedish Environmental Council (requirements for environmental product declarations dated 27 March 2000.

References

- LCA report PLCRC TR 00-011
- PSR for Transformers (PSR 2000:6)
- Requirements for Environmental Product Declarations, EPD (MSR 1999:2) - an application of ISO TR 14025, published 2000-03-27 by the Swedish Environmental Management Council

The above mentioned documents are available upon request.

Time of Validity

This Environmental Product Declaration which has been reviewed and approved by BVQI according to MSR 1999:2 and PSR 2000:6 is valid up to and including December 2003.

Accredited certification body

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GLOSSARY

Acidification, AP. Chemical alternation of the environment, resulting in hydrogen ions being produced more rapidly than they are dispersed or neutralized. Occurs mainly through fallout of sulfur and nitrogen compounds from combustion processes. Acidification can be harmful to terrestrial and aquatic life.

Eutrophication. Enrichment of bodies of water by nitrates and phosphates from organic material or the surface runoff. This increases the growth of aquatic plants and can produce algal blooms that deoxygenate water and smother other aquatic life.

Global warming potential, GWP. The index used to translate the level of emissions of various gases into a common measure to compare their contributions to the absorption by the atmosphere of infrared radiation. GWPs are calculated as the absorption that would result from the emission of 1 kg of a gas to that from emission of 1 kg of carbon dioxide over 100 years.

Life cycle assessment, LCA. A management tool for appraising and quantifying the total environment impact of products or activities over their entire life cycle of particular materials, processes, products, technologies, services or activities. Life cycle assessment comprises three complementary components-inventory analysis, impact analysis and improvement analysis.

Ozone depletion potential, ODP. The index used to translate the level of emissions of various substances into a common measure to compare their contributions to the breakdown of the ozone layer. ODPs are calculated as the change that would result from the emission of 1 kg of a substance to that from emission of 1 kg of CFC-11 (a freon)

Photochemical ozone creation, POCP. The index to translate the level of emissions of various gases into a common measure to compare their contributions to the change of ground-level ozone concentration. POCPs are calculated as the change that would result from the emission of 1 kg of a gas to that from emission of 1 kg of ethylene.

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