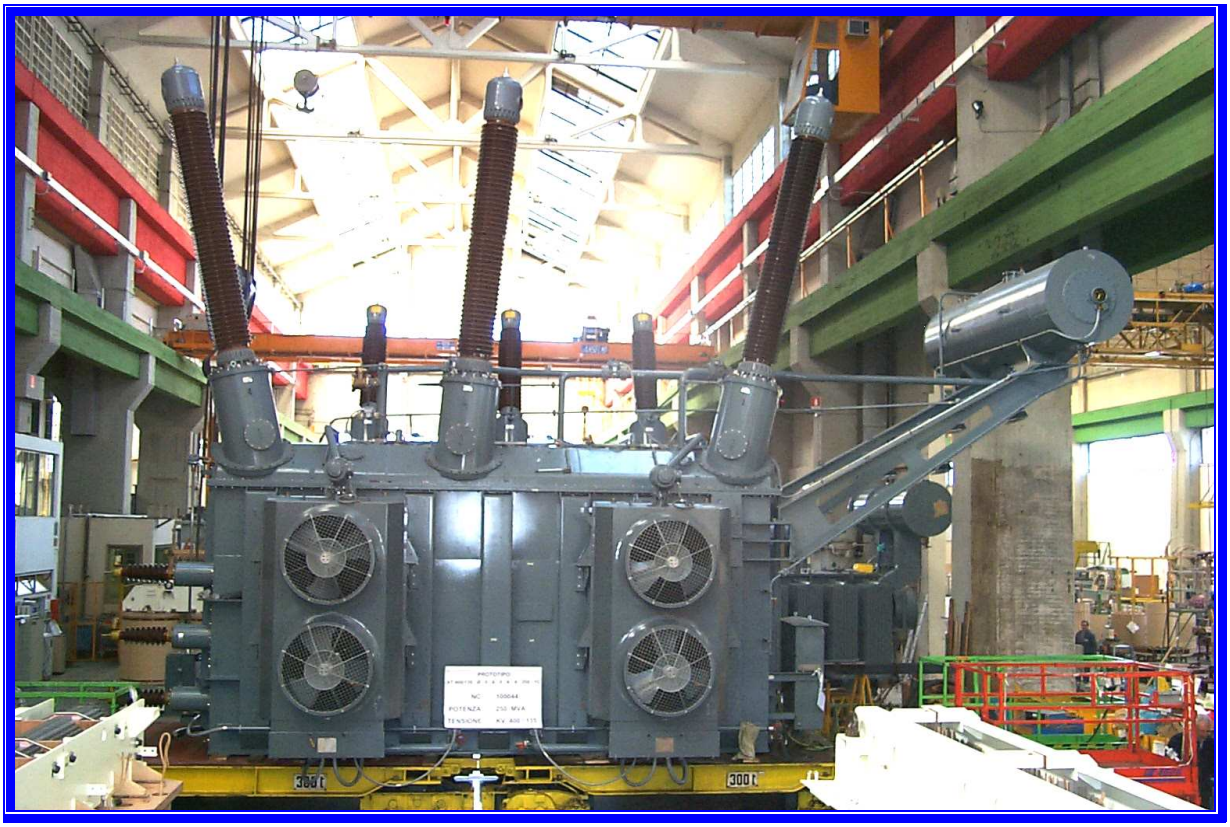
Environmental Product Declaration

Power Transformer 250 MVA

Registration nr. S-P- 00054



Issue	Rev	Description	Issue	Approved	Date
0	2	Revision “Additional qualifying factors”	S. Lo Rizzo	L. De Martin	10/09/2003
0	1	Revision “Environmental performance”	S. Lo Rizzo	L. De Martin	28/08/2003
0	0	Emission	S. Lo Rizzo	L. De Martin	16/06/2003

Presentation

Manufacturer

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ABB T&D S.p.A. Unità Operativa Trasformatori belongs to BA PTPT (Business Area Power Technologies Power Transformers).
BA PTPT is first in distribution transformer worldwide.
We have 23 factories located around the world in 20 countries.
We produce 1500 units per year.
The BAU (Business Area Unit) of Legnano is the focused factory for Large Power and Industrial Transformer.

Environmental management

The implementation process of Environmental System according to international standard UNI EN ISO 14001:96 started in 1998 and ABB T&D S.p.A. Unità Operativa Trasformatori received the certificate in July 1999.

Product description

For the design and manufacture of Power Transformers it is used the common ABB concept named TrafoStar and contained in Common Technology design system.
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 manufactured in interleaved or shielded disc windings, while the low voltage windings are manufactured using the transposed cable conductor with layer or helical 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.

EPD Transformer characteristics

The characteristics of transformer chosen for EPD are:

Power:	250 MVA
Voltage:	400/135 kV
Frequency:	50 (Hz)
Vector group:	Yn0
Type of cooling:	OFAF

Scope of declaration

Data and calculations are according to PSR 2000:6 (Product Specific Requirements for "Liquid- or gas-filled and dry type transformers within the range of < 1000 MVA" version 1.1 dated 2001-02-21) and MSR 1999:2 (Environmental Product Declaration, EPD – an application of ISO TR14025, published 2000-03-27 by the Swedish Environmental Management Council). (www.environdec.com).
This EPD is also valid for similar transformers, provided that the range of variations within each impact category does not exceed ±5%.

Functional unit

The functional unit, as specified in the PSR 2000:6, is defined as 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%.
In order to calculate potential impact, ETH LCI data source, for the manufacturing phase and ANPA-LCA version 2 database, for the use phase, were used.

Manufacturing phase

Total weight of excluded materials doesn't exceed 2% of total transformer weight.

Materials	[kg/trafo]	[Kg/MVA]	%
Electrical steel	67165	268.66	33.58
Steel sheet	38073	152.29	19.04
Steel profile	7500	30	3.75
Glass fiber	1109	4.44	0.55
Kraft paper	1479	5.92	0.74
Copper wire	391	1.56	0.20
Copper profile	23837	95.35	11.92
Presspan	5294	21.17	2.65
Porcelain	2009	8.03	1.00
Aluminium	1987	7.95	0.99
Paint	95	0.38	0.05
Transformer oil	48000	192	24.00
Resin	188	0.75	0.09
Total	197127	788	98.56
Assembled Transformer	200000	800	100,0
Cut-off			1.44

Packaging of product is not included in the system.

Use phase

Energy losses have been calculated according to PSR 2000:6 and are equal to 103.300.000 kWh.
No energy consumed by auxiliary equipment has been taken into account.
In case of air forced cooling, electrical energy consumed by auxiliary equipment stand for about 2% of total energy losses.

End of life

End of life phase has been limited to a list of generated waste.
The transformer consists of large metals parts (copper,steel) relatively easy to dismantle and recycle. Remaining components (except for transformer oil) should be landfill. More information about transformer management at the end of life, are reported in the "Instruction and Operating Manual".

Waste	[kg/trafo]	[kg/MVA]
Total waste (incl. hazardous)	200000	800
Hazardous waste	48000	190
Recycled waste	137000	548
Landfill waste	15000	60

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 use

Main resources associated to the various phases of the life cycle are the following:

Use of non renewable resources				
Resource	Manufacture		Use phase	
	[kg/trafo]	[kg/MVA]	[kg/trafo]	[kg/MVA]
Aluminium in ore	200	0.8	-	-
Bauxite	7300	29.3	5400	21.6
Chromium in ore	4.3	0.02	900	3.6
Clay	13.2	0.053	-	-
Copper in ore	15300	61.3	1200	4.8
Crude oil	100000	400	2430000	9700
Gravel	6.7	0.027	-	-
Hard coal	140000	556	14800000	59100
Iron in ore	115000	460	143000	570
Lead in ore	0.45	0.0018	50	0.20
Lignite	1600	6.6	12200000	49000
Limestone	4100	16.4	300000	1200
Manganese in ore	1.6	0.0066	150	0.61
Natural gas	51200	200	2770000	11100
Nickel in ore	0.77	0.0031	630	2.5
Sand	13400	54	-	-
Uranium in ore	2.3	0.091	1030	4.1

Use of renewable resources					
Resource	Unit	Manufacture		Use phase	
		[Unit/ trafo]	[Unit/ MVA]	[Unit/ trafo]	[Unit/ MVA]
Elec.Geother	MJ	5800	23.3	-	-
Hydro energy	MJ	172000	700	-	-
Water	kg	10020000	40100	2114000000	8450000
Wood	kg	8700	35	1220000	4900

Energy net consumption and losses

The net energy consumption and losses in the two phases are the following:

Energy	Manufacturing		Use phase	
Resource	[kWh/ trafo]	[kWh/ MVA]	[kWh/ trafo]	[kWh/ MVA]
Electrical energy	9280000	37100	103000000	413000
Heat energy	296000	1200	-	-

Waste

Waste produced in the different phases of the life cycle considered, are the following:

Waste	Manufacturing		Use phase	
	[kg/ trafo]	[kg/ MVA]	[kg/ trafo]	[kg/ MVA]
Hazardous waste	3000	12	4900	20
Regular waste (incl. waste water)	4300000	17200	7200000	28800

Potential Environmental Impact

Potential environmental impacts tied to the various phases of the life cycle are the following:

Impact category	Equivalent Unit per MVA	Manufacturing	Use phase	Manufacturing + Use phase
Global warming (GWP)	kg CO_2	2600	219000	222000
Acidification (AP)	mol H^+	1450	41500	42900
Ozone depletion (ODP)	kg CFC-11	0.0003	0.0015	0.0018
Photochemical oxidant formation (POCP)	kg C_2H_4	0.99	43	43.9
Eutrophication (NP)	kg O_2	54.7	2500	2550

Additional qualifying factors

Sound power levels

The audible sound is originated mainly in the core because of the magnetostriction property of electrical steel.

Type	Measured value dB(A)
250 MVA	69.2

Surface coating

The tank is coated with two components solvent-based paint.

Life cycle results

It is observed that the environmental impact during the use phase is the most important one.

Impact category	Use phase in % of total
GWP	98.85
AP	96.63
POCP	97.72
NP	97.86
ODP	82.99

In manufacturing phase copper production for windings is the most significant source of pollution.

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 <1000 MVA”, version 1.1 dated 2001-02-21, with the Swedish Environmental Council (requirements for environmental product declarations dated 27 March 2000).

Time of Validity

This EPD, reviewed by Det Norske Veritas according to MSR 1999:2 and PSR 2000:6, is valid up to September 2006 because no significant variations will aspect in this period.

Accredited Certification Body

Det Norske Veritas Certification AB
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References

- LCA report
- 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.

GLOSSARY

Life cycle assessment, LCA: It provides a framework, an approach and methods for identifying and evaluating environmental burdens associated with the life cycles of materials and services, from cradle to grave. The LCA method consists of four steps: goal and scope definition, inventory analysis, impact assessment and interpretation.

Acidification, AP. Chemical alternation of the environment, resulting in hydrogen ions being produced more rapidly than they are dispersed or neutralized. Occurs mainly through fall of sulfur and nitrogen compounds from combustion processes. Acidification affects crops, forests, water life and buildings.

Eutrophication, NP. Nitrification causes oxygen in lakes and waters to be consumed by growth and decomposition of plants and algae and, finally, to the death of organisms living close to the bottom of the sea.

Global warming potential, GWP. Estimated greenhouse effect in 100 years perspective. The greenhouse effect means that the average temperature in the atmosphere to such an extent that the average temperature on earth increases over time, affecting growth of crops and living conditions. GWP is based on the degree to which a mass unit of a specific substance can absorb infrared radiation relative to CO_2. In this way all emissions can be converted into an equivalent quantity of CO_2 that would cause an equal greenhouse effect.

Ozone depletion potential, ODP. Risk for depletion of the stratospheric ozone layer. Depletion of ozone layer allows more ultraviolet radiation to reach earth and cause damage to humans and crops. ODP is defined as the ratio between ozone (O_3) breakdown in the equilibrium state due to annual emissions of substance and ozone breakdown due to an equal quantity of CFC-11.

Photochemical ozone creation, POCP. Photochemical oxidant formation results from reactions between nitrogen oxides (NOx) and volatile organic compounds (VOCs) on exposure to UV light and it is mainly associated with summer smog. Photochemical oxidants are toxic to humans and affect growth of crops, trees and other green plants. Ethylene (C_2H_4) is used as a reference substance for POCP, i.e. POCP is measured in kg of C_2H_4 equivalent.

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