Environmental Product Declaration

Large Distribution Transformer 16/20 MVA (ONAN/ONAF)

CERTIFIED ENVIRONMENTAL PRODUCT DECLARATION
S-P-00056
http://www.environdec.com

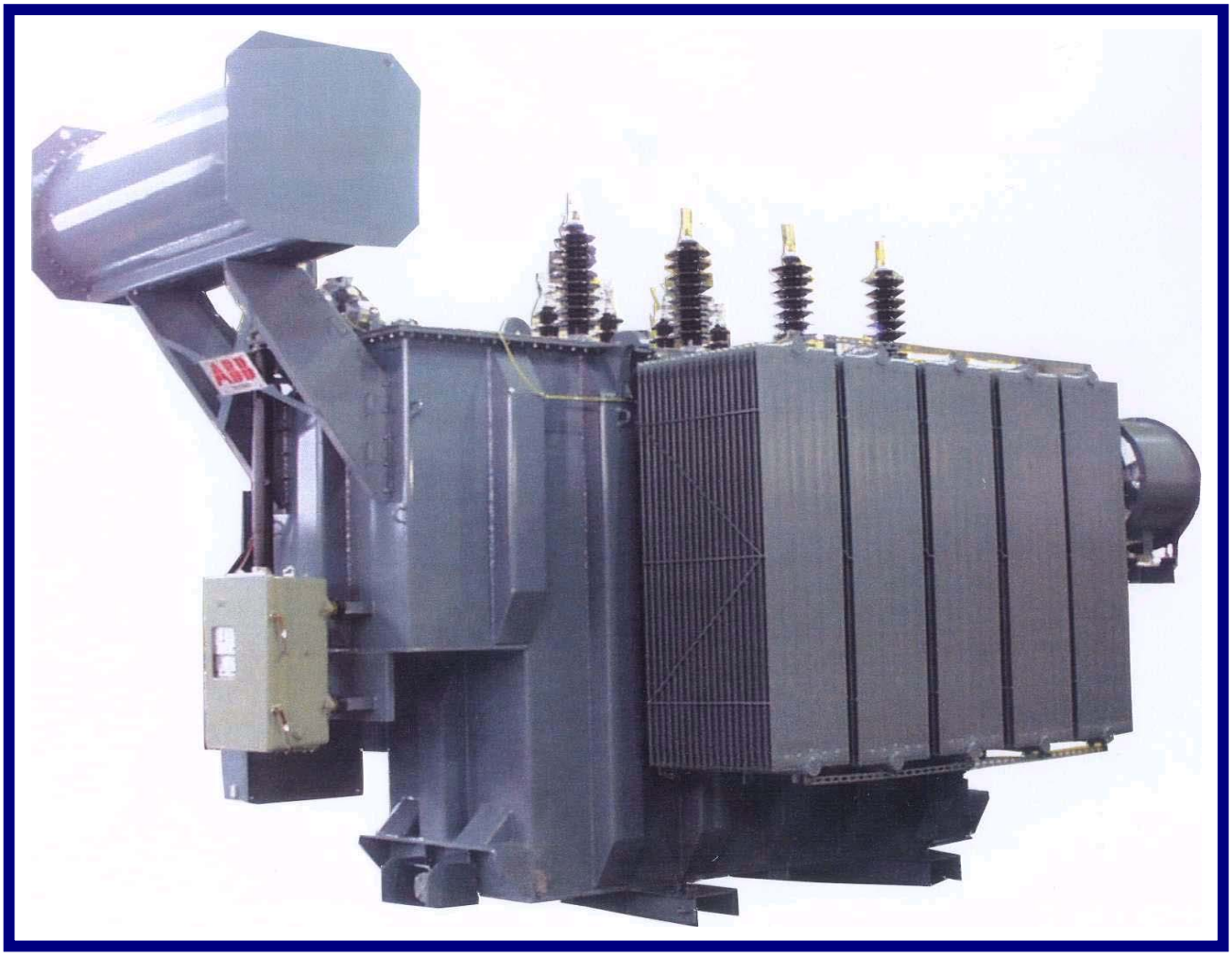

ABB T&D S.p.A.
Unità operativa Trasformatori di Distribuzione
Monselice (Padova) - ITALY

09/09/03 Emis.0 Rev.4

Presentation

Manufacturer

ABB T&D S.p.A. Unità operativa Trasformatori di Distribuzione
35043 Monselice (Padova), Italy
Phone: +39-0429-787300
Fax: +39-0429-75078
Contact person EPD: Diego Ferrarese, Monica Alaggio.

ABB T&D S.p.A. Unità operativa Trasformatori di Distribuzione belongs to BA PTDT (Business Area Power Technologies Distribution Transformers).
BA PTDT is first in distribution transformer worldwide.
We have 33 factories located around the word in 25 countries.
We produce 400000 units per year and there are 5500 employees.
The BAU (Business Area Unit) of Monselice is the focused factory for Large Distribution liquid-filled Transformers (LDT).

Environmental management

The implementing process of Environmental System according to international standard UNI EN ISO 14001:96 started two years ago.
ABB T&D S.p.A. Unità operativa Trasformatori di Distribuzione received the certificate in October 2002.

Product description

For the design and manufacture of LDT it is used the common ABB concepts contained in Common Technology design system.
A Large Distribution Transformer (5 ÷ 25 MVA and ≤ 72,5 kV) 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.
LDT 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 foil 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.

EPD Transformer characteristics

The characteristics of transformer chosen for EPD are:

Power:	16000 / 20000 (kVA)
Voltage:	66 ± 11 x 1.515 / 22 (kV)
Frequency:	50 (Hz)
Vector group:	YNyn0
Type of cooling:	ONAN/ONAF

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 1kVA 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 30 years and average load assumed as 50%.
Italian energy mix has been used for calculating energy consumption during manufacturing phase and European mix for calculating energy losses during use phase (ANPA LCA version 2 database).

Manufacturing phase

Total weight of excluded materials doesn't exceed 1% of total transformer weight.

Materials	[kg/trafo]	[kg/kVA] ONAN	[kg/kVA] ONAF	%
Aluminum	94	0.0059	0.0047	0.2
Construc. steel	10006	0.63	0.50	24.3
Copper	8673	0.54	0.43	21.1
Electrical steel	10411	0.65	0.52	25.3
Insulation mat.	656	0.041	0.033	1.6
Paint	210	0.013	0.011	0.5
Porcelain	125	0.0078	0.0063	0.3
Silver	0.08	0.000005	0.000004	0.0
Transformer oil	10206	0.64	0.51	24.8
Wood	517	0.032	0.026	1.3
Other	84.5	0.0053	0.0042	0.2
Total	40983	2.56	2.05	99.5
Weighted	41176	2.57	2.06	100.0
Cut-off				0.5

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 12,240,202 kWh for a transformer working as 16 MVA ONAN and 16,943,386 kWh if it works as a 20 MVA ONAF.
No energy consumed by auxiliary equipment has been taken into account.
In case of air forced cooling, electrical energy consumed by auxiliary equipment stands for less than 1% of total energy losses.

End of life

End of life phase has been limited to a list of generated wastes.
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 on waste disposal is reported in the "Usage and Maintenance handbook" of transformer.

Waste	[kg/trafo]	[kg/kVA] ONAN	[kg/kVA] ONAF
Total waste (incl. hazardous)	41176	2.57	2.06
Hazardous waste	10206	0.64	0.51
Recycled waste	29093	1.82	1.45
Landfill waste	1880	0.12	0.094

Allocation unit

The factor for allocation of common environmental aspects during manufacturing phase 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.

Environmental performance

The environmental performances associated to the transformer working in ONAN and ONAF conditions are showed in the tables below follow.

Resource use

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

Use of non renewable resources					
Resource		ONAN		ONAF	
Name	Category	Manufacturing [kg/kVA]	Use phase [kg/kVA]	Manufacturing [kg/kVA]	Use phase [kg/kVA]
Aluminum	Material resource	0.0045	0	0.0036	0
Barytes	Material resource	0.00026	0.12	0.00021	0.13
Bauxite	Material resource	0.029	0.041	0.023	0.046
Chromium	Material resource	0.00015	0.0082	0.00012	0.091
Clay	Material resource	0.00044	0.17	0.00035	0.19
Copper	Material resource	0.34	0.0082	0.27	0.091
Crude oil	Energy resource	1.30	22.31	1.04	24.7
Gravel	Material resource	0.0040	5.08	0.0032	5.62
Hard coal	Energy resource	1.99	96.4	1.60	107.0
Iron	Material resource	1.34	1.01	1.08	1.13
Lead	Material resource	0.0006	0	0.0005	0
Lignite	Energy resource	0.043	123.3	0.034	137.0
Limestone	Material resource	0.076	2.3	0.061	2.53
Manganese	Material resource	0.0020	0	0.0016	0
Natural gas	Energy resource	0.48	14.0	0.39	15.5
Nickel	Material resource	0.00005	0.0055	0.00004	0.061
Sand	Material resource	0.30	0.55	0.24	0.61
Silver	Material resource	0.000005	0	0.000004	0
Uranium	Energy resource	0.00004	0.0082	0.00003	0.0091

Use of renewable resources					
Resource		ONAN		ONAF	
Name	Unit	Manufacturing	Use phase	Manufacturing	Use phase
Hydro energy	MJ/kVA	3.98	543	3.20	600
Water	kg/kVA	9.65	17500	7.73	19400
Wood	kg/kVA	0.24	0.73	0.19	0.81

Net energy consumption and losses

The net energy consumption and losses in the two phases are according to the table below:

Energy	ONAN				ONAF			
	Manufacturing		Use phase		Manufacturing		Use phase	
	[kWh/trafo]	[kWh/kVA]	[kWh/trafo]	[kWh/kVA]	[kWh/trafo]	[kWh/kVA]	[kWh/trafo]	[kWh/kVA]
Electrical energy	207550	12.9	12240000	765	207550	10.4	17000000	850
Heat energy	31800	1.99	0	0	39750	1.99	0	0

Wastes

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

Waste	ONAN		ONAF	
	Manufacturing [kg/kVA]	Use phase [kg/kVA]	Manufacturing [kg/kVA]	Use phase [kg/kVA]
Hazardous waste	0.024	0.005	0.021	0.006
Regular waste (incl. waste water)	93.7	52.3	75.0	58.0

Potential Environmental Impact

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

ONAN				
Impact category	Equivalent unit per kVA	Manufacturing	Use phase	Manufacturing + Use phase
Global warming (GWP)	kg CO_2 (100 years)	7.65	404.0	412.0
Acidification (AP)	mol H^+	7.31	89.0	96.3
Ozone depletion (ODP)	kg CFC-11 (20 years)	0.00008	0	0.00008
Photochemical oxidant formation (POCP)	kg C_2H_4	0.004	0.08	0.084
Eutrophication (NP)	kg O_2	0.23	4.39	4.62

ONAF				
Impact category	Equivalent unit per kVA	Manufacturing	Use phase	Manufacturing + Use phase
Global warming (GWP)	kg CO_2 (100 years)	6.12	447.6	454.0
Acidification (AP)	mol H^+	5.84	98.6	104.4
Ozone depletion (ODP)	kg CFC-11 (20 years)	0.0000006	0	0.0000006
Photochemical oxidant formation (POCP)	kg C_2H_4	0.003	0.090	0.093
Eutrophication (NP)	kg O_2	0.18	4.86	5.04

Additional information

Sound power levels

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

Type	Achievable if requested dB(A)	Typical dB(A)
ONAN	45	60
ONAF	50	65

Surface coating

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

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 ONAN	ONAF
GWP	98.1	98.7
AP	92.4	94.4
POCP	95.5	96.7
NP	95.0	96.4
ODP	0	0

In manufacturing phase copper production for windings is the most significant source of pollution. Only on Ozone depletion potential (ODP) transporter of transformer oil has a major contribution. Being the transformer commissioned with specific requirements by the Client, considerable differences may arise from the usage phase performance evaluation herein declared. ABB will check consistency of this EPD with your product if required.

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 Norsket 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.

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.

Accredited Certification Body

Det Norsket Veritas Certification AB
P.O. Box 30234 Warfvinges väg 19, SE
104 25 Stockholm Sweden
Tel.: + 46 8 587 940 00 fax: + 46 8 651 70 43

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. A photochemical oxidant formation result from reactions between nitrogen oxides (NOx) and volatile organic compounds (VOC's) 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.

ABB T&D S.p.A. Unità operativa Trasformatori di Distribuzione
Via Piave, 8 - 35043 Monselice (Padova), ITALY
Tel. +39-0429-787300; fax +39-0429-75078
www.abb.com