Power^{IT} Generator Circuit-Breaker, Type HECS

Environmental Product Declaration

Industrial IT enabled

Industrial IT Enabled products from ABB are the building blocks for greater productivity, featuring all the tools necessary for lifecycle product support in consistent electronic form.

ABB

Organizational Framework

Name and Adress of Producer

ABB Switzerland Ltd
High Voltage Products
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The ABB Switzerland Ltd, High Voltage Products, is part of the ABB Division „Power Technology Products“.

Environmental Management

The ISO 14001 management standard has been implemented at ABB Switzerland Ltd, High Voltage Products, since 1998. Life cycle assessment (LCA) is applied continually to all product development.

Product description

The three phase generator circuit-breaker system, type HECS, consists of a circuit-breaker and a disconnector both mounted in single phase enclosures. As an option earthing switches, a starting switch, current transformers, voltage transformers, surge arresters and an adequate control cubicle can be added to the system. The HECS series is based on mature technology-knowledge and extensive experience and provides high flexibility due to costumers needs.
Requirements based on international standards are completely fulfilled. A generator circuit-breaker system is placed between the generator and the stepup transformer of a power plant. It permits the separation and the connection of the generator under nominal as well as under fault conditions.

Methods

This LCA was carried out using ABB standard LCA program “ECOLAB (Version 5.3.2a)” developed by Nordic Port S.A. based on the “product specific requirements” (PSR) for generator circuit-breakers.

The life cycle of the product is separated in three phases: Manufacture, use and disposal. Transports of components were calculated in the manufacture-phase, transports of the product to the costumer, as well as filling the product with SF_6-gas and losses of SF_6 were calculated in the use-phase.

The results consist in material and energy inventories and characteristic environmental impacts in the three life cycle phases.

Inputs of LCA

Functional unit

The functional unit of the analysis is one HECS generator circuit-breaker with a total weight of 3725 kg.

Manufacturing

In the maufacturing phase the following materials were used:

Material	Weight (kg)
Aluminum	1'837
Steel	1'377
Copper	190
Iron	25
Expoxy Resin	239
SF_6	37.4
Other	19.6

Table: Inventory of materials

Proportions of larger pre-manufatured components were estimated. Materials were transported on average for 500 km by lorry.

Energy consumption and heat were not included in this phase.

Energy	Manufacture	Use	Disposal
electrical	0	182'208	0
heat	0	0	0

Table: Energy consumption in life cycle phases (kWh)

Use of the product

Transports of the product to the costumer, energy losses, and emissions of SF_6 were calculated in the use phase. Use of other materials or energies were neglected.

An average transportation mix was calculated from the overall distribution of the product to the continents: North and South America, Asia and Europe, and from the average choice of transportation media: Ship, aircraft and lorry. This mix consist in 5934 km ship freight, 675 km transport by lorry and 56 km air freight.

The calculation of the environmental impact of energy losses was based on the European electricity mix. This mix is defined by: 10 % gas, 15 % hydro power, 36 % nuclear power, 10 % oil, 19 % coal and 10 % lignite.

SF_6-emissions were 0.5 kg assuming loss of 0.1 % based on experience, a life span 40 years and a total volume of 40 kg.

Disposal and Recycling

Recycling of metals was according to PSR: 90 % of copper, 80 % of steel and aluminum and 99 % of SF_6. Remaining parts were disposed as landfill regarding them as a lump sum.

Environmental performance

74 % to 83 % of the environmental impacts are generated in the use phase. Besides of the impacts due to transportation the impacts of generation of electrical energy are the main reasons.

Main environmental impacts in the manufacture phase are due to metal producing processes especially in the production of aluminum.

The disposal phase doesn't add much impacts to the LCA. Reasons may be due to the metal recycling and the majority of inert materials in the landfill waste fraction.

Resource	Manufacture	Use	Disposal
Coal	5'747.3	49'907.7	0
Oil	2'601.1	5'392.2	1.1
Gas	774.1	3'457.4	0
Nuclear	0.2	1.9	0
Copper	191.1	0	0
Iron	1'194.3	0	0
Aluminum	1'873.7	0	0
Stainless steel	116.5	0	0
Steel	219.6	0	0

Table: Use of non-renewable resources (in kg)

Resource	Manufacture	Use	Disposal
Hydro Power	301.2	0	0

Table: Use of renewable resources (in MJ)

Impact	Manufature	Use	Disposal
Global Warming Potential (GWP) in kg CO_2 equivalents	31'512.0	93'250.3	1'088.2
Acidification(AP) in kmol H^+ equivalents	5.4	18.5	0
Ozone depletion(ODP) in kg CFC_{11} equivalents	0	0	0
Photochemical Ozone Creation (POCP) in kg C_2H_4 equivalents	4	20.9	0
Nutrification in kg O_2 equivalents	368	1219	0

Table: Environmental impacts in life cycle phases

The GWP is to 74 % in the use phase. It comes mainly from the energy consumption. GWP in the manufacturing phase results mainly from the production of aluminum.

This is also true for the acidification potential (acid rain) and the photochemical ozone creation (summer smog). Values are even higher in the use phase with 77 % and 83 %, respectively.

Ozone depletion potential may be neglected.

The nutrification potential (leeds to oxygen depletion in water) comes to 77 % from the use phase as a consequence from energy consumption, and ship freight transport.

In the manufacture phase this potential comes from aluminum production and production of resins.

The estimated loss of about 1.5 kg SF_6 or 0.1 % of the original gas volume doesn't influence the GWP in this LCA.

The risk of more important loss of SF_6-gas as a consequence of mishandling is relevant and may lead to the emission of the whole volume into the air.

Please see the corresponding literature or contact:

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SF_6 Infobox

In electrical equipment SF_6-gas exhibits outstanding insulating and arc-extinguishing properties. It retains these properties up to a moderate degree of decomposition product, air or moisture contamination. Through purification of the gas the contamination fractions can be removed, as a result of which the original quality of the SF_6-gas is restored.

For economic as well as ecological reasons it is therefore worthwhile and advisable to purify and reuse the gas again and again for as long as its quality criteria can be restored. SF_6-gas from installations which are taken out of service can be reused in newly installed equipment.

Prerequisite to the reuse of SF_6 is professional handling during evacuation, filling and recovery.

From a technical, economical and ecological standpoint, equivalent alternatives to SF_6 as an insulating and arc-extinguishing agent are as yet unknown.

Literature

- PSR High Voltage Circuit Breakers, 2001
- MSR 1999:1, Enclosure A
- D. Braun, A. Guerig, „Life Management for Generator Circuit Breakers", CIGRE 1994: 13-204
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- ABB Hochspannungstechnik AG, „Erklärung zu SF_6 in elektrischen Schaltgeräten und -anlagen in der Schweiz", 2000

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