Environmental Product Declaration

for ACS 600 frequency converter, 250 kW power
ABB Industry Oy in Finland forms part of ABB’s Automation Technology Products segment. The company develops, manufactures and markets electrical machines and drives for ABB Group customers world-wide and is responsible for several key product groups, including variable-speed AC drives and drive systems for speed control of electric motors.

Environmental management
The ISO 14001 international environmental management standard has been implemented and the Helsinki factory has been certified since 1996. Life cycle assessment is applied continually to all product development.

Organisational framework

Environmental performance

The data and calculations are in accordance with Product Specific Requirements (PSR) for Variable Speed Electric Drives, which specifies the following baselines for the LCA calculation.

Functional unit
The functional unit for the LCA is 1 kW of rated output power.

System boundaries
The life cycle assessment covers all environmental aspects for extraction and production of raw materials, manufacturing of main parts, assembly, transportation and use of the product, dismantling, fragmentation and disposal and recycling of scrap after end of life. It includes consumption of material and energy resources as well as emissions and waste generation.

Calculations are based on an estimated lifetime of 15 years when operating 5,000 hours per year. A Finnish mix of energy has been used for calculating energy consumption during manufacturing and an OECD mix of energy for calculating energy consumption during use and disposal.

Allocation unit
The factor for allocation of common environmental aspects during manufacturing (such as manufacturing waste) is calculated as used working hours in relation to the total annual production volume.

Product description

ABB Industry Oy, Drives Group comprises the following product lines:

- **Comp-AC**
  - ACS 100 power range 0.12 to 2.2 kW
  - ACS 140 power range 0.12 to 2.2 kW
  - ACS 160 power range 0.55 to 2.2 kW
  - ACS 400 power range 2.2 to 37 kW

- **ACS 600** power range 2.2 to 4,300 kW
- **SAMI MEGASTAR** power range 1 to 8 MW

This document applies to the ACS 604 032 050 000 0901 model which is a 250 kW, 500 V, 365 A product.

Material according to the table below is used for the product.

<table>
<thead>
<tr>
<th>Type of material</th>
<th>kg / product</th>
<th>kg / kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel</td>
<td>100.82</td>
<td>0.403</td>
</tr>
<tr>
<td>Copper</td>
<td>24.39</td>
<td>0.098</td>
</tr>
<tr>
<td>Aluminium</td>
<td>34.88</td>
<td>0.140</td>
</tr>
<tr>
<td>Plastics</td>
<td>12.50</td>
<td>0.050</td>
</tr>
<tr>
<td>Cardboard (package)</td>
<td>19.62</td>
<td>0.078</td>
</tr>
<tr>
<td>Other materials</td>
<td>4.47</td>
<td>0.018</td>
</tr>
</tbody>
</table>

Resource utilisation

<table>
<thead>
<tr>
<th>Use of non-renewable resources</th>
<th>Manufacturing phase unit / kW</th>
<th>Usage phase unit / kW</th>
<th>Disposal phase unit / kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal kg</td>
<td>1.13</td>
<td>800.27</td>
<td>-0.64</td>
</tr>
<tr>
<td>Aluminium (Al) kg</td>
<td>0.14</td>
<td>0.00</td>
<td>-0.13</td>
</tr>
<tr>
<td>Copper (Cu) kg</td>
<td>0.10</td>
<td>0.00</td>
<td>-0.09</td>
</tr>
<tr>
<td>Iron (Fe) kg</td>
<td>0.43</td>
<td>0.00</td>
<td>-0.36</td>
</tr>
<tr>
<td>Manganese (Mn) kg</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Natural Gas kg</td>
<td>0.19</td>
<td>66.44</td>
<td>-0.04</td>
</tr>
<tr>
<td>Uranium (U) kg</td>
<td>0.00</td>
<td>0.02</td>
<td>0.00</td>
</tr>
<tr>
<td>Oil kg</td>
<td>0.41</td>
<td>65.40</td>
<td>-0.22</td>
</tr>
</tbody>
</table>

| Use of renewable resources     |                           |                       |                         |
|--------------------------------|                           |                       |                         |
| Hydro Power MJ                 | 0.10                       | 2,024.07              | 0.00                    |
| Wood kg                        | 0.08                       | 0.00                  | 0.00                    |

Energy consumption and losses

<table>
<thead>
<tr>
<th>Energy form</th>
<th>kWh / product</th>
<th>kWh / kW</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Manufacturing phase</td>
<td>Usage phase</td>
</tr>
<tr>
<td>Electrical energy</td>
<td>99.0</td>
<td>677,662.2</td>
</tr>
<tr>
<td>Heat energy</td>
<td>54.5</td>
<td>-</td>
</tr>
</tbody>
</table>

The average Finnish electricity mix is defined as being 10 percent gas, 31 percent hydro, 40 percent nuclear, 2 percent oil and 17 percent stone coal. The average OECD electrical energy is defined as being 13 percent gas, 16 percent hydro, 23 percent nuclear, 7 percent oil, 33 percent stone coal, 6 percent lignite coal, 1.5 percent biomass & waste and 0.5 percent other. The resultant resource utilisation is shown in the table above.
Environmental effect | Equivalent unit | Manufacturing phase | Usage phase | Total life cycle
--- | --- | --- | --- | ---
Global warming potential GWP | kg CO₂ / kW | 4.85 | 1,623.16 | 1,625.70
Acidification potential AP | kmol H⁺ / kW | 0.00 | 0.29 | 0.29
Eutrophication | kg O₂ / kW | 0.07 | 21.69 | 21.73
Ozone depletion potential ODP | kg CFC-11 / kW | 0.00 | 0.00 | 0.00
Photochemical oxidants POCP | kg ethylene / kW | 0.00 | 0.29 | 0.29

**Recycling and disposal**
The main parts of the product can be recycled - some parts need to be fragmented to separate different types of material. A list of parts and components that can be fragmented and recycled can be obtained from the manufacturer. See references.

**Usage phase in relation to the total**
It should be observed that the environmental impact during the usage phase is the most important. As an example, GWP for the usage phase is approximately 340 times larger than GWP for the manufacturing phase.

**Additional qualifying factors**

**Glossary**

**Acidification, AP**
Acidification originates from the emissions of sulphur dioxide and oxides of nitrogen. In the atmosphere, these oxides react with water vapour and form acids which subsequently fall down to the earth in the form of rain or snow, or as dry depositions. Acidification potential translates the quantity of emission of substances into a common measure to compare their contributions to the capacity to release hydrogen ions.

**Eutrophication**
Nutrients (mainly nitrogen and phosphorus) from sewage outfalls and fertilised farmland accelerate the growth of algae and other vegetation in water. The degradation of organic material consumes oxygen resulting in oxygen deficiency and fish kill. Eutrophication translates the quantity of emission of substances into a common measure expressed as the oxygen required for the degradation of dead biomass.

**Global warming, GWP**
Some of the gases in the earth’s atmosphere (in particular water vapour and carbon dioxide) have an ability to absorb infrared radiation. They do not prevent sunlight reaching the earth’s surface, but they do trap some of the infrared radiation emitted back into space causing an increase in the surface temperature. Global Warming Potential, GWP100, translates the quantity of emission of gases into a common measure to compare their contributions - relative to carbon dioxide - to the absorption of infrared radiation in 100 years perspective.

**Ozone depletion, ODP**
Ozone forms a layer in the stratosphere protecting plants and animals from much of the sun’s harmful UV-radiation. The ozone levels have declined as a consequence of CFCs and halons released into the atmosphere. A depletion of the ozone layer will increase the UV-radiation at ground level. Ozone depletion potential translates the quantity of emission of gases into a common measure to compare their contributions - relative to CFC-11 (a freon) - to the breakdown of the ozone layer.

**Photochemical ozone creation, POCP**
Photochemical ozone or ground level ozone is formed by the reaction of volatile organic compounds and nitrogen oxides in the presence of heat and sunlight. Ground-level ozone forms readily in the atmosphere, usually during hot summer weather. Photochemical ozone creation potential translates the quantity of emission of gases into a common measure to compare their contributions - relative to ethylene - to the formation of photochemical oxidants.

**References**
- LCA report, 3AFE 64429043
- PSR 2000:7 for Variable Speed Electric Drives
- ACS/ACP/ACC 604/607/627 Hardware manual, 3BFE 61201394
- ACS 600 frequency converter, Environmental Information, Recycling Instructions 3AFE 64428969
- MSR 1999:2 Requirements for Environmental Product Declarations, EPD from the Swedish Environmental Management Council

The above mentioned documents are available upon request from ABB Industry Oy, Drives.