Ecodesign approach on an electronic board: “IMPN block”

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06/11/2014
With Alstom, designing fluidity becomes a reality

• Strong collaborative relationships with our customers and our partners, right from the start and throughout the projects
• Strong implication and long term commitment
• Global expertise in sustainable solutions

A promise that Alstom keeps every day

Alstom Transport creates smarter mobility by designing and maintaining railway solutions that run smoothly and efficiently.
State-of-the-art solutions created for public authorities, transport operators and individual passengers

The largest range of the market: from tramway to very high-speed train…
Alstom Transport: a global leader in the rail industry

- Signalling
- Passenger information
- Safety Control center
- Track equipments
- Point machines
- Integrated solutions
- Global systems
Ecodesign approach fundamentals

Ecodesign: a process for Green products, services & solutions

**In Products & Operations**
- Protection of natural resources
- Pollution reduction
- Protection of Biodiversity

**SUSTAINABILITY**

**Profit**
- Risk Management
- Corporate Governance
- Contribution to local development

**People**
- Health and Safety
- Equity and diversity
- Sustainable sourcing
- Community involvement

**Planet**
- Protection of biodiversity
- Pollution reduction
- Protection of natural resources

**Transport**

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Some examples of ecodesign approach at train level.

Coradia solution
Some examples of ecodesign approach at train level....

Coradia solution

Clever counters, to control and optimize electrical consumption

Clean and recyclable materials

Improved stand-by modes
... corresponding to a global commitment

- 5 priority axes:
  - Energy efficiency
  - Clean materials: recyclable, renewable, REACH
  - Noise & Vibration reduction
  - Air emissions reduction
  - Easy end of life management

- Environmental performance characterised
- Environmental Targets into development processes
- Legal compliance
- Training
- Continuous Improvement principles
In villeurbanne, a continuous improvement framework already in place

<table>
<thead>
<tr>
<th>N°</th>
<th>steps</th>
<th>actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Environment management system</td>
<td>Responsibilities, roles, ressources</td>
</tr>
<tr>
<td>2</td>
<td>Skills</td>
<td>Training for stakeholders and suppliers</td>
</tr>
<tr>
<td>3</td>
<td>Communication</td>
<td>PEP, customer events</td>
</tr>
<tr>
<td>4</td>
<td>Environmental analysis</td>
<td>Significant aspects</td>
</tr>
<tr>
<td>5</td>
<td>Operational control</td>
<td>Design process, Ecodesign rules for electronics (« golden rules »)</td>
</tr>
<tr>
<td>6</td>
<td>indicators</td>
<td>Reporting, audits</td>
</tr>
<tr>
<td>7</td>
<td>Compliance evaluation</td>
<td>Regulations, customer requirements</td>
</tr>
<tr>
<td>8</td>
<td>Management</td>
<td>Objectives set up</td>
</tr>
</tbody>
</table>
...leading to ecodesign certification

Ecodesign implementation (according to ISO 14006)

AFAQ ecodesign evaluation, From AFNOR: Level “confirmed” (3/4) obtained.
Operational control: IMPN, a new development

<table>
<thead>
<tr>
<th>Monitoring functions</th>
<th>IMP block</th>
<th>IMPN block</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untimely traction</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Untimely energy recovery</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Incorrect differential current</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Travel direction (by low voltage signals)</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Travel direction (by speed sensor)</td>
<td>✔️</td>
<td>✔️</td>
</tr>
</tbody>
</table>

Block used on metro solutions
High security level (SIL 3) according to railway standards (NF EN 50129)
In accordance with EN 50 155 standard
Product functions:

“Its main function is to open the circuit breaker if a malfunction has been spotted according to the low voltage and speed sensor signals (untimely traction or energy recovery, invalid motor traction differential current or travel direction) in accordance with the specifications NF EN 50155\(^{(3)}\) performance level for a lifetime of twenty years.”

Standards applicable:
An approach in accordance with ISO 14040 and ISO 14044.

Environmental declaration:
compliant with the PCR version PEP–PCR–ed 2.1-FR-2012 12.11 from PEP ecopassport® program.

LCA tool:
EIME® V5, Bureau Veritas
IMP, What is significant?

### Impact observation

<table>
<thead>
<tr>
<th>Use phase for all the indicators</th>
<th>Energy dissipation in the components</th>
<th>Reduction of energy consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing phase for raw material depletion and hazardous waste production</td>
<td>Use of rare and strategic material in EEE Many processes of manufacturing</td>
<td>Make the product lighter and simpler</td>
</tr>
</tbody>
</table>

#### Results in accordance with environmental analysis done during ISO 14001 setting

- **End of life**
- **Use**
- **Distribution**
- **Manufacturing**

#### Impact observation

<table>
<thead>
<tr>
<th>Indicator</th>
<th>End of life</th>
<th>Use</th>
<th>Distribution</th>
<th>Manufacturing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Acidification</td>
<td>10%</td>
<td>90%</td>
<td>0%</td>
<td>10%</td>
</tr>
<tr>
<td>Global Warming Potential</td>
<td>10%</td>
<td>90%</td>
<td>0%</td>
<td>10%</td>
</tr>
<tr>
<td>Photochemical Ozone Creation</td>
<td>10%</td>
<td>90%</td>
<td>0%</td>
<td>10%</td>
</tr>
<tr>
<td>Water Eutrophication</td>
<td>10%</td>
<td>90%</td>
<td>0%</td>
<td>10%</td>
</tr>
</tbody>
</table>

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### IMP/IMPN: redesign axis

<table>
<thead>
<tr>
<th>Priority actions</th>
<th>Design provisions taken</th>
</tr>
</thead>
</table>
| energy           | • Component miniaturisation  
                  • No more « hot point »  
                  • New system to sample the input data |
| materials        | • Connector standardization  
                  • Better spreading of the components on the board: no more heat sink (-95g) |

**Objective:**

Decrease of the impacts for **ALL** indicators

**Communication priorities:**

- **Energy consumption**: energy efficiency is strong customer request
- **Carbon footprint**: customer requirement + comparison between different means of travel
- **Raw material depletion**: high issue for electronic materials
IMPN/IPM, life cycle assessment

**Manufacturing**

**included:** impacts of the factory including energy consumption (ratio “site consumption”/board manufactured”)

**Optimization:** packaging weights and delivery modes performed to minimize the environmental impacts

**Distribution**

Villeurbanne (France)

445 km → Sesto (Italy)

**Use**

No emissions during its use.

**Hypothesis:** 20 years (365 days/year, 20 h/day)

- Annual consumption: 18.1 KWh
- Energy mix chosen: French (EIME module: “ELCD-Electricity Mix; 1kV – 60 kV; France; FR

**End of life**

Dismantling and selecting operations facilitated (removable block)

**Hypothesis:** according to recommendations given by Bureau Veritas CODDE® guide

“Fiches de bonnes pratiques” edited on the 17 of April 2012. (« card F. Modélisation du traitement de fin de vie d’un déchet EEE »).
## IMPN/IPM, Results

<table>
<thead>
<tr>
<th>Impact environnemental</th>
<th>Unity</th>
<th>IMPN block (new)</th>
<th>Comparison</th>
<th>IMP block (old)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Acidification</td>
<td>kg H+ eq.</td>
<td>1,32E-02</td>
<td></td>
<td>2,01E-02</td>
</tr>
<tr>
<td>Air toxicity</td>
<td>m³</td>
<td>1,67E+07</td>
<td></td>
<td>2,54E+07</td>
</tr>
<tr>
<td>Energy Depletion</td>
<td>MJ</td>
<td>7,26E+03</td>
<td></td>
<td>1,08E+04</td>
</tr>
<tr>
<td>Global Warming Potential</td>
<td>kg CO₂ eq.</td>
<td>1,04E+02</td>
<td></td>
<td>1,51E+02</td>
</tr>
<tr>
<td>Hazardous Waste Production</td>
<td>kg</td>
<td>1,16E+00</td>
<td></td>
<td>1,23E+00</td>
</tr>
<tr>
<td>Ozone Depletion Potential</td>
<td>kg CFC-11 eq.</td>
<td>1,61E-04</td>
<td></td>
<td>2,40E-04</td>
</tr>
<tr>
<td>Photochemical Ozone Creation</td>
<td>kg C₂H₄ eq.</td>
<td>1,19E-02</td>
<td></td>
<td>1,91E-02</td>
</tr>
<tr>
<td>Raw Material Depletion</td>
<td>Y-1</td>
<td>1,39E-13</td>
<td></td>
<td>3,16E-13</td>
</tr>
<tr>
<td>Water Depletion</td>
<td>dm³</td>
<td>1,02E+03</td>
<td></td>
<td>1,51E+03</td>
</tr>
<tr>
<td>Water Eutrophication</td>
<td>kg PO₄³⁻ eq.</td>
<td>4,39E-03</td>
<td></td>
<td>7,38E-03</td>
</tr>
<tr>
<td>Water Toxicity</td>
<td>m³</td>
<td>1,28E+02</td>
<td></td>
<td>1,84E+02</td>
</tr>
</tbody>
</table>
IMPN/IPM, Results

Energy consumption: -32%
representing a saving of 3,540 MJ / block

Carbon footprint: -31%
representing a saving of 47 Kg of CO₂ / block

Raw material use: -56%
representing a saving of 1.77x10^{-13} years / block

On average, the other impacts were reduced by -30%
IMPN: an ecodesigned product with significant environmental savings!

Environmental improvement:

- Significant improvement for all indicators
- Enrichment of « ecodesign golden rules » for electronic
- Set up of tools for a PEP publication goal

Next steps:

PEP approach at product and system level
Other Environmental Declaration Types: EPD

Communication

- ISO 14021, ISO 14025
- EPD: Environmental Product Declaration
  - PCR: transparency & credibility
  - LCA

### Environmental impact categories

<table>
<thead>
<tr>
<th></th>
<th>Upstream</th>
<th>Core</th>
<th>Downstream</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Use</td>
<td>End-of-Life</td>
</tr>
<tr>
<td>[kg eq./ ton · 100 km]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GWP</td>
<td>4.84E-03</td>
<td>3.87E-04</td>
<td>1.97E-01</td>
<td>2.81E-04</td>
</tr>
<tr>
<td>ODP</td>
<td>6.21E-10</td>
<td>3.53E-10</td>
<td>4.18E-07</td>
<td>1.53E-11</td>
</tr>
<tr>
<td>AP</td>
<td>2.98E-05</td>
<td>4.32E-07</td>
<td>2.09E-04</td>
<td>4.58E-07</td>
</tr>
<tr>
<td>EP</td>
<td>1.19E-06</td>
<td>2.08E-07</td>
<td>6.41E-05</td>
<td>1.25E-07</td>
</tr>
<tr>
<td>POCP</td>
<td>2.30E-06</td>
<td>3.96E-08</td>
<td>2.10E-05</td>
<td>4.03E-08</td>
</tr>
</tbody>
</table>

### External Noise

- dB(A)
- Stationary sound pressure level: 62
- Acceleration sound pressure level: 84
- Constant speed sound pressure level (measured at 140km/h and normalized at 80km/h): 85

### Internal Noise

- dB(A)
- Constant speed sound pressure level at 140km/h: 74
Other Environmental Declaration Types: EPD

ENVIRONMENTAL PRODUCT DECLARATION DT5

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Alstom proposes
Environmental-friendly transports

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