Environment Compatibility Technology for Power Supplies

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1. Introduction

There is a growing demand for environmentally friendly products that alleviate environmental burden such as global warming, pollution, and depletion of resources. It has become imperative to assess the environmental burden and to develop a design that would reduce the impact the product will have on the environment.

The entire company is currently committed to product assessment at the designing stage as a simplified LCA (Life Cycle Assessment) that normally assesses the environmental strain that each production process (manufacturing, distribution, use, retrieval and disposal.) will have on the environment. This article describes the approach being taken by the Power Systems Division with some specific implementation examples in which our representative models are used.

2. Approach to the Issue of Design for Environment

Any power supply unit from the Power Systems Division is a complex functional aggregate consisting of at least several thousand components and materials, with a wide range of factors to be taken into account at the designing stage, leaving many technical problems for us to solve in order to satisfy the economy, functional, and performance requirements. Therefore, it is important to clarify our actions regarding a power supply unit so the criteria for assessing of this particular product can be established as we approach the issue of design for environment.

Table 1 gives the specific actions to take for the environmental compatibility of a power supply unit. Of all the specific actions to take, those of particular environmental concern will be discussed as follows:

2.1 Weight Reduction (for smaller and lighter product)

What is most expected when making a product smaller or lighter is a reduction in the amount of resources, energy and time expended on processing materials.

Since the power supply unit being made smaller and lighter also means it's a smaller footprint and floor weight, the size of a power supply unit is an important factor to take into consideration when designing a product.

2.2 Energy Saving

Generation of electrical energy consumes a great deal of fossil oil, which is a limited resource and emits CO_2 gas, which is believed to be the main cause of global warming effect.

Saving energy is one of the most important goals we hope to achieve, as it directly reduces environmental burden. The energy saved for a power supply unit represents the power consumption (loss) reduced during operation. Many later models, using components with lower power consumption ratings and newly developed highly efficient circuitries, are proving to be effective in reducing power consumption.

Table 1 Actions to Take About the Design for Environment for a Power Supply

Item	Description	Specific action
Weight reduction	Smaller	For smaller footprint (Important), reduce production energy
	Lighter	Reduce floor weight (important), Reduce production energy
Energy saving	Rational use of energy by improving performance	Reduce power consumption (important)
Longer life	Long-term operation	Designing the product to last longer pushes up the cost of production. So a way must be found to design the product to last as long as the market-required cost permits.
Safety/ Environmental preservation	Using less hazardous material	Use Lead free solder and wires
	Safe disposal	Establish a procedure for battery disposal Emphasize in instruction manuals
	Preserving of environment at operation and disposal	Establish a procedure for battery disposal Emphasize in instruction manuals
Recycling	Using fewer materials	Unify materials used (important)
	Recycle ratio	Labeling batteries and plastic parts Use easy-to-recycle materials Use cardboards
Ease of disassembly	Easier disassembly	Allows for easy disassembly
	Easy-to-recycle design	Use reusable parts
	Labeling materials	Label materials on a frame
Disposal	Ratio of environmentally harmful substances used	Investigate and use more such materials
Collection/Transport	Ease of collection and transport	Design to allow easy transport for disposal
Information disclosure	Providing information that helps with re-use of recycled resources	Mention in instruction manuals Label on materials and exterior of packaging materials
	Cooperation from materials/parts suppliers	Gather information swiftly

2.3 Using Less Hazardous Material

The number of printed wiring circuit boards (hereafter referred to PWBs) used in a power supply unit ranges from several to a few dozen, depending on the type of the unit. We have already established a manufacturing process that allows PWBs to be cleaned free of CF, which is known to deplete the ozone layer. In response to the call for a lead-free environment, we are committed to establishing a manufacturing process that allows Lead-free soldering (lead is believed to be indispensable for soldering PWBs).

2.4 Safety/Environmental Preservation

We have in place already an in-house system that is capable of investigating every potential hazardous material and building a database covering every component and material used. Particularly where uninterruptible power supply (hereafter referred to UPS) are concerned, we take every caution, as is emphasized in instruction manuals concerning the safety and preservation of the environment whenever such units are to be discarded, as they contain lead-acid batteries as the backup at the power failure.

2.5 Using Fewer Types of Material

Using fewer types of components and materials in a product will facilitate recycling of the product. It is also important that easy-to-recycle materials be selected. In our continuing efforts to improve the product, we are sorting the materials used in power supply units according to their recyclability in order to build a database that helps those involved in designing power supply units to have a shared vision.

3. Examples of Our Main Products Assessed for Environment Compatibility

The Power Systems Division has assessed 8 products at their designing stage. We will present the environmental compatibility-based improvements we have made on the small/medium capacity UPSs, the power conditioner for photovoltaic power system, and the effects brought about by such improvements.

3.1 Small Capacity UPS "SANUPS ASE"

The improvements we have made on the existing small capacity UPS "SANUPS ASC," newly introduced as the "SANUPS ASE," and the effects brought about by such improvements are as follows: Fig. 1 is the appearance of the small capacity UPS "SANUPS ASE".

For more on the small capacity UPS "SANUPS ASE", refer to the article on new products "Small Capacity UPS SANUPS ASE".

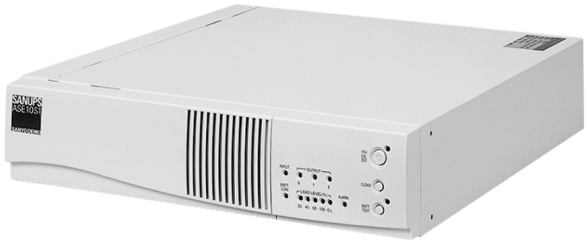

Fig. 1 Appearance of Small Capacity UPS "SANUPS ASE"

(1) Smaller and Lighter
- Improvements
  Optimization of parts usage, reduction in the number of components used, higher efficiency
- Effects
  Volume reduced 26% from 17643cm^3 to 13072cm^3
  Weight reduced 18% from 22kg to 18kg

(2) Energy Saving
- Improvements
  High-efficiency circuit method adopted in the main circuit
- Effects
  Power consumption reduced 56% from 124W to 69W

(3) Easier Disassembly
- Improvements
  Number of components reduced
- Effects
  Number of components at the printed wiring circuit board reduced 40% from 1248 to 755

(4) Recycling
- Improvements
  Labeling raw materials used for plastic parts
- Effects
  All the plastic parts are now labeled as such

3.2 Mid-Capacity UPS "SANUPS AMB T3"

The improvements we have made on the existing medium capacity UPS "SANUPS AMA T3," newly introduced as the new "SANUPS AMB T3," and the effects brought about by such improvements are as follows: Fig. 2 is the appearance of the medium capacity UPS "SANUPS AMB".

Fig. 2 Appearance of Medium-Capacity UPS "SAN UPS AMB"

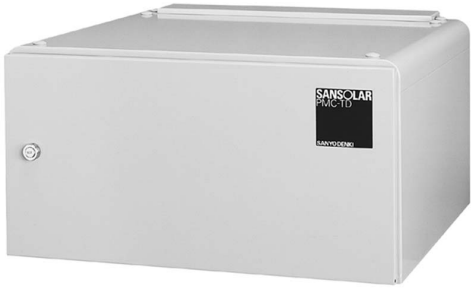

Fig. 3 Appearance of Power Conditioner for Solar Ray Power Generation "SANSOLAR PMC-TD"

(1) Smaller and lighter
- Improvements
  Insulation transformer replaced with semi-conductor insulation method (pending patent application)
- Effects
  Volume reduced 55% from 1.06m^3 to 0.474m^3
  Weight reduced 45% from 850kg to 460kg

(2) Energy Saving
- Improvements
  Insulation transformer replaced with semi-conductor insulation method (pending patent application)
- Effects
  Power consumption reduced 23% from 3650W to 2820W

(3) Longer Life
- Improvements
  Number of components replaced within life span of products reduced
- Effects
  Number of component types replaced reduced 43% from 7 to 4

(4) Using fewer types of material
- Improvements
  Fewer types of material used
- Effects
  Number of material types reduced 44% from 898 to 501

3.3 Power Conditioner For Photovoltaic Power System " SANSOLAR PMC-TD"

The improvements we have made on the existing power conditioner for photovoltaic power system "SANSOLAR PMB," newly introduced as the new "SANSOLAR PMC-TD," and the effects brought about by such improvements are as follows: Fig. 3 is the appearance of power conditioner for photovoltaic power system "SANSOLAR PMC-TD".

(1) Smaller and Lighter
- Improvements
  Optimization of parts usage, reduction in the number of components used, higher efficiency
- Effects
  Volume reduced 74% from 0.4m^3 to 0.1044m^3
  Weight reduced 64% from 180kg to 65kg.

(2) Energy Saving
- Improvements
  Control circuit integrated and carrier frequency optimized
- Effects
  Power consumption reduced 32% from 1100W to 750W

(3) Easier Disassembly
- Improvements
  Number of components reduced and all-in-one design adopted
- Effects
  Number of components reduced 65% from 277 to 97
  Disassembly time reduced 85% from 2534 min to 384 min

(4) Using fewer types of material
- Improvements
  Fewer types of material used; number of composite materials reduced
- Effects
  Number of material types reduced 27% from 15 to 11.
  Number of composite material types reduced 62% from 26 to 10

4. Conclusion

We have presented our approach and examples of Design for environment for the power supply units already implemented at the Power Systems Division.

We intend to commit ourselves to the LCA that can quantitatively assess the effects the product will have on the environment at each stage of production, use, distribution, retrieval, and disposal, in addition to the assessment at the designing stage.

With our in-house system already in place, any product can be certified as a product of Design for environment if it satisfies a certain requirement, making it imperative for us to come up with such certified products as soon as possible as we continue to develop products that are friendly to the Earth.

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Power Systems Division, 1st Design Section
Worked on development and design of power supply systems

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