Changzhou Sieyuan Toshiba Transformer Co.,LTD.

ENVIRONMENTAL PRODUCT DECLARATION

Transformer OSFSZ-200000/230

No. 26 Chunjiang Road, Changzhou City, Jiagsu Province， China

In accordance with ISO 14025 and EN 50693:2019

Program Operator	EPDItaly
Publisher	EPDItaly

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GENERAL INFORMATION

EPD OWNER	
Name of the company	Changzhou Sieyuan Toshiba Transformer Co.,LTD.
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PROGRAM OPERATOR	
EPDItaly	Via Gaetano De Castillia n° 10 - 20124 Milano, Italy

INFORMATION ON THE EPD	
Product name (s)	Transformer OSFSZ-200000/230
Site (s)	No. 26 Chunjiang Road, Changzhou City, Jiagsu Province, China
Short description and technical information of the product (s)	OSFSZ-200000/230 Transformer
Field of application of the product (s)	Transformer
Product (s) reference standards (if any)	EN 50693:2019 – Product category rules for life cycle assessment of electronic and electrical products and systems
CPC Code (number) https://unstats.un.org/unsd/classifications/Econ	46121'Electricial transformer'

VERIFICATION INFORMATION	
PCR (title, version, date of publication or update)	EPDItaly007 – PCR for Electronic and electrical products and systems, Rev. 3.1, 2024/11/12 reviewd by Ing. Ugo Pannuti, ICMQ Spa (Moderator), Eng. Elena Neri, Indaco2 (Committee) EPDItaly018 – Electronic and electrical products and systems – Power transformers, Rev. 3.6, 2024/07/01 NA - Implementation of the Core-PCR EPDItaly007 Rev.3 (Moderator & Committee)
EPDItaly Regulation (version, date of publication or update)	REGULATIONS OF THE EPDItaly PROGRAMME VER. 6.0, ISSUED ON 2023/10/30
Project Report LCA	SIEYUAN TRANSFORMER OSFSZ-200000/230 LCA Report
Independent Verification Statement	Independent verification of the declaration and data, carried out according to ISO 14025: 2010. ☐ Internal ☑ External Third party verification carried out by: ICMQ S.p.A., via Gaetano De Castillia n ° 10 - 20124 Milan, Italy. Accredited by Accredia.
Comparability Statement	Environmental statements published within the same product category, but from different programs, may not be comparable. In particular, EPDs of construction products may not be comparable if they do not comply with EN50693:2019
Liability Statement	The EPD Owner releases EPDItaly from any non-compliance with environmental legislation. The holder of the declaration will be responsible for the information and supporting evidence. EPDItaly disclaims any responsibility for the information, data and results provided by the EPD Owner for life cycle assessment.

OTHER INFORMATION **The reference production year of the product is 2024**	

Contents

GENERAL INFORMATION 2

1. Company information 4

2. Product Information 5

3. Life Cycle Assessment Information 6

3.1. Declared unit 6
3.2. System, temporal, and geographical boundaries 6
3.3. Impact categories 8
3.4. Cut-off 9
3.5. Allocation Principles 9
3.6. Limitation and Assumption 9

4. Inventory analysis 11

5. Environmental Impact Assessment 12

6. References 0

1. Company information

Changzhou Sieyuan Toshiba Transformer Co., Ltd was established through a joint venture between Changzhou Toshiba Transformer Co., Ltd and Sieyuan Electric Co., Ltd. It has more than 280 employees, including about 70 technicians, 11 quality engineers and 10 test engineers. The registered capital is CNY 100,100,000. The total factory area is 80000m2, and the production capacity is 60000MVA/year. The product of CST is 35-500kV oil immersed power transformers, shunt reactors, ester-oil transformers, gas insulated transformers.

In the operation of the company, the respective roles of Toshiba and Sieyuan are Toshiba to provide technical information such as design specification, process specification, inspection procedure, and dispatch technical chief engineer to the factory for technical guidance and quality supervision, and Sieyuan is responsible for management of capital investment, finance, personnel and other aspects.

The company's products are widely used in wind power, photovoltaic, hydropower, rail transit, data center, metallurgical construction and other industries. The products have operation performance in the Grid Company, such as China State Grid, ENEL, Solaria, Celsia,METKA, ANDRITZ, SIMENS,CFE, Vietnam State Grid, Nigeria State grid. Meanwhile, it has been successfully put into operation in major construction projects such as the South-to-North Water Diversion project, West-to-east gas transmission project and Hong Kong-Zhuhai-Macao Bridge. The products produced by the company are also exported to Europ, Central Asia, North America, South America, Southeast Asia, Africa, Australia and other more than 40 countries and regions, deeply trusted by users.

2. Product Information

Product Name: Power transformer; Product Model: OSFSZ-200000/230 Transformer

RATED FREQUENCY：50 Hz

RATED POWER：200/200/63 MVA

VOLTAGE COMBINATION：（230±12×1.25%）/138/13.8 kV

RATED CURRENT：502.0/836.7/2636 A

COOLING TYPE：ONAN/ONAF160/160/50.4 - 200/200/63 MVA

Table 1 Material composition of the products (in accordance with EN IEC 62474)

Product Identification Code	OSFSZ-200000/230		
Rated power (kVA)	200000/200000/63000		
Country of installation	Spain		
Total product mass, without packaging and transformer oil (kg)	146788		
Material content	**ID**	**kg**	**%**
Stainless steel	M-100	285	0.38%
Other ferrous alloys, non-stainless steels	M-119	45900	62.09%
Aluminium and its alloys	M-120	183	0.25%
Copper and its alloys	M-121	6818	9.22%
Ceramics	M-160	40	0.05%
Polyamide (unfilled)	M-208		0.00%
Other unfilled thermoplastics	M-249	269	0.36%
NBR	M-320	30	0.04%
Paper	M-341	797	1.08%
Oils and greases	M-410	16000	21.64%
Other material（cable，BVR，etc）		3600	4.87%

No substance in the product greater than 0.10% by weight is present on the "List of Potentially Hazardous Substances" (SVHC in English) candidates for authorization under the REACH legislation.

3. Life Cycle Assessment Information

A Life Cycle Assessment (LCA) is a methodology for assessing the environmental impacts associated with the entire life cycle of a particular product or process. LCA consists of 4 stages (Goal and Scope, Inventory Analysis, Impact Assessment, and review/presentation) which must follow similar procedures to a PCR (Product Category Rules) and helps to evaluate the carbon footprint and natural resources of a product or process. In this EPD, LCA is conducted separately to obtain environmental impact information.

3.1. Declared unit

According to PCR EPDItaly018, the transformer is defined as an assembly of electric and electronic devices adjusting and regulating voltage and current intensity components of electric power, during a reference service life of 35 years.

The declared unit is therefore defined as a single piece of transformer operating for 35 years. Reference flow is one single piece of transformer.

3.2. System, temporal, and geographical boundaries

The system boundary includes the whole life cycle of the analyzed product, according to a “from cradle to grave” application, covering the following life cycle stages:

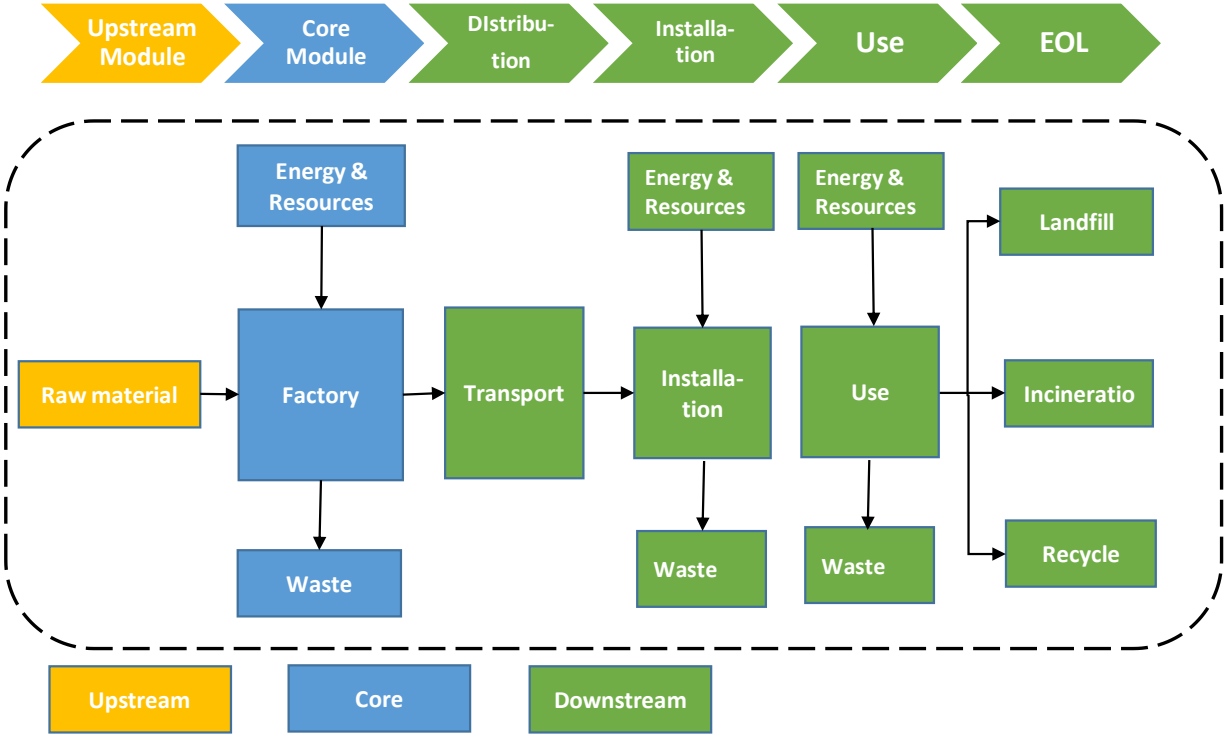

Figure 3.2.1: Phases and processes included

Manufacturing stage. This phase includes the upstream and core modules described previously (raw material transformation, transportation of raw materials and semi-finished products, production of the finished product packaging, generation of process waste including its transportation to the disposal sire, energy and material consumption associated to plant operations);

Distribution stage. This module includes the impacts related to the distribution of the product at the

installation site;

Installation stage. This module includes the end of life of packaging, the energy consumption associated to installation and setup, scrap and waste generated during the installation stage;

Use & Maintenance Stage. This module includes the energy consumed by the transformer to operate during its entire reference service life, ordinary scheduled maintenance and extraordinary scheduled maintenance.

The total energy consumed shall be expressed in kWh and it can be computed via the following formula:

$$E_d[kWh] = [P_{load} * k_{load}^2 + P_{noload}] * t_{year} * RSL + P_{aux} * f_{aux} * t_{year} * RSL$$

End of Life Stage. This module includes the transportation of the transformer to the collection site, disassembly operations, distribution and destination of the various material flows to be sent for recycling or disposal.

Table 4.6.2 – EoI treatment inventory (revised)

Lifecycle stage	Material	Material	Weight of material to be disposal (kg)	Recycle Rate	Weight of material being recycled (kg)	Weight of material being treated (kg)	Treatment method
EoI Waste Treatment	Treated as single material	steel	107520	95%*95%	97036.8	10483.2	50% incinerated and 50% landfilled
		Copper	20048	98%*98%	19254.10	793.90	All incinerated
		cardboard	8851	0%	0	8851	All incinerated
	Separation before treatment	Aluminum	871.3	90%*90%%	705.75	165.55	All incinerated
		Copper	865.37	93%*93%	748.46	116.91	All incinerated
		Steel	7290	93%*93%	6305.12	492.44	50% incinerated and 50% landfilled
		Plastics	385	0%	0	385	Dispose according to Spain scenario
		Ceramics	40	0%	0	40	50% incinerated and 50% landfilled
		Paper	0	0%	0	0	All incinerated
		Glass	0.4	0%	0	0.4	50% incinerated and 50% landfilled
		Zinc	0	0%	0	0	50% incinerated and 50% landfilled
	Special treatment	Nitrile rubber	649.2			649.2	All incinerated
		Power cord	67.19	0%	0	614.39	Incinerated after treatment
		Oil	59500	0%	0	59500	Dispose according to average scenario
		Rest of Electronic wastes	227	0%	0	227	Incinerated after treatment
	Total		208361	/	117793	90567	/

It should be noted that the construction, maintenance, and decommissioning of infrastructure, i.e. buildings and machinery, as well as the occupation of industrial land have not been considered, as their contribution to the environmental impact of the declared unit is considered negligible.

For the study, reference was made to the data deriving from the BOMs of the specific products, whose production began in 2024 (reference year). For plant consumption, reference was made to the data related to the Sieyuan production plant and referred to the year 2024 (January – December), considered representative (at the time of conducting the study, this is the last complete calendar year for which the

data are available).

The suppliers of raw materials and semifinished products are located in China. Where possible, the specific origin of the raw material has been investigated and characterized accordingly. For the downstream phases, and Spain scenario was considered, knowing the exact position of where the transformers will be installed.

3.3. Impact categories

The methodology chosen to evaluate the potential environmental impacts of the product subject of this study includes all the impact categories required by the Standard EN 50693:2019. The models used are those shown in EN 15804 + A2: 2019, as implemented in the SimaPro software. The categories analyzed are therefore:

Indicator name and abbrevation (EN)	Unit (EN)
Global Warming Potential – fossil fuels (GWP-fossil)	kg CO_2 eq.
Global Warming Potential – biogenic (GWP-biogenic)	kg CO_2 eq.
Global Warming Potential – land use and land use change (GWP-luluc)	kg CO_2 eq.
Global Warming Potential – total (GWP-total)	kg CO_2 eq.
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC-11 eq.
Acidifcation potential, Accumulated Exceedance (AP)	mol H+ eq.
Eutrophication potential – freshwater (EP-freshwater)	kg P eq.
Eutrophication aquatic marine (EP-marine)	kg N eq.
Eutrophication terrestrial (EP-terrestrial)	mol N eq.
Photochemical Ozone Creation Potential (POCP)	kg NMVOC eq.
Abiotic depletion potential – non-fossil resources (ADPE)	kg Sb eq.
Abiotic depletion potential – fossil resources (ADPF)	MJ, net calorific value
Water (user) deprivation potential (WDP)	m^3 world eq. Deprived

*Please also noted that the EN 15804+A2 method is based on the EF 3.1 version for this study.

3.4. Cut-off

According to EPD Italy Regulations and PCR EPDItaly007, the following flows and operations are cut-offed:

- Production, use and disposal of the packaging of components and the packaging of semi-finished intermediates.
- Materials making up the transformer itself whose total mass does not exceed 1% of the total weight of the device.
- Material and energy flows related to dismantling phase which is performed by adopting manual tools (e.g. screwdrivers, hammers, etc.).
- Manufacture of equipment used in production, buildings or any other capital goods;
- The transportation of personnel to the plant;
- Transportation of personnel within the plant;
- Research and development activities;
- Long-term emissions.

  During the production process, auxiliary materials such as alcohol (used for cleaning agents), machine oil are utilized. However, due to their minimal consumption and the resulting waste generation being far less than 1% of the weight of the raw materials per unit of product produced, they have negligible impact on the overall results of the life cycle assessment (LCA) and are therefore cut-offed in accordance with cut-off principle from the calculation.

  As far as possible, the entire calculation is based primarily on primary data, and secondary data is obtained based on life-cycle databases or literature, among them, energy consumption is mainly geographical, that is, refer to local data.

3.5. Allocation Principles

Firstly, the principle of "modularity" is followed. The life cycle phases of OSFSZ-200000/230 transformer according to EN 50693:2019 are divided to five modules: Manufacturing, Distribution, Installation, Use and maintenance, End of life. Secondly, the energy and resources usage per functional unit in the production stage of the product is calculated by dividing the annual energy or resource consumption by the total output of the company's product, In detail, the allocation of energy resources for plant processing use is converted using the proportion of rated power of transformer OSFSZ-200000/230 to the total rated power of transformers produced in the plant in 2024.that is, the physical allocation method is used for allocation.

In addition, the default distribution rule for the environmental impacts and benefits of reuse, recovery and/or recycling is based on the polluter pays principle (PPP), which means that the recovery or reuse beneficiary bears the environmental impacts and benefits associated with the recovery or reuse treatment, and the original product manufacturer does not have to bear this part of the impact burden. It also does not participate in the sharing of benefits (environmental impact of the production of the same product avoided by recycling and reuse).

3.6. Limitation and Assumption

The results are only valid for the situation defined by the assumptions described in the present report, and they are subject to change if these manufacturing conditions change. The following assumptions are used in this assessment:

Table 3.6.1 – Assumptions for each stage of the life cycle

Life cycle module	Life cycle stage	Assumption
MANUFACTURING STAGE	Upstream Module	• Raw material information is provided by SIEYUAN according to product's bill of material, losses for metal cutting, wood and transformer oil are considered while others were excluded. Raw material loss rate is assumed to be 5% for silicon steel sheet, 5% for wires, 5% for carboard insulation parts.

		• The density of wood package is assumed to be 746 kg/m3 as glued solid timber is used.
	Core Module	• China consumption electricity mix from East Centre China Grid was used in the core module. For 1kWh electricity used, upstream CO2 emission is 0.881kgCO2e. • Assume same amount of energy and resource consumption were used to produce each unit of rated power of transformer in the manufacturing phase. • Assume same amount of waste were produced to produce each unit of transformer in the manufacturing phase. • The distance from the SIEYUAN plant to the downstream waste disposal site is assumed to be 200 km.
DISTRIBUTION STAGE	Downstream Module	• The product is to be used in Colombia. Downstream distribution distances are estimated from the GAODE map and SEARATE website for shipment distances, inland transport is by truck freight and sea transport is by ship. • The distance from Port of Spain to the client is assumed to be 500 km.
INSTALLATION STAGE		• Energy and resources needed during installation are provided by SIEYUAN, it is assumed the same amount were used to install each unit of transformer. • The distance from the user installation site to the downstream waste disposal site is also assumed to be 200 km • In this stage, package of the transformer and oil tank were disposed, of which 95% of steel is assumed to be recycled and 5% is assumed to be landfilled in accordance with IEC/TR 62635, and 100% of waste wood package is assumed to be incinerated.
USE & Maintenance STAGE		• Energy used during the product service life is provided by SIEYUAN in accordance with PCR EPDItaly018, it is assumed the same amount were used to install each unit of transformer. • According to expert judgement and from various users provided by SIEYUAN, inspection and maintenance do not require replacement parts during the service life, and transformer oil changes are not necessary or foreseen, therefore are not considered in the study.
END-OF-LIFE STAGE De-installation		• In the end of life disposal stage, materials of transformer components can be categorized into several categories - Major components (steel and copper) that can be easily recycled as a single material, components that need to be disassembled and then processed as separate materials, components that are processed as a whole, materials that need to be treated as hazardous waste, and components that need special treatment such as power cords and paper based insulation parts. Global waste material treatment data were used to calculate the potential environment impact at the disposal stage. Recycling rate of each material is assumed in accordance with IEC TR 62635:2012.

4. Inventory analysis

In this EPD, where available, reference was made to primary data. Where access to this type of data was not possible, datasets from the Ecoinvent v3.11 database were used as reference.

Data collection was carried out by preparing a sheet that collected input and output data, in terms of mass, energy consumption were obtained within production site. The data collection sheet was verified and checked by mass balances and reporting any inconsistencies that were clarified and resolved.

In the study, SimaPro 9.6 software was used to establish the model for the life cycle of products and calculate LCA results.

5. Environmental Impact Assessment

Potential Environmental impact of each lifecycle stage are shown below.

Table 5.1.1 – Environmental impact descriptive parameters

Impact category	Unit	Total	Upstream	Core	Downstream			
			Manufacturing		Distribution Stage	Installation Stage	Use & Maintenance Stage	End of Life Stage
Acidification	mol H+ eq	6.23E+04	3.06E+03	2.84E+02	1.25E+03	2.01E+01	5.77E+04	4.26E+01
Climate change	kg CO2 eq	1.53E+07	4.60E+05	5.33E+04	5.94E+04	2.14E+04	1.45E+07	1.89E+05
Climate change - Biogenic	kg CO2 eq	1.63E+05	-4.89E+03	2.31E+02	1.34E+01	1.90E+04	1.34E+05	1.41E+04
Climate change - Fossil	kg CO2 eq	1.50E+07	4.64E+05	5.30E+04	5.93E+04	2.48E+03	1.42E+07	1.75E+05
Climate change - Land use and LU change	kg CO2 eq	1.99E+05	2.95E+02	2.05E+01	3.07E+01	1.00E+00	1.98E+05	1.47E+02
Eutrophication, marine	kg N eq	1.30E+04	4.24E+02	7.20E+01	3.11E+02	7.32E+00	1.22E+04	1.81E+01
Eutrophication, freshwater	kg P eq	2.48E+02	2.39E+01	1.99E+00	3.89E-01	3.25E-02	2.21E+02	7.70E-01
Eutrophication, terrestrial	mol N eq	1.45E+05	4.73E+03	6.67E+02	3.46E+03	7.96E+01	1.36E+05	1.94E+02
Ionising radiation	kBq U-235 eq	5.90E+06	4.82E+03	7.57E+02	1.76E+02	4.89E+01	5.89E+06	3.02E+01
Land use	Pt	6.43E+07	3.31E+06	6.38E+04	3.07E+05	6.83E+03	6.05E+07	7.60E+04
Ozone depletion	kg CFC11 eq	1.35E+00	1.12E+00	2.27E-04	8.50E-04	2.32E-05	2.23E-01	2.25E-04
Photochemical ozone formation	kg NMVOC eq	5.31E+04	2.01E+03	1.90E+02	9.73E+02	2.21E+01	4.99E+04	5.62E+01
Abiotic depletion potential – fossil resources (ADPF)	MJ	4.84E+08	7.90E+06	7.58E+05	7.74E+05	2.96E+04	4.75E+08	1.01E+05
Abiotic depletion potential – non-fossil resources (ADPE)	kg Sb eq	3.74E+01	1.57E+01	8.16E-03	9.36E-02	7.46E-03	2.16E+01	9.55E-03
Water use	m3 depriv.	1.49E+07	9.29E+04	6.19E+03	2.55E+03	5.20E+02	1.48E+07	3.44E+03
Freshwater	m3	2.15E+05	3.02E+03	1.81E+02	7.84E+01	1.60E+01	2.12E+05	9.10E+01

Note: The negative value upstream and distribution stage of Climate change -Biogenic indicator is due to the use of container board as packaging material and plywood as auxiliary material that will be used in the main material of the upstream and container for sea transportation in the distribution stage. Container board, plywood and container for sea transportation will be seen as CO2e absorbed, since they are from biogenic material.

Parameters describing resource use are shown below.

Table 5.1.2 – Parameters describing resource use

Parameter	Unit	Total	Upstream	Core	Downstream			
			Manufacturing Stage		Distribution Stage	Installation Stage	Use & Maintenance Stage	End of Life Stage
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw material (PENRE)	MJ, net calorific value	4.84E+08	7.85E+06	7.58E+05	7.74E+05	2.96E+04	4.75E+08	1.01E+05
Use of renewable primary energy excluding renewable primary energy resources used as raw material (PERE)	MJ, net calorific value	1.42E+08	3.24E+05	6.16E+04	7.35E+03	1.15E+03	1.41E+08	2.44E+03
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials) (PERT)	MJ, net calorific value	1.42E+08	5.13E+05	6.16E+04	7.35E+03	1.15E+03	1.41E+08	2.44E+03
Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials) (PENRT)	MJ, net calorific value	4.84E+08	7.90E+06	7.58E+05	7.74E+05	2.96E+04	4.75E+08	1.01E+05
Use of renewable primary energy resources used as raw material (PERM)	MJ, net calorific value	1.89E+05	1.89E+05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of non-renewable primary energy resources used as raw material (PENRM)	MJ, net calorific value	4.27E+04	4.27E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of secondary raw materials (MS)	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of renewable secondary fuels (RSF)	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of non-renewable secondary fuels (NRSF)	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Waste production descriptive parameters are shown below.

Table 5.1.3 – Waste production descriptive parameters

Parameter	Unit	Total	Upstream	Core	Downstream			
			Manufacturing Stage		Distribution Stage	Installation Stage	Use & Maintenance Stage	End of Life Stage
Hazardous waste disposed (HWD)	kg	3.17E+04	4.97E+02	8.75E+01	1.35E+01	1.24E+02	7.21E+03	2.38E+04
Non-hazardous waste disposed (NHWD)	kg	1.04E+06	5.39E+04	3.45E+03	2.33E+04	6.87E+02	8.46E+05	1.11E+05
Radioactive waste disposed (RWD)	kg	4.03E+03	3.07E+00	5.76E-01	1.10E-01	3.67E-02	4.02E+03	1.96E-02
Materials for energy recovery (MER)	kg	2.26E+04	0.00E+00	0.00E+00	0.00E+00	3.75E+03	0.00E+00	1.89E+04
Material for recycling (MFR)	kg	6.96E+04	0.00E+00	2.14E+03	0.00E+00	4.75E+03	0.00E+00	6.27E+04
Components for reuse (CRU)	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported thermal energy (ETE)	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported electricity energy (EEE)	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

6. References

- ISO 14040:2006 Environmental management — Life cycle assessment — Requirements and guidelines
- ISO 14044:2006 Environmental management — Life cycle assessment — Principles and framework
- EPDItaly007 – PCR for Electronic and electrical products and systems, Rev. 3.1, 2024/11/12
- EPDItaly018 – Electronic and electrical products and systems – Power transformers, Rev. 3.6, 2024/07/01
- EN 50693:2019 Product category rules for life cycle assessments of electronic and electrical products and systems
- Regulations of the EPDItaly Programm Rev.5.2, 2022/02/16
- SIEYUAN TRANSFORMER OSFSZ-200000/130 LCA Report Date of Report 31.10.2025 version 6.0