ENGINEERING TOMORROW

Environmental **Product Declaration**

Sensor DST P146

(measuring range 0 up to 50bar)

EPD issued	2023-12-15
EPD expires	2028-12-15
EPD author	Danfoss Climate Solutions
EPD type	Cradle-to-grave
Declared unit	One product over its Reference Service Life
Products included	Sensor DST P146 (Sales code 075G4140) & Sensor DST P140 (Sales code 075G4029)
Manufacturing Location	Wuqing, China
Use Location	European union
Application	Booster Pumps and Air Compressors
Mass	0,091 kg without packaging 0,103 kg with packaging
Dimensions (H×W×D)	H: 51,5 mm D: ø29,5 mm
Verification	[ ] External [X] Internal [ ] None
Produced to	Danfoss Product Category Rules (2022-09)
Internal independent verifier	Danfoss Power Solutions

Product Description

This Environmental Product Declaration (EPD) follows the Danfoss Product Category Rules (PCR) (2022-09-20). These rules provide a consistent framework for calculating and reporting the environmental performance of Danfoss' products and is aligned with relevant international standards, particularly ISO 14025:2006 and EN 15804+A2:2019.

This document has been produced by Danfoss A/S following an internal verification process, but it is not a third-party verified document.

What is an EPD?

An EPD is a document used to communicate transparently, the quantified environmental impacts of a product over its lifecycle stages. This quantification is done by performing a Life Cycle Assessment (LCA) in line with a consistent set of rules known as a PCR (Product Category Rules).

An EPD provides:

- A product's carbon footprint together with other relevant environmental indicators, including air pollution, water use, energy consumption and waste, over its own life cycle (Modules A-C), as well as the expected benefits of reuse and recycling in reducing the impact of future products (Module D). See Table 1 for module descriptions.
- Environmental data allowing customers to calculate LCAs and produce EPDs for their own products.

Type of EPD

This EPD is of the type 'cradle-to-grave' and includes all relevant modules: production (A1-A3), shipping (A4) and installation (A5); operational energy use (B6); deconstruction (C1), waste collection and transport (C2), treatment (C3) and disposal (C4). It also includes potential net benefits to future products from recycling or reusing post-consumer waste (D). The codes in brackets are the module labels from EN 15804+A2. Modules concerning use, maintenance, repair, replacement, refurbishment (B1-B5) and operational water use (B7) are excluded, following the cut-off rules from EN 15804.

Table 1: Modules of the product's life cycle included in the EPD

Product stage			Installation		Use stage							End-of-life stage				Benefits
Raw materials	Transport	Manufacture	Transport	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-install.	Transport	Waste processing	Disposal	Benefits and loads outside system boundaries
A1	**A2**	**A3**	**A4**	**A5**	B1	B2	B3	B4	B5	B6	B7	**C1**	**C2**	**C3**	**C4**	**D**
X	**X**	**X**	**X**	X	MNR	MNR	MNR	MNR	MNR	**X**	MNR	**X**	**X**	**X**	**X**	**X**

(X = declared module; MNR = module not relevant)

Product Description

The Danfoss Sensor Technology (DST) P140 & P146 are designed for use in industrial applications like Booster Pumps and Air Compressors. The DST P140 & P146 pressure sensor are based on a MEMS measuring principle and with a robust, stainless steel, welded design — eliminating the need for an internal gasket on the media side and reducing the number of potential leak points. Its high overload and burst pressure capabilities guarantee long-term stability even in harshest environments.

The media applies a pressure on the internal diaphragm and the pressure is then transferred through the oil filling to the MEMS chip. Via the internal electronics the pressure is converted to e.g. a standard current (4-20 mA) output signal.

The hermetically sealed design provides excellent media compatibility and makes it ready for todays and future media.

See more information about the P140 & P146 series on Danfoss product store.

Figure 1: Sensor DST P146 4-20mA (0-10 bar SG)

Reference Service Life

For the purpose of this EPD the reference service life (RSL) of the product is considered to be 8 years.

Intended market.

The intended market of this study is European Union, and the baseline scenario involves the distribution, installation, and end-of-life in European Union.

Table 2: Product composition

Object description	Net weight	Unit	%
Metals	8,26E-02	kg	90,74%
Aluminum	4,80E-05	kg	0,05%
Steel	4,39E-03	kg	4,83%
Stainless steel	7,81E-02	kg	85,86%
Plastics	4,30E-03	kg	4,73%
PBT	4,30E-03	kg	4,73%
Other	2,80E-03	kg	3,07%

Product Description

Glass	6,00E-06	kg	0,01%
OIl	2,60E-03	kg	2,86%
SBR	1,90E-04	kg	0,21%
Electrical	1,33E-03	kg	1,46%
Actives	1,93E-10	kg	0,00%
Passives	2,10E-05	kg	0,02%
PWBs	1,30E-03	kg	1,43%
Solders	1,00E-05	kg	0,01%
Total product	9,10E-02	kg	100,00%
Cardboard	4,84E-03	kg	39,75%
PET	7,33E-03	kg	60,25%
Total packaging	1,22E-02	kg	100,00%
Total product & packaging	1,03E-01	kg	

The EPD values were calculated for the DST P146 composition. For both P146 and P140 an LCA calculation was made, based on the results from both LCA calculations the environmental indicators for both sensors are within -/+ 10 %. Based on the results this EPD values apply for both sensors (P140 & P146). All sales codes covered by this EPD are shown in table 13.

The declared unit is One product over its Reference Service Life (8 years), with the mass of 0,091 kg.

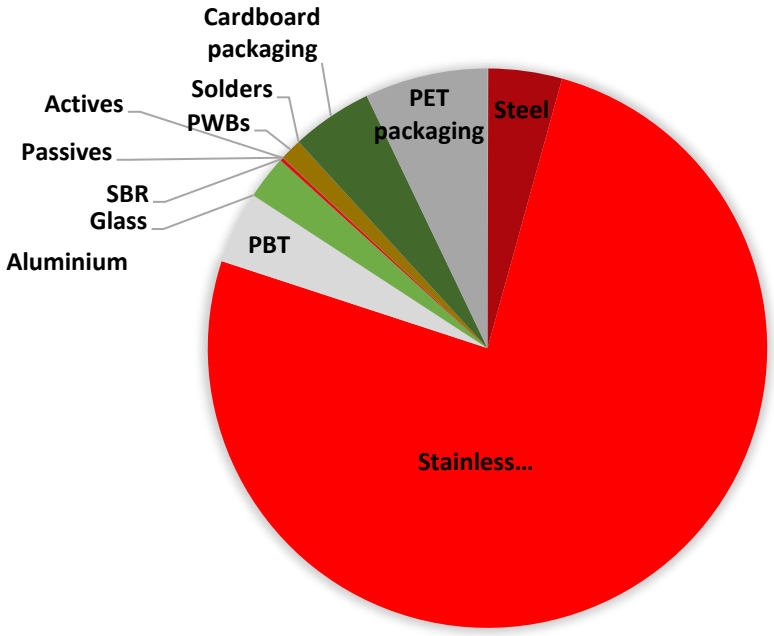

Figure 2: Material Composition Overview

Overview of LCA study

Data quality

Data quality of the selected datasets is generally assessed as good and very good in terms of geographical, time and technology representativeness and applicability. Background data is from LCA software LCA for Experts (Sphera) database version 2023.1.

Allocation and cut-off criteria

The allocation is made in accordance with the provisions of EN 15804+A2. All major raw materials and all the essential energy are included. All hazardous materials and substances are considered in the inventory. Data sets within the system boundary are complete and fulfil the criteria for the exclusion of inputs and output criteria. No known material or energy flows were ignored, including those which fell below the limit of 1%.

Due to its low mass Printer ribbon & glue and are excluded from the study. SBR was used to represent a FKM rubber in the LCA study.

Accordingly, the total sum of input flows ignored is certainly less than 5% of the energy and mass applied.

System boundaries

The results in this EPD are split into life cycle modules following EN 15804 (Figure 1): production (A1-A3), distribution (A4), (A5) installation, use (B6) and the end of the product's life (C1-C4). Module D represents environmental benefits and loads that occur beyond the system boundary (i.e., in future products).

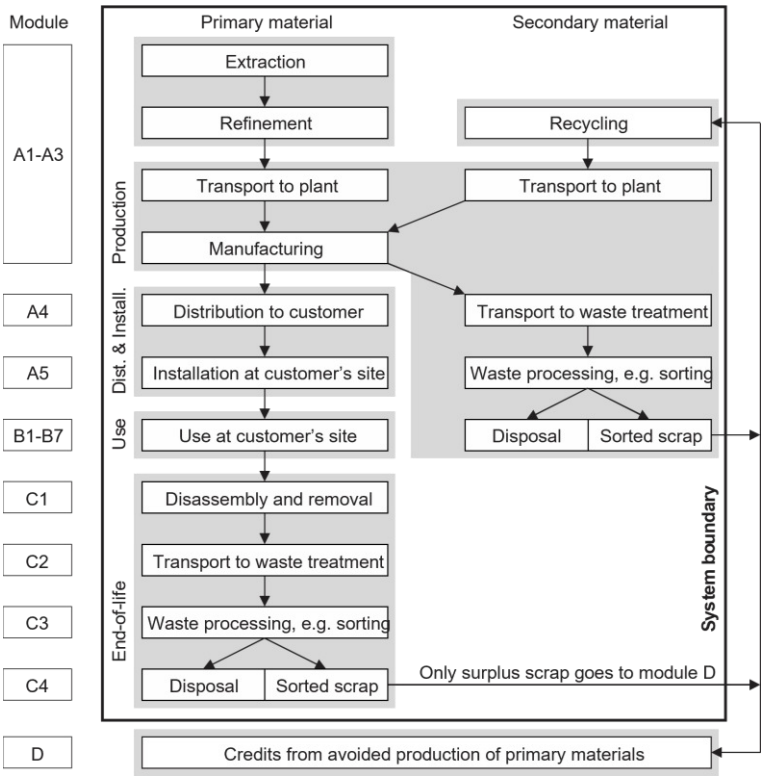

Figure 4: Modular structure used in this EPD (following EN 15804+A2)

Overview of LCA study

Product and packaging manufacture (A1-A3)

Final manufacturing occurs in the Wuqing plant, China, data collected for year 2022. The facility is certified according to IATF 16949 compliant, ISO 50001, ISO 14001, ISO 9001, and UL, where waste generated on-site is separated and recycled comply with local regulations. For further information, see here. The product is shipped in the packaging as described in Table 2. All packaging materials can be safely recycled.

Table 4: Biogenic carbon content in product

	Total (excluding recycling)
Biogenic carbon content in accompanying packaging [kg]	2,08E-03

Note: 1 kg biogenic carbon is equivalent to 44/12 kg of CO_2.

Shipping and installation (A4-A5)

The reference market for the P140 & P146 sensor for this EPD is EU. The assembly factory is in Wuqing, China so a distance of 387 km by truck, and 7300 km by air was used to represent the distance between the factory and the final customer.

Module A5 includes disposal of packaging materials only, the benefits from e.g., energy recovered after plastic incineration are allocated to module D. The product is assumed to be installed by hand and there is no loss of product during installation. Energy use in handheld tools during installation is not included as it falls under the cut-off criteria.

Use phase (B1-B6)

The Reference Service Life (RSL) applied in this EPD is 8 years.

Table 9: Use phase data for P146 sensor

P1xx type	Representative segment for this EPD	Representative output type	Power consumption (w)	Product lifetime (years)	Average operating time (h/year)
P140/146	Water	Current (mA)	0,288	8	8760

The scope of this study is targeted for the European Union market; therefore, the product under study is sold and used in European Union. Sales also occur outside of European Union, which is important to note considering the impact the electricity grid mix can have on the emissions in the use phase. To represent the EU market for the purpose of this assessment, an average EU-27 CO_2 factor from LCA for Experts database (2023.1) is applied.

For this reason, 2 alternative scenarios were made to represent the use phase for the USA and China market.

Overview of LCA study

Table 10: CO2 emissions per use phase location for ABQM with AME 435

Location of use	Use phase, kgCO2eq (GWPF)
European Union (Baseline scenario)	6,39E+00
China	1,61E+01
USA	9,53E+00

The major limitation of the impact calculations for the use phase is that the electricity grid mix in use is assumed to remain at the same carbon intensity over time. Following the plans for the decarbonization of the grid across EU, USA and China, the environmental impacts are expected to decrease over time within the course of the next 10 years. However, as decarbonization will occur in the future and as the pace of decarbonization is uncertain, the use of the emission intensity of today's grid should prove to be a "worst-case", conservative assumption.

End-of-life (C1-C4)

The following end-of-life procedure has been applied:

- Manual dismantling is used to separate recyclable bulk materials, e.g. bulk metals and plastics.
- Shredding is used for the remaining parts, such as printed circuit board assemblies.
- Ferrous metals, non-ferrous metals and bulk plastics are recovered through recycling.
- The remaining materials go to either energy recovery or landfill.

In line with EN 15804+A2, only the 'net scrap' (i.e., the leftover recyclable materials remaining after inputs of recycled content required in the manufacturing phase are first satisfied) is used to calculate the benefits and loads beyond the system boundary (Module D).

For this EPD, it is assumed the sensor will be disposed correctly as e-waste, hence an average scenario with 50% of the product sent to recycling % 50% of the product sent to landfill (C3, C4, D) was used.

This scenario is designed to represent an average end-of-life scenario.

For the EPD this average scenario was chosen as it is assumed that it represents the majority of cases on average.

1. Recycling scenario with 100% of the product sent to recycling at the end-of-life, excluding fractions that cannot be recycled or incinerated (e.g., glass reinforcing in glass-filled plastics) and are sent to landfill.

This scenario illustrates best case performance. It assumes a 100% collection rate and best available recycling technologies. Under this scenario electrical cables, and all metals, flat glass and unreinforced plastics found within the body and chassis of the product are recycled. Printed circuit board assemblies are incinerated, and the copper and precious metals (gold, silver, palladium, and platinum) are recycled.

2. Landfill scenario with 100% of the product sent to landfill.

This scenario assumes that the whole product, including its packaging, is landfilled. It is designed to represent a poor end of-life-route where valuable resources are lost.

Overview of LCA study

Benefits and loads beyond the system boundary (D)

Module D considers the net benefit of recycling (including energy recovery) of materials in the product and packaging, taking account of losses in the recycling process and the recycled material used in the production of the product. Module D covers the two end-of-life scenarios, as described above.

Environmental performance

This section presents the environmental performance of one-unit Sensor DST P146 4-20mA (0-10 bar SG). Figure 5 presents the environmental impact of one-unit Sensor DST P146 4-20mA (0-10 bar SG) across a number of environmental impact categories (following EN 15804+A2:2019) per life cycle stage, over its full life cycle, including Global Warming Potential.

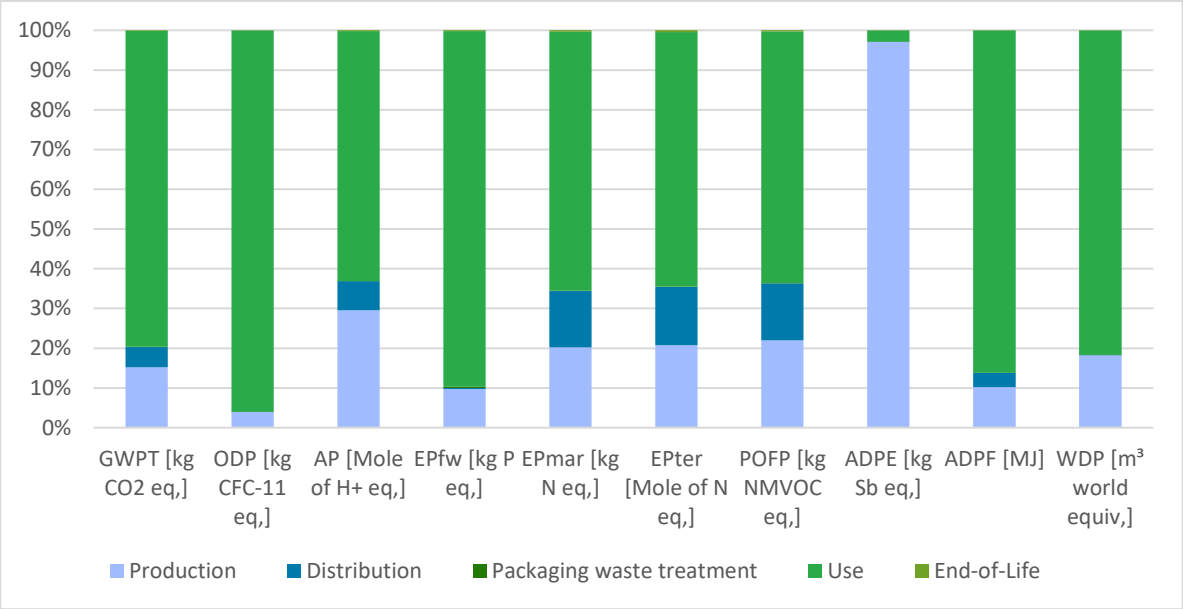

Figure 5: Breakdown of environmental impacts by life cycle stages (see Table 6 for descriptions of environmental impact indicators).

Table 5: Environmental impact indicators

	Production	Distribution	Packaging waste treatment	Use	End-of-Life				(not included in Figure 5)
Life cycle stages based on EN 15804+A2	**A1-A3**	**A4**	**A5**	**B6**	**C1**	**C2**	**C3**	**C4**	**D**
Description / **Environmental Impact Indicators**	Manufacture of the product from 'cradle-to-gate'	Transport of the product to the customer	Installation of the product and disposal of used packaging	Use of the product over its lifetime e.g., 10 years	Deinstallation of the product from the site	Transport of the product to waste treatment	Processing waste for recycling	Disposal of waste that cannot be recycled (through landfill and incineration)	Potential benefits and loads beyond the system boundary due to reuse, recycling, and energy recovery
GWPT [kg CO2 eq.]	1,22E+00	4,06E-01	8,79E-03	6,39E+00	0,00E00	9,29E-04	5,20E-03	2,05E-03	-2,40E-01
GWPF [kg CO2 eq.]	1,23E+00	4,06E-01	1,16E-03	6,32E+00	0,00E00	9,29E-04	5,15E-03	2,05E-03	-2,39E-01
GWPB [kg CO2 eq.]	-7,63E-03	0,00E+00	7,63E-03	6,87E-02	0,00E00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
GWPLULUC [kg CO2 eq.]	8,54E-04	3,76E-05	1,19E-06	6,81E-04	0,00E00	2,24E-08	4,67E-05	2,17E-06	-6,20E-04
ODP [kg CFC-11 eq.]	4,77E-12	2,20E-14	7,81E-16	1,15E-10	0,00E00	1,09E-19	1,92E-15	2,12E-15	-8,60E-14
AP [Mole of H+ eq.]	6,24E-03	1,55E-03	5,71E-06	1,33E-02	0,00E00	1,27E-06	3,19E-05	8,55E-06	-1,65E-03
EPfw [kg P eq.]	2,54E-06	7,72E-08	7,13E-08	2,34E-05	0,00E00	2,01E-10	1,87E-08	3,12E-08	-3,79E-07
EPmar [kg N eq.]	9,88E-04	6,94E-04	2,78E-06	3,19E-03	0,00E00	5,07E-07	1,55E-05	3,00E-06	-2,15E-04
EPter [Mole of N eq.]	1,08E-02	7,61E-03	2,80E-05	3,33E-02	0,00E00	5,58E-06	1,72E-04	3,31E-05	-2,33E-03
POFP [kg NMVOC eq.]	2,95E-03	1,93E-03	6,27E-06	8,51E-03	0,00E00	1,21E-06	2,95E-05	7,31E-06	-6,80E-04
ADPE [kg Sb eq.]	3,25E-05	4,23E-09	6,00E-11	9,68E-07	0,00E00	3,31E-11	3,42E-10	5,32E-11	-2,98E-06
ADPF [MJ]	1,56E+01	5,50E+00	1,59E-02	1,31E+02	0,00E00	1,34E-02	7,00E-02	1,89E-02	-3,32E+00
WDP [m^3 world equiv.]	3,06E-01	6,07E-04	5,07E-05	1,37E+00	0,00E00	1,57E-06	7,60E-05	1,98E-04	-9,65E-02

How to read scientific numbers:

e.g. 2,05E02 = 2,05 x 10^2 = 205

2,04E-01 = 2,04 x 10^{-1} = 0,204

Table 6: Environmental impact indicator descriptions

Acronym	Unit	Indicator
GWPT	kg CO_2 eq.	Carbon footprint (Global Warming Potential) – total
GWPF	kg CO_2 eq.	Carbon footprint (Global Warming Potential) – fossil
GWPB	kg CO_2 eq.	Carbon footprint (Global Warming Potential) – biogenic
GWPLULUC	kg CO_2 eq.	Carbon footprint (Global Warming Potential) – land use and land use change
ODP	kg CFC-11 eq.	Depletion potential of the stratospheric ozone layer
AP	Mole H+ eq.	Acidification potential
EPfw	kg P eq.	Eutrophication potential – aquatic freshwater
EPmar	kg N eq.	Eutrophication potential – aquatic marine
EPter	Mole of N eq.	Eutrophication potential – terrestrial
POFP	kg NMVOC eq.	Summer smog (photochemical ozone formation potential)
ADPE*	kg Sb eq.	Depletion of abiotic resources – minerals and metals
ADPF*	MJ	Depletion of abiotic resources – fossil fuels
WDP*	m^3 world eq.	Water deprivation potential (deprivation-weighted water consumption)

Results for module A1-A3 are specific to the product. All results from module A4 onwards should be considered as scenarios that represent one possible outcome. The true environmental performance of the product will depend on actual use.

The results in this section are relative expressions only and do not predict actual impacts, the exceeding of thresholds, safety margins, or risks. EPDs from others may not be comparable.

Carbon footprint

The total carbon footprint (GWPT), cradle-to-grave, of the product is 8,04E+00 kg CO2-eq (A1-C4). The carbon footprint (GWPT) of production of this product, cradle-to-gate, is 1,22E+00 kg CO2-eq (A1-A3).

Table 7: Resource use

	A1-A3	A4	A5	B6	C1	C2	C3	C4	D
PERE [MJ]	3,66E+00	2,09E-02	9,67E-04	7,85E+01	0,00E00	4,42E-05	5,85E-03	1,76E-03	-5,75E-01
PERM [MJ]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PERT [MJ]	3,66E+00	2,09E-02	9,67E-04	7,85E+01	0,00E00	4,42E-05	5,85E-03	1,76E-03	-5,75E-01
PENRE [MJ]	1,56E+01	5,52E+00	1,66E-02	1,31E+02	0,00E00	1,34E-02	7,05E-02	1,89E-02	-3,32E+00
PENRM [MJ]	7,26E-02	0,00E+00	0,00E+00	0,00E+00	0,00E00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PENRT [MJ]	1,56E+01	5,52E+00	1,66E-02	1,31E+02	0,00E00	1,34E-02	7,05E-02	1,89E-02	-3,32E+00
SM [kg]	7,15E-03	0,00E+00	0,00E+00	0,00E+00	0,00E00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
RSF [MJ]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
NRSF [MJ]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
FW [m3]	8,74E-03	2,84E-05	1,80E-06	6,31E-02	0,00E00	7,10E-08	6,15E-06	5,24E-06	-4,00E-03

Table 8: Resource use indicator descriptions

Acronym	Unit	Indicator
PERE	MJ	Use of renewable primary energy excluding renewable primary energy resources used as raw materials
PERM	MJ	Use of renewable primary energy resources used as raw materials
PERT	MJ	Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)
PENRE	MJ	Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials
PENRM	MJ	Use of non-renewable primary energy resources used as raw materials
PENRT	MJ	Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials)
SM	kg	Use of secondary material
RSF	MJ	Use of renewable secondary fuels
NRSF	MJ	Use of non-renewable secondary fuels
FW	m^3	Net use of fresh water

Table 9: Waste categories and output flows

	A1-A3	A4	A5	B6	C1	C2	C3	C4	D
HWD [kg]	1,01E-07	1,07E-11	5,58E-13	-1,03E-08	0,00E00	9,22E-14	1,01E-13	4,45E-13	-2,61E-05
NHWD [kg]	5,70E-02	4,98E-04	5,45E-03	9,63E-02	0,00E00	1,34E-06	1,16E-05	4,58E-02	2,63E-03
RWD [kg]	4,02E-04	4,90E-06	9,97E-08	2,08E-02	0,00E00	1,44E-08	3,58E-07	1,55E-07	-2,05E-05
CRU [kg]	0,00E+00	0,00E+00	0,00E+00	0,00E00	0,00E00	0,00E00	0,00E+00	0,00E+00	0,00E+00
MFR [kg]	0,00E+00	0,00E+00	0,00E+00	0,00E00	0,00E00	0,00E00	0,00E+00	4,48E-02	0,00E+00
MER [kg]	0,00E+00	0,00E+00	0,00E+00	0,00E00	0,00E00	0,00E00	0,00E+00	0,00E+00	0,00E+00
EEE [MJ]	1,24E-05	0,00E+00	0,00E+00	0,00E00	0,00E00	0,00E00	0,00E+00	1,38E-03	0,00E+00
EET [MJ]	0,00E+00	0,00E+00	0,00E+00	0,00E00	0,00E00	0,00E00	0,00E+00	2,58E-03	0,00E+00

Table 10: Waste category and output flow descriptions

Acronym	Unit	Indicator
HWD	kg	Hazardous waste disposed
NHWD	kg	Non-hazardous waste disposed
RWD	kg	Radioactive waste disposed
CRU	kg	Components for reuse
MFR	kg	Materials for recycling
MER	kg	Materials for energy recovery
EEE	kg	Exported energy (electrical)
EET	kg	Exported energy (thermal)

Table 11: Additional indicators*

	A1-A3	A4	A5	B6	C1	C2	C3	C4	D
PM [Disease incidences]	8,26E-08	5,01E-09	4,13E-11	1,12E-07	0,00E00	1,77E-11	2,05E-10	8,47E-11	-3,25E-08
IRP [kBq U235 eq.]	4,72E-02	6,62E-04	1,31E-05	3,46E+00	0,00E00	2,03E-06	5,70E-05	1,98E-05	-1,94E-03
ETPfw [CTUe]	6,03E+00	3,86E+00	1,39E-02	5,78E+01	0,00E00	9,71E-03	4,94E-02	1,28E-02	-1,97E+00
HTPc [CTUh]	1,89E-07	7,09E-11	4,00E-13	1,93E-09	0,00E00	1,81E-13	1,02E-12	9,64E-13	-3,48E-09
HTPnc [CTUh]	1,84E-08	3,05E-09	3,23E-11	4,75E-08	0,00E00	7,89E-12	6,30E-11	9,58E-11	-4,46E-09
SQP [Pt]	2,81E+00	3,23E-02	2,36E-03	5,17E+01	0,00E00	3,43E-05	2,92E-02	2,45E-03	-4,20E-01

Table 12: Optional indicator descriptions

Acronym	Unit	Indicator
PM	Disease incidence	Potential incidence of disease due to particulate matter emissions
IRP**	kBq U235 eq.	Potential human exposure efficiency relative to U235
ETPfw*	CTUe	Potential Comparative Toxic Unit for ecosystems (fresh water)
HTPc*	CTUh	Potential Comparative Toxic Unit for humans (cancer)
HTPnc*	CTUh	Potential Comparative Toxic Unit for humans (non-cancer)
SQP*	Dimensionless	Potential soil quality index

**Disclaimer for ADPE, ADPF, WDP, ETPfw, HTPc, HTPnc, SQP:* The results of these environmental impact indicators shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.

***Disclaimer for ionizing radiation:* This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

Annex 1: The sales codes of all products covered in this EPD

Sales code	Product description
075G4029	Sensor DST P140 4-20mA(0 - 16 bar Gauge)
075G4140	Sensor DST P146 4-20mA(0-10 bar SG)

References

CEN (2019). *EN 15804:2012+A2:2019: Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products.* Brussels, Belgium: European Committee for Standardization.

Danfoss (2022). *Danfoss Product Category Rules: Environmental Product Declarations for Danfoss Products.* Nordborg, Denmark: Danfoss A/S.

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