شركة صلب ش.م.ب مقفلة
SULB COMPANY B.S.C. CLOSED

Environmental Product Declaration

SULB Company B.S.C.(c)

Hot-Rolled Structural Steel

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ASTM INTERNATIONAL

1. General Information

Name of the Manufacturer: SULB Company B.S.C.(c)

Program Operator: ASTM International

Declaration Number: EPD 080

Reference PCR: IBU PCR Part A: Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project report – Version 1.3 (19.06.2014). & IBU PCR Part B: Requirements on the EPD for Structural steels – Version 1 (11.04.2013).

Date of Issuance: April 24, 2018

End of Validity: April 24, 2023

Product Name: Hot Rolled Steel

EPD Owner: SULB Company B.S.C.(c)
PO Box 50177, Hidd
Kingdom of Bahrain

Product Group: Structural Steels

Declared Product/Declared Unit: 1 ton hot rolled steel

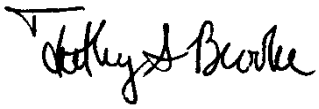
EPD Scope: Cradle-to-gate A1, A2, and A3

Verification:

The CEN Norm EN 15804:2012+A1:2013 serves as the core PCR. Independent verification of the declaration according to ISO 14025:2006 and ISO 21930:2007.

☐ internal ☒ external

LCA Reviewer and EPD Verifier:
Name: Timothy S. Brooke
Organization: ASTM International

Signature: 

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2. Product

2.1 Product Description

The declared unit is 1 metric ton of hot rolled steel – as Manufactured by SULB Company B.S.C.(c). Product specifications are available upon request.

The SULB Company B.S.C.(c) product range includes Equal Leg Angles, I-Beams, H-Beams, H-Piles (HP), Parallel Flange Channels (PFC), Universal Beams (UB) and Universal Columns (UC).

The products are manufactured in accordance with the following international standards:

ASTM International:

- A36/A36M Standard Specification for Carbon Structural Steel
- A572/A572M Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
- A992/A992M Standard Specification for Structural Steel Shapes

EN (European Norms):

- EN 10025-2 Hot rolled products of structural steels - Part 2: Technical delivery conditions for non-alloy structural steels

JIS (Japanese Industrial Standards):

- JIS G 3101 Rolled steels for general structure
- JIS G 3106 Rolled steels for welded structure

KS (Korean Standards):

- KS D 3503 Rolled steels for general structure
- KS D 3515 Rolled steels for welded structure

2.2 Application:

Hot rolled steel is used in a variety of structural applications. Various profiles and grades are specified according to engineering requirements specific to the application.

2.3 Technical Data:

Table 1: Technical Information

Name	Value	Unit
Density	Approx. 7850	kg/m3
Strength and other technical properties vary and are available from the manufacturer for specific orders		

2.4 Delivery Status:
The declared unit is 1 ton of hot rolled steel. The product is available in the following profiles: Equal Leg Angles, I-Beams, H-Beams, H-Piles (HP), Parallel Flange Channels (PFC), Universal Beams (UB) and Universal Columns (UC).

2.5 Base Materials:
The steel product is 100% steel. Steel is is an iron alloy that also contains small amounts of carbon and other base metals. For the purposes of toxicity screening, steel is considered a base ingredient with CAS # 12597-69-2.

2.6 Manufacturing:
The processes that occur at the SULB Company B.S.C.(c) Bahrain facility include: direct reduction of iron (DRI), electric arc furnace (EAF), ladle furnace (LF), continous casting (CCM), and hot-rolling.

2.7 Environment and Health Considerations during Manufacturing:
All relevant Environmental legislation is complied with. The Environmental Management System, based on ISO 14001, is a crucial tool in achieving our aims. Workplace environmental standards are continuously monitored to ensure compliance. Monitoring of work place environmental standards and incident records are well established procedures at the heart of the EMS. Also "Near miss" investigation is a key tool in improving environmental standards leading to continual improvement.

All relevant Occupational health and safety legislation is complied with. In addition, properly engineered facilities and equipment are provided, together with robust systems of work. The Occupational health and safety Management System is a crucial tool in achieving our aims. OHSAS 18001 is the standard on which the H&SMS is based. Monitoring of work place safety standards and accident records are well established procedures at the heart of the H&SMS. Also "Near miss" investigation is a key tool in improving safety standards leading to continual improvement.

2.8 Product Processing/Installation:
The product is installed in a manner and with equipment that is specific to the application for which it was purchased.

2.9 Packaging:
Hot rolled steel is considered a bulk product and is not customarily packaged for shipment. The product is secured to transport vehicles using straps. Any packaging that is required by a

particular customer is negotiated separately from the materials contract and is thus outside the system boundary.No packaging was included in the product system.

2.10 Conditions of Use:
No special features of contents are required for the period of use.

2.11 Environment and Health Considerations During Use:
Hot rolled steel is comprised of inert materials and poses no signficant environmental or health considerations during the use phase.

2.12 Reference Service Life:
No reference service life is declared in this EPD as the scope is limited to A1-A3.

2.13 Extraordinary Effects:
SULB Company B.S.C.(c) holds a Certificate of Factory Production Control (FPC) against EN 10025-1 for the CE Marking of products. SULB Company B.S.C(c) also holds two KS Certificates (Korean Standards) against KS D 3503 and KS D 3515 for the KS Marking of products and operates a BIS (Bureau of Indian Standards) Certification Marks License against IS 2062. SULB Company B.S.C.(c) Declarations of Performance (DoP's) for structural steel sections complying with EN Standards are available upon request.

2.14 Re-use Phase:
At the end of the product's service life, hot rolled steel may be reused or recycled, however, neither of these are included in this EPD. No energy recovery possibilities exist.

2.15 Disposal:
The waste code in accordance with the European Waste Index is 17 04 05. At the end of service life the product may either be re-used, disposed in a landfill, or recycled.

2.16 Further Information:
No further information is reported in this EPD.

2.17 Content Declaration Regarding Potential Toxicity
This EPD makes no claim as to the potential toxicity of the product during use. As noted in Section 2.5, the product is 100% steel which is considered a base ingredient with CAS # 12597-69-2. No known health risks are associated the use of hot rolled steel.

3: LCA Calculation Rules

3.1 Declared Unit:

The declared unit is 1 metric ton of hot rolled steel produced by SULB Company B.S.C.(c).

3.2 System Boundary:

The system boundary for this study is limited to a cradle-to-gate focus. The following three life cycle stages as per the governing PCR are included in the study scope:

- A1- Raw material supply (upstream processes): extraction, handling, and processing of the iron ore, natural gas, limestone, and other material inputs.
- A2- Transportation: transportation of all input materials and fuels from the suppliers to the gate of the manufacturing facility.
- A3- Manufacturing (core process): the processes that occur at the SULB Company B.S.C.(c) facility: direct reduction of iron (DRI), electric arc furnace (EAF), ladle furnace (LF), continous casting (CCM), and hot-rolling.

3.3 Estimates and Assumptions:

All significant foreground data was gathered from the manufacturer based on measured values (i.e. without estimation). The weighted average product profile is assumed to be representative of the various dimensions and options offered by SULB Company B.S.C.(c) product offerings.

3.4 Cut-off Criteria:

The cut-off criteria for all activity stage flows considered within the system boundary conform with ISO14044:2006, section 6 of the IBU PCR Part A:

- All inputs and outputs to a (unit) process were included in the calculation for which data is available. Data gaps were filled by conservative assumptions with average or generic data. Any assumptions for such choices were documented;
- In case of insufficient input data or data gaps for a unit process, the cut-off criteria were 1% of renewable and non-renewable primary energy usage and 1% of the total mass of that unit process. The total neglected input flows, e.g. per module A1-A3 were a maximum of 5% of energy usage and mass. Conservative assumptions in combination with plausibility considerations and expert judgement were used to demonstrate compliance with these criteria;
- Particular care was taken to include material and energy flows known to have the potential to cause significant emissions into air and water or soil related to the environmental indicators of this standard. Conservative assumptions in combination with plausibility considerations and expert judgement were be used to demonstrate compliance with these criteria.

3.5 Background Data and 3.6 Data Quality:

Data was gathered for the primary material inputs used in the production of the hot rolled steel for calendar year 2016. Table 2 describe each LCI data source for raw materials (A1), transportation by mode (A2) and the core manufacture process (A3). Table 2 also includes a data quality assessment for all secondary data on the basis of the technological, temporal, and geographical representativeness as per the IBU PCR.

Table 2: Secondary Data Sources and Data Quality Assessment

A1: Raw Material Inputs				
Inputs	**LCI Data Source**	**Geography**	**Year**	**Data Quality Assessment**
Iron Oxide Pellets	ecoinvent 3.2: Iron pellet {GLO}| market for | Alloc Def, U	Global	2015	**Technology:** very good Process models average global technology **Time:** very good Data is <5 years old **Geography:** very good Data is representative of global conditions.
Natural Gas	Ecoinvent 3.2: Natural gas, high pressure {RoW}| market for | Alloc Def, U	Global	2015	**Technology:** very good Process models average global technology **Time:** very good Data is <5 years old **Geography:** very good Data is representative of global conditions.
Limestone	ecoinvent 3.2: Limestone, crushed, washed {GLO}| market for | Alloc Def, U	Global	2015	**Technology:** very good Process models average global technology **Time:** very good Data is <5 years old **Geography:** very good Data is representative of global conditions.

Table 2 Continued: Secondary Data Sources and Data Quality Assessment

Dolomite	ecoinvent 3.2: Dolomite {GLO}| market for | Alloc Def, U	Global	2015	**Technology:** very good Process models average global technology **Time:** very good Data is <5 years old **Geography:** very good Data is representative of global conditions.
Oxygen (O2)	ecoinvent 3.2: Oxygen, liquid {RER}| market for | Alloc Def, U	Global	2015	**Technology:** very good Process models average global technology **Time:** very good Data is <5 years old **Geography:** very good Data is representative of global conditions.
Carbon (C)	ecoinvent 3.2: Graphite {RoW}| production | Alloc Def, U	Global	2015	**Technology:** very good Process models average global technology **Time:** very good Data is <5 years old **Geography:** very good Data is representative of global conditions.
Nitrogen (N)	ecoinvent 3.2: Nitrogen, liquid {RER}| market for | Alloc Def, U	Global	2015	**Technology:** very good Process models average global technology **Time:** very good Data is <5 years old **Geography:** very good Data is representative of global conditions.

Table 2 Continued: Secondary Data Sources and Data Quality Assessment

Argon (Ar)	ecoinvent 3.2: Argon, liquid {GLO}| market for | Alloc Def, U	Global	2015	**Technology:** very good Process models average global technology **Time:** very good Data is <5 years old **Geography:** very good Data is representative of global conditions.
Ferro-Alloys	ecoinvent 3.2: Ferrite, at plant/GLO with US electricity U	Global	2015	**Technology:** very good Process models average global technology **Time:** very good Data is <5 years old **Geography:** very good Data is representative of global conditions.
Electrodes	ecoinvent 3.2: Graphite {RoW}| production | Alloc Def, U	Global	2015	**Technology:** very good Process models average global technology **Time:** very good Data is <5 years old **Geography:** very good Data is representative of global conditions.
Refractory	ecoinvent 3.2: Refractory, high aluminium oxide, packed {GLO}| market for | Alloc Def, U	Global	2015	**Technology:** very good Process models average global technology **Time:** very good Data is <5 years old **Geography:** very good Data is representative of global conditions.

Table 2 Continued: Secondary Data Sources and Data Quality Assessment

A2: Transportation				
Inputs	**LCI Data Source**	**Geography**	**Year**	**Data Quality Assessment**
Trucking	ecoinvent 3.2: Transport, freight, lorry >32 metric ton, EURO3 {GLO}| market for | Alloc Def, U	Global	2015	**Technology:** very good Process models average global technology **Time:** good Data is < 5 years old **Geography:** very good Data is representative of global conditions.
Ocean Transport	ecoinvent 3.2: Transport, freight, sea, transoceanic ship {GLO}| market for | Alloc Def, U	Global	2015	**Technology:** very good Process models average global technology **Time:** good Data is < 5 years old **Geography:** very good Data is representative of global conditions.
A3: Manufacturing				
Energy	**LCI Data Source**	**Geography**	**Year**	**Data Quality Assessment**
Electricity	ecoinvent 3.2: Bahrain custom electricity grid based on IEA[1] for fuel breakdown (100% Natural Gas) and line loss (2.4%) and ecoinvent 3.2 for electricity generation process data	Bahrain	2015	**Technology**: very good Process models average Bahrain technology **Time**: very good Data is less than 5 years old **Geography**: very good Data is representative of Bahrain electricity.
Water	**LCI Data Source**	**Geography**	**Year**	**Data Quality Assessment**
Municipal Water	Modeled as elementary flow	N/A	N/A	N/A

[1] http://www.iea.org/statistics/statisticssearch/report/?country=BAHRAIN&product=electricityandheat&year=2015

Table 2 Continued: Secondary Data Sources and Data Quality Assessment

Ancillary Materials	LCI Data Source	Geography	Year	Data Quality Assessment
Greases	ecoinvent 3.2: Diesel {RoW}| market for | Alloc Def, U	Global	2015	**Technology:** very good Process models average global technology **Time:** good Data is < 5 years old **Geography:** very good Data is representative of global conditions.
Waste	**LCI Data Source**	**Geography**	**Year**	**Data Quality Assessment**
Steel Coproducts	Excluded from product system as per PCR	N/A	N/A	N/A
Steel Production Waste	ecoinvent 3.2: Process-specific burden, sanitary landfill {RoW}| processing | Alloc Def, U Packaging	Global	2015	**Technology:** very good Process models average global technology **Time:** good Data is < 5 years old **Geography:** very good Data is representative of global conditions.
Secondary Processing	**LCI Data Source**	**Geography**	**Year**	**Data Quality Assessment**
Rolling Mill	ecoinvent 3: Hot rolling, steel {RER}| processing | Alloc Def, U	Global	2015	**Technology:** very good Process models average global technology **Time:** good Data is < 5 years old **Geography:** very good Data is representative of global conditions.

3.7 Period under Review:

Data was gathered for the primary material inputs used in the production of the hot rolled steel for the period 01.12.2016 to 30.11.2017.

3.8 Allocation:

SULB Company B.S.C.(c) produces several valuable coproducts from the unit processes that were included in the scope of the study. The IBU PCR requires economic allocation but, in this case, the overall value of the various coproducts was less than 5% of total revenue. Thus, in accordance with the PCR's principle of making conservative estimations, we did not allocate any of the environmental burden to the coproducts and instead allocated 100% to the primary product output. As per the PCR, all the loads from secondary processing and transportation of coproducts are attributed to 100% to the coproducts.

Recycling processes were treated as closed loop recycling because the scrap is recycled in the same facility. No credits were given to the product system for the value of the recyclable materials and the burden to recycle the scrap was incorporated within the modeled unit processes.

3.9 Comparability:

This LCA was created using industry average data for upstream materials. Data variation can result from differences in supplier locations, manufacturing processes, manufacturing efficiency and fuel types used.

4: LCA: Scenarios and additional technical information

The scope of this EPD is limited to modules A1-A3 and thus no additional scenario or technical information is applicable.

5. LCA: Results

Life cycle impact assessment (LCIA) is the phase in which the set of results of the inventory analysis – the inventory flow table – is further processed and interpreted in terms of environmental impacts and resource use inventory metrics. As specified in the IBU PCR, Table 3 below summmarizes the LCA results for the cradle-to-gate (A1-A3) product system.

Table 3: LCA Results
Description of the System Boundary
(x : included in LCA; mnd: module not declared)

Product			Construction Installation		Use							End-of-life				Benefits of Loads Beyond the System Boundary		
Raw Material supply	Transport	Manufacturing	Transport	Construction/Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	De-Construction/ Demolition	Transport	Waste processing	Disposal	Reuse	Recovery	Recycling
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D	D	D
x	x	x	mnd	mnd	mnd	mnd	mnd	mnd	mnd	mnd	mnd	mnd	mnd	mnd	mnd	mnd	mnd	mnd

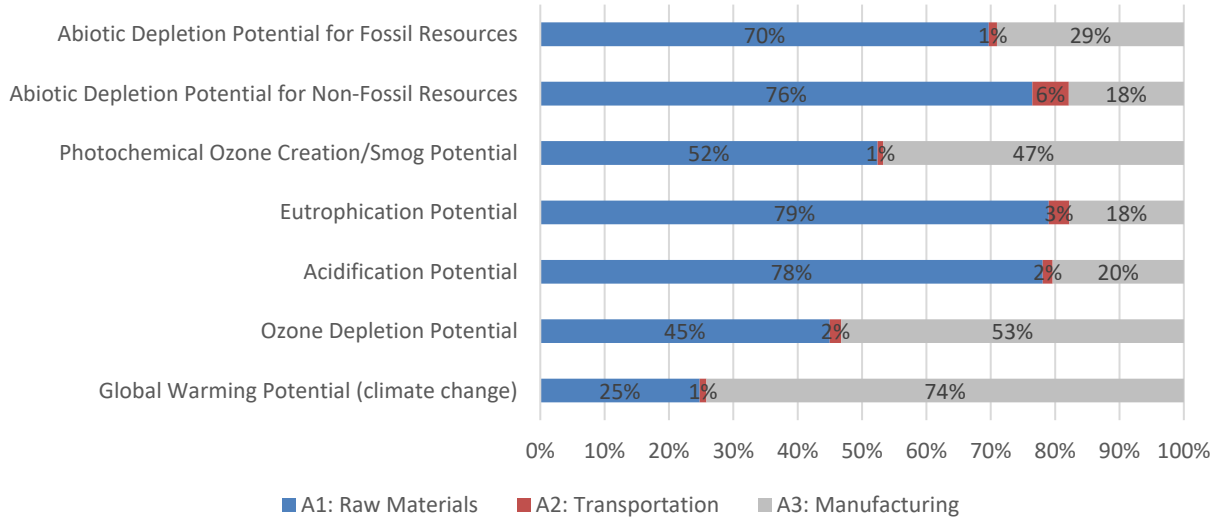
Table 3 Continued: Impact Assessment Results for 1 ton Hot Rolled Steel

LCIA Indicators		Unit	A1-A3 Total
GWP	Global Warming Potential (climate change)	kg CO2-eq	2.67E+03
ODP	Ozone Depletion Potential	kg CFC-11-eq	1.10E-04
AP	Acidification Potential	kg SO2-eq	1.03E+01
EP	Eutrophication Potential	kg PO4-eq	9.00E-01
POCP	Photochemical Ozone Creation/Smog Potential	kg C2H4 eq	6.08E-01
ADPE	Abiotic Depletion Potential for Non-Fossil Resources	kg Sb eq	1.31E-03
ADPF	Abiotic Depletion Potential for Fossil Resources	MJ Surplus	3.51E+04
Inventory Metrics – Resources		**Unit**	**A1-A3 Total**
PERE	Use of renewable primary energy as energy	MJ	9.11E+01
PERM	Use of renewable primary energy as a material	MJ	0.00E+00
PERT	Total use of renewable primary energy	MJ	9.11E+01
PENRE	Use of non-renewable primary energy as energy	MJ	3.34E+04
PENRM	Use of non-renewable primary energy as a material	MJ	0.00E+00
PENRT	Total use of non-renewable primary energy	MJ	3.34E+04
SM	Use of secondary materials	kg	0.00E+00
RSF	Use of renewable secondary fuels	MJ	0.00E+00
NRSF	Use of non-renewable secondary fuels	MJ	0.00E+00
FW	Use of freshwater resources	m3	4.36E+00
Inventory Metrics – Waste and Outputs		**Unit**	**A1-A3 Total**
HWD	Disposed of Hazardous Waste	kg	0.00E+00
NHWD	Disposed of Non-Hazardous Waste	kg	0.00E+00
RWD	Disposed of Radioactive Waste	kg	0.00E+00
CRU	Components for Reuse	kg	0.00E+00
MFR	Materials for Recycling	kg	0.00E+00
MER	Materials for Energy Recovery	kg	0.00E+00
EEE	Exported Electrical Energy (Waste to Energy)	kg	0.00E+00
ETE	Exported Thermal Energy (Waste to Energy)	kg	0.00E+00

6. Interpretation

Figure 1 shows the relative contribution to the cumulative impacts of the A1 through A3 phases of the cradle-to-gate life cycle. The impact categories abiotic depletion potential, eutrophication potential, and acidification potential are dominated by Module A1. This is due to the fact this module incorporates all the upstream extraction of the primary material inputs to the steel product. Module A2 causes very little impacts because the primary material input (iron oxide pellets) are sourced from a facility that is next door to the SULB Company B.S.C.(c) Bahrain operation. The manufacturing Module A3 causes the highest proportion of global warming potential and ozone depletion potential due to the emissions from the steel production processes and the electricity consumed at the facility.

Figure 1: Contribution of Modules A1, A2, and A3 to Environmental Impact Indicators



7. Requisite Evidence

No environemental claims beyond the LCA results are made in this EPD and thus no additional evidence is required.

8. References

1. Athena Institute: 2018 - A Cradle-to-Gate Life Cycle Assessment of Hot Rolled Steel Products Manufactured by SULB Company B.S.C.(c). Background LCA report to this EPD.
2. EN 15804:2012+A1:2013 Sustainability of construction works – Environmental product declarations –Core rules for the product category of construction products.
3. IBU PCR Part A: Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project report – Version 1.3 (19.06.2014).
4. IBU PCR Part B: Requirements on the EPD for Structural steels – Version 1 (11.04.2013).
5. ISO 21930:2007 Building construction – Sustainability in building construction – Environmental declaration of building products.
6. ISO 14025:2006 Environmental labeling and declarations - Type III environmental declarations - Principles and procedures.
7. ISO 14044:2006 Environmental management - Life cycle assessment - Requirements and guidelines.
8. ISO 14040:2006 Environmental management - Life cycle assessment - Principles and framework.