Employer
SAKO BRNO A.S.

Project
High-efficient combined heat and power facility utilizing renewable sources (OHB II - line K1)

Date
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PART III, APPENDIX 22
SAFETY IN DESIGN

SAKO

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Project name	**High-efficient combined heat and power facility utilizing renewable sources (OHB II - line K1)**
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1. DESIGN

The Contractor shall consider all aspects of health, safety and environment in the design, both in terms of the future operation and maintenance of the Line and in planning of the construction, erection and commissioning of the Contract Object to ensure these can be carried out in a safe manner and fulfil any relevant Legal regulation.

For operation and maintenance, these aspects shall include planned and foreseen operation and maintenance works, including likely unplanned works from e.g. accidental damages and leakages. All Line and material, equipment and systems supplied by the Contractor must comply with the list of requirements below and enable the Employer to discharge its legal duties as a user of the Line.

National, legal and statutory requirements:

- All Legal regulation
- All relevant harmonised standards
- Recognised standards and codes of practice (International, National & Local)
- Employer Requirements and codes of practice.

In the event of conflict, the priority of order shall be as shown above.

The Contractor must state, within the CE certificate, which statutory requirements have been considered and must supply all relevant declarations of conformity, safety documentation/certification as part of the Contract Object.

The Contractor shall comply with the general principles and priorities for implementation of safety in the design and ensure this is followed throughout the Works, e.g. by using the principles from the EN ISO 12100 "Safety of machinery - General principles for design. Risk assessment and risk reduction".

1.1 Relevant directives

The Contractor shall comply with all relevant CE marking directives and regulations for the Contract Object, including, but not limited to:

- Machinery Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006 on machinery, and amending Directive 95/16/EC (recast) (MD)

- ATEX Directive 2014/34/EU of the European Parliament and of the Council of 26th February 2014 concerning equipment and protective systems intended for use in potentially explosive atmospheres (ATEX2014)

- Pressure Equipment Directive 2014/68/EU of the European Parliament and of the Council of 15th May 2014 on the approximation of the laws of the Member States concerning pressure equipment (PED)

- Low Voltages Directive 2014/35/EU of the European Parliament and of the Council of 26th February, 2014on the harmonisation of the laws of Member States relating to Electrical Equipment designed for use within certain voltage limits (LVD)

- EMC Directive 2014/30/EU of the European Parliament and of the Council of 26th February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility (EMC)

- Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC (Construction Products Regulation (CPR))

1.2 Relevant norms and standards

The Contractor shall comply with all relevant norms and standards for the Contract Object, including, but not limited to those listed below and the equivalent Czech standards (note that each standard can have more separate parts that are relevant for the Contract Object):

- ČSN/EN ISO 12100 - *Safety of machinery – General principles for design – Risk assessment and risk reduction*

- ČSN/EN 50156 - *Electrical equipment for furnaces and ancillary equipment*

- ČSN/EN 12952 - *Water-tube boilers and auxiliary installations*

- ČSN/EN 61508 - *Functional safety of electrical/electronic/programmable electronic safety-related systems*

- ČSN/EN 61511 - *Functional safety – Safety instrumented systems for the process industry sector*

- ČSN/EN 62061 - *Safety of machinery*

- ČSN/EN ISO 13849 - *Safety of machinery – Safety-related parts of control systems*

- ČSN/EN 60204-1 – *Safety of machinery – Electrical equipment of machines – Part 1: General requirements*

- ČSN/EN 60204-11 – *Safety of machinery – Electrical equipment of machines – Part 11: Requirements for HV equipment for voltages above 1 000 V a.c. or 1500 V d.c. and not exceeding 36 kV*

- ČSN/EN 13445 – *Unfired pressure vessels*

- ČSN/EN 13480 - *Metallic industrial piping*

- ČSN/EN ISO 4126-5 - *Safety devices for protection against excessive pressure – Part 5: Controlled safety pressure relief systems (CSPRS)*

- ČSN/EN 764-7 - *Pressure equipment – Part 7: Safety systems for unfired pressure equipment*

- ČSN/EN 617 - *Continuous handling equipment and systems – Safety and EMC requirements for the equipment for the storage of bulk materials in silos, bunkers, bins and hoppers*
- ČSN/EN 618 - *Continuous handling equipment and systems – Safety and EMC requirements for equipment for mechanical handling of bulk materials except fixed belt conveyors*
- ČSN/EN 620 + A1 - *Continuous handling equipment and systems – Safety and EMC requirements for fixed belt conveyors for bulk materials*
- VDMA 4315 - *Turbomachinery and generators - Application of the principles of functional safety*
- ČSN/IEC 61882 - *Hazard and operability studies (HAZOP studies) – Application guide*
- ČSN/EN 1090 - *Execution of steel structures and aluminium structures*
- ČSN/EN ISO 80079-36 - *Explosive atmospheres – Part 36: Non-electrical for explosive atmospheres – Basic method requirements*
- ČSN/EN ISO 80079-37 - *Explosive atmospheres – Part 37: Non-electrical for explosive atmospheres – Non-electrical type of protection constructional safety ''c'', control of sources ''b'', liquid immersion ''k''*
- ČSN/EN 60079-14 - *Explosive atmospheres – Part 14: Electrical design, selection and erection*
- ČSN/EN 60079-17 - *Explosive atmospheres – Part 17: Electrical installations inspection and maintenance*
- ČSN/EN 60079-10-1 - *Explosive atmospheres – Part 10-1: Classification of – Explosive gas atmospheres*
- ČSN/EN 60079-10-2 - *Explosive atmospheres – Part 10-2: Classification of – Explosive dust atmospheres*
- ČSN/EN 1127-1 - *Explosive atmospheres – Explosion prevention and protection – Part 1: Basic concepts and methodology*
- ČSN/EN 50495 - *Safety devices required for the safe functioning of equipment with respect to explosion risks*
- ČSN/EN ISO 13850 - *Safety of machinery – Emergency stop function – for design*
- ČSN/EN ISO 14120 - Safety of machinery – Guards – General requirements for the design and construction of fixed and movable guards (ISO 14120:2015)
- ČSN/EN ISO 14122 - Safety of machinery – Permanent means of access to machinery

The Contractor shall be responsible for ensuring that all standards used are current. The use of superseded or obsolete standards is unacceptable.

1.3 Risk Assessment

All risk identification and risk mitigation are included in the Contract Object. All risk within the Contract Object as well as risk to be transferred to the Employer or other party at any interface shall be mitigated as a part of the Contract Object. In so far that it is reasonably practicable, unacceptable residual risk shall not be transferred to the Employer or other party, unless agreed by all involved parties.

Any risk reduction measures, or actions arisen from risk assessments shall be implemented in the design as an integrated part of the Contract Object, e.g. it is not an option to mitigate risk by excluding access to areas where daily cleaning or operator inspections are expected.
The Contractor shall conduct risk assessment and analyses in accordance with the regulations and in line with the requirements of the directives (e.g. MD, PED, ATEX, EMC, and LVD) and harmonised standards for the Contract Object. The risk assessment shall document compliance with the Essential Health and Safety Requirements (EHSR) in the Legislation as well as relevant standards.
The Contractor shall conduct HAZOP-studies to analyse health, safety and operational issues. The HAZOP shall cover the Contract Object and interfaces internally and externally towards other parties.
The HAZOP shall be conducted strictly according to IEC / EN 61882 and shall be chaired by an experienced HAZOP leader, subject to approval by the Employer. The HAZOP team shall involve the necessary competent parties including, but not limited to, Contractor's experts, Subcontractors, other contractors in interfaces etc. The Employer shall be invited to participate in HAZOP workshops. The HAZOP shall be fully documented and recorded by 'full recording' (i.e. 'recording by exception' is not acceptable). The Contractor is obliged to participate with experienced personnel in any additional risk assessment workshops with relevance to his Works and interfaces. These additional risk assessments will be initiated by the Employer if needed.
The Contractor shall assess, and document all identified hazards and risk scenarios with Layer of Protection Analysis (LOPA) and ensure compliance with the risk acceptance criteria.

In accordance with the reviewable design data detailed in appendix C1 *Reviewable Project and Design Data,* the Contractor shall present risk assessment methodology and documentation templates containing a complete and detailed description of areas to be covered by HAZOP at least two weeks before the agreed assessment date. The Employer must review and approve the template before any risk assessment is carried out.

In addition, the Contactor shall present updated documentation and background material including but not limited to process & instrumentation diagrams (P&IDs), functional descriptions, material lists, isometrics at least one week before the assessment schedule date.

Risk assessment results shall be sent out latest one week after the risk assessment workshops and meeting have been held.

The figure below shows the workflow for risk reduction to be followed by the Contractor:

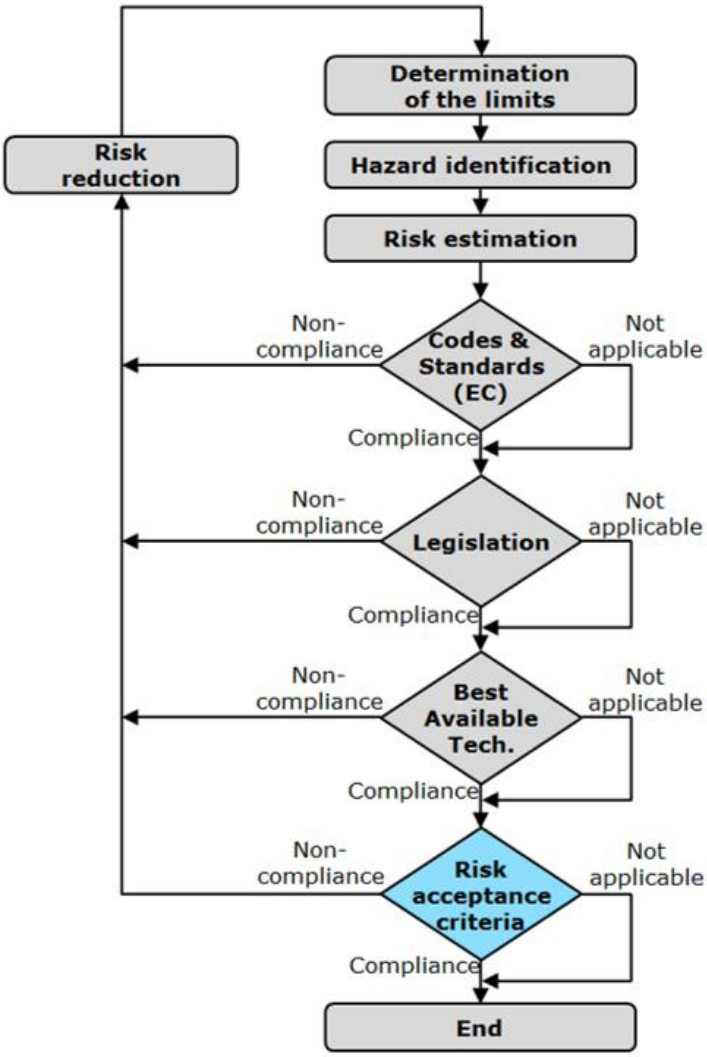

Figure 1 Risk reduction and compliance workflow

The flow chart shall be used in conjunction with the workflow described in EN ISO 12100 "Safety of machinery. General principles for design - Risk assessment and risk reduction". The flow chart shows how to ensure compliance with standards, legislation and the Employer's risk acceptance criteria in the risk identification and risk reduction.

The Contractor shall check risk and design for compliance with:

- European codes and standards
- National and local Legal regulation
- Best available technology (usually sector specific standards)
- Risk acceptance criteria

1.4 Risk Acceptance Criteria and reduction to ALARP

The Contractor shall reduce risk to an acceptable level according to the Employer's risk acceptance criteria specified by the Risk Acceptance Matrix and Consequence Table below.

Risk Acceptance Matrix									
Consequence		Risk Acceptance Matrix - single hazards							
Consequence level	People H&S Environment Economy								
C5	Catastrophic	4	5	6	7	8	9	10	11
C4	Extensive	3	4	5	6	7	8	9	10
C3	Serious	2	3	4	5	6	7	8	9
C2	Considerable	1	2	3	4	5	6	7	8
C1	Marginal	0	1	2	3	4	5	6	7
C0	Negligible	0	0	0	0	0	0	0	0
Likelihood [1/year]	Lower Annual Event Frequency	-	$>10^{-7}$	$>10^{-6}$	$>10^{-5}$	$>10^{-4}$	$>10^{-3}$	$>10^{-2}$	$>10^{-1}$
	Higher Annual Event Frequency	$\leq 10^{-7}$	$\leq 10^{-6}$	$\leq 10^{-5}$	$\leq 10^{-4}$	$\leq 10^{-3}$	$\leq 10^{-2}$	$\leq 10^{-1}$	-
	Frequency level	F7	F6	F5	F4	F3	F2	F1	F0
Legend		Negligible risk. No further mitigation needed							
		Low risk. Broadly acceptable, mitigation according to ALARP							
		Medium risk. Tolerable risk, mitigation according to ALARP							
		High risk. Unacceptable, mitigation necessary							
Calibration	People H&S is calibrated for single hazards scenarios for persons at work (approx. 10% of the lifetime), taking into consideration that a person may be exposed to several hazards (up to 10) simultaneously.								

Figure 2 Risk Acceptance Matrix

Consequence table			
Consequence level	**People H&S**	**Environment**	**Economy**
C5 Catastrophic	Multiple fatalities.	Catastrophic damage to the environment, plant shut down, nearby areas contaminated / evacuated	Property and production loss: >€50,000,000
C4 Extensive	1-2 fatalities.	Extensive damage to the environment. Substantial clean up required	Property and production loss: €5,000,000 to €50,000,000
C3 Serious	Serious irreversible disability.	Serious damage to the environment. Potential for long term damage that requires clean up	Property and production loss: €500,000 to €5,000,000
C2 Considerable	Reversible injury that requires medical attention and lost time.	Considerable damage to the environment but no permanent effects	Property and production loss: €50,000 to €500,000
C1 Marginal	Minor Injury that could require medical attention but no lost time.	Minor damage to the environment but no permanent effects	Property and production loss: €5,000 to €50,000
C0 Negligible	Negligible harm	Negligible effect	Negligible loss

Figure 3 Consequence Table

Risk to People Health and Safety, Environment and Economy shall be assessed.

All risk shall be reduced to ALARP "as low as reasonably practicable", and at least follow relevant good practice. Risks in the red region in unacceptable and must be further mitigated. Risks in the yellow region can be tolerated if ALARP is justified. Risks in green region will be acceptable if ALARP is justified.

The Contractor shall conduct an ALARP evaluation for all risks, whether they are evaluated to be in the green or yellow categories. The ALARP evaluation can be done qualitatively using good engineering judgement, or quantitative using cost benefit analysis. Quantitative ALARP evaluation using cost benefit analysis shall be used for risks in yellow area and with consequence level C3 to C5. Parameters for quantitative ALARP justification, such as value of a lost life shall be aligned with national requirements. Parameters shall be projected to the value present tense.

1.5 Functional Safety Requirements

All electrical or programmable functions used in a protective manner for the Line shall be functional safety. For all such instances of this, the Contractor shall conduct a detailed assessment to decide the integrity required for the function and the equipment. The assessment shall specify any safety requirements dictated by Safety Integrity Level (SIL) to be implemented in the functionality as a Safety Instrumented Function (SIF). When a SIF is implemented, the rules from functional safety shall be followed.

The Contractor shall document compliance with the relevant functional safety standards to ensure functional safety is managed via a structured approach to technical design, management and documentation. Relevant functional safety standards include, but are not limited to, the following:

- ČSN/EN 61511 - *Functional safety – Safety instrumented systems for the process industry sector*
- ČSN/EN 61508 - *Functional safety of electrical/electronic/programmable electronic safety-related systems*
- ČSN/EN 62061 - *Safety of machinery*
- ČSN/EN ISO 13849 - *Safety of machinery – Safety-related parts of control Systems*
- ČSN/EN 50156 - *Electrical equipment for furnaces and ancillary equipment*

To ensure effective project execution and coordination of interfaces, the Contractor shall provide description of the Functional Safety Management (FSM) and planning, Safety Requirement Specifications (SRS), SIL assessments and verifications, and Documentation for Functional Safety Assessments as stated in the reviewable design data.

The following sections refer to requirements from ČSN/EN 61511. When ČSN/EN ISO 13849-1 is used instead of ČSN/EN 61511, similar requirements apply.

1.5.1 FUNCTIONAL SAFETY MANAGEMENT (FSM)

The Contactor shall describe its FSM to demonstrate safe implementation of SIFs. The FSM description shall, as a minimum, include the items listed below, and must be complied with and kept up to date throughout the implementation of Contract Object.

- Functional safety plan
- Functional safety document list
- Roles and responsible persons
- Validation, verification and functional safety assessment plan
- Plan for management of change

The Functional Safety Management plan shall be issued for the Employer's review and approval according to the reviewable design data detailed in appendix C1 *Reviewable Project and Design Data*.

1.5.2 SIL ASSESSMENT

For each individual instrumented function allocated for protection or risk reduction, the Contractor shall carry out SIL assessment. The SIL Assessment shall be conducted to the principles of ČSN/EN 61511-2 guidance for the determination of the required safety integrity level. The SIL assessment shall be chaired by an experienced SIL assessment leader. The SIL assessment team shall involve the necessary competent parties including, but not limited to, Contractor's Experts, Subcontractors, other interfacing contractors. The Employer shall be invited to participate in SIL assessment.

The SIL assessment shall be executed and documented by Layer of Protection Analysis (LOPA). The SIL assessment shall be issued for Employer's review and approval according to the reviewable design data detailed in appendix C1 *Reviewable Project and Design Data*.

1.5.3 SAFETY REQUIREMENT SPECIFICATION (SRS)

The Contractor shall develop and perform a SRS for each individual Safety Instrumented Function (SIF), according to ČSN/EN 61511-1. The SRS shall describe Safety Instrumented System (SIS) safety requirements from ČSN/EN 61511-1 clause 10.3 in a structured, clear and precise format.

SIF shall be specified, designed and verified to achieve required SIL with proof-test interval of minimum 12 months. This means that proof-test intervals lower than 12 months, e.g. 6 months will not be accepted.

A requirement specification for application program shall be derived from the SRS to comply with application program safety requirements as per ČSN/EN 61511-1 clause 10.3.
The SRS shall be issued for the Employer's review according to the reviewable design data detailed in appendix C1 *Reviewable Project and Design Data.*

1.6 SIL verification

The Contractor shall verify achieved SIL for all SIF's. The SIL verification shall include, but not be limited to, the following topics:

- Calculations of the achieved SIL and corresponding Risk Reduction Factor (RRF)
- Hardware fault tolerance compliance
- Systematic capability compliance
- Reliability block diagram or equivalent overview documentation

- built Documentation (e.g. wiring, hook ups and logic)
- SIL certificates and safety manual for equipment, with clear indication of used values (e.g. failure rates, hardware fault tolerance, and constraints).
- All SIL certificates must be based on realistic data and be prepared third party.

All equipment and components used as a part of the Safety Instrumented Functions with SIL requirements, shall be implemented with SIL certified components. If non-SIL certified components is planned to be used, this shall be issued for Employers review and approval prior to design decision.

The SIL verification shall be issued for Employers review and approval according to the reviewable design data detailed in appendix C1 *Reviewable Project and Design Data.*

1.7 Validation and test

The validation and test of all SIF's according to EN61511 part 13, 14 and 15 is part of the Contract Object.
The Contractor shall validate, through inspection and testing, that the installed and commissioned SIF's achieve the requirements as stated in the SRS. The complete system must be validated, inclusive software, functionality, hardware and O&M procedures.

Factory Acceptance Test (FAT) shall be carried out by the Contractor as part of the Contract Object. The Employer shall be invited for participation and supervision in FAT.

A Site Acceptance Test (SAT) shall be carried out by the Contractor as a part of the Contract Object. The Employer shall be invited for participation and supervision in the SAT.

All validation results are included in the Contract Object and must be delivered to the Employer, upon request, immediately after the validation activity is executed.

Prooftest procedures shall be prepared prior to the SAT, and the Contractor must demonstrate that the prooftests are effective and easy to use for Employer's and operator staff. Note that the prooftest procedures will be used frequently in the lifetime of the Line, and it is of the highest importance that the quality is adequate. The prooftests are an essential part of the Line user manual, and the prooftest procedures shall be "tested" during validation of sensor and final element parts of the SIFs, in conjunction with commissioning tests during SAT.

The validation plan including FAT and SAT plans and protocols, and prooftests procedures shall be issued for Employer's review and approval according to the reviewable design data detailed in appendix C1 *Reviewable Project and Design Data.*

1.7.1 FUNCTIONAL SAFETY ASSESSMENT (FSA)

Functional Safety Assessments (FSA) shall be conducted according to ČSN/EN 61511-1 clause 5.2.6.1. The Contractor shall provide an independent assessor, subject to the Employer's approval, to carry out these assessments as required. Resolving issues identified during FSA is part of the Contract Object.

The Contractor shall invite the Employer for participation and review of the following stages of FSA:

- Stage 1: When the risk assessments have been conducted and the SRS have been made.

- Stage 3: When all Safety Integrated Functions (SIFs) have been installed and before potential process risks are present.

FSA findings list or report shall be issued for Employer immediately after the FSA has been carried out.

1.8 CE Marking and declaration

The Contractor shall be regarded as the manufacturer for the Line (as defined by applicable EU Directives) and shall therefore supply Documentation in accordance with the provisions of these directives and CE mark the Line as a whole.

The CE marking shall be done in accordance with Legal regulation applicable EU Directives and national legislation. To ensure an effective project execution and coordination of interfaces, the Contractor shall deliver the following as part of the reviewable design data detailed in appendix C1 *Reviewable Project and Design Data*:

- Plan for CE marking, including preliminary CE-diagram and description. The Contractor shall map out the Line with each section / sub-package included (e.g. boiler, burner, conveyor), how each package is assessed and to which standard(s) each section of Line complies.
- Declaration of Conformity (DoC), not signed, with preliminary indication of EU Directive and all standards expected to be applicable for the Line
- Template for risk assessment, based on the machine directive (MD) covering interfaces to / from the Line.

The Contractor shall deliver a draft risk assessment to the Employer for review prior to all risk assessment workshops and meetings taking place. The draft risk assessment shall include, as a minimum, all suggested areas on which to focus the workshop and all required background material to achieve suitable outcome in workshops / meetings.

1.8.1 PLAN FOR CE MARKING

The plan for CE marking shall contain a CE-diagram for the Line and a description of the CE marking approach; e.g. what sub-assemblies, both regarding MD and the PED, are included in the Line, and what EU Directives are the sub-assemblies and the Line in conformity with.

Some sub-assemblies might be CE marked assemblies of machinery or CE marked assemblies of pressure equipment, whereas others sub-assemblies might be machinery and partly completed machinery that is to be part of the overarching CE marked assembly of machinery.

1.8.2 DECLARATION OF CONFORMITY (DOC)

The DoC shall cover the Line as a whole and shall be in conformity with and contain reference to applicable EU Directives and standards, it shall be signed by the Contractor and it shall be translated into the English language as required.

1.8.3 CE RISK ASSESSMENT

The Contractor shall perform risk assessments according to applicable EU Directives and harmonised standards (EN) for the Line and interfaces to / from the Line. Compliance with shall be ensured by using harmonised standards as far as possible. If this is not possible then the

Contractor shall demonstrate that the solution is in conformity with applicable taking account of the current state of the art.

The Contractor shall include risk assessments of interfaces e.g. the delivery of technical auxiliaries and dispatch of residues. The interfaces shall be clearly identified and a risk assessment covering interfaces shall be made available at an early stage of the Works for Employer review / discussions of interfaces. The Contractor shall be obliged to participate with experienced personnel in any additional risk assessments workshops with relevance to the Line and its interfaces.

Risks within the Contract Object as well as risks transferred though any interfaces shall be mitigated; i.e. risks are not to be transferred, unless agreed upon with the Employer. Risks at incoming interfaces shall further be mitigated if originating from e.g. delivery of technical auxiliaries or similar.

1.8.4 CE MARKING OF STEEL AND ALUMINIUM STRUCTURES

Steel and aluminium structures shall be CE marked in accordance with ČSN/EN 1090-1. The Contractor shall ensure that the manufacturer of steel and aluminium structures shall draw up a DoC for steel and aluminium structures, that entitles him to affix a CE mark, see ČSN/EN 1090-1, ZA.2.3. The CE mark shall be affixed either on the component or on an accompanying label, the packaging or on the commercial documentation, see ČSN/EN 1090-1, ZA.3.

The Contractor shall ensure that the performance characteristics given in EN1090-1, table 1, shall be declared by the manufacturer and that the manufacturer shall issue a Declaration of Performance (DoP).
The Contractor shall ensure that the manufacturer shall establish, document and maintain a factory production control (FPC) system to ensure that products placed on the market conform to the declared performance characteristics, see ČSN/EN 1090-1, section 6.3.1.

1.8.5 DOCUMENTATION

The Contractor shall in accordance with applicable Directives and Legal regulation prepare and deliver the following Documentation:

- One DoC covering the Line
- Instructions according to requirements in EU Directives, like MD (EHSR 1.7.4 Instructions) and harmonised EN standards. Instructions shall be in the official language(s) of the country.
- DoC / DoP for steel and aluminium structures in the Contract Object
- FPC certificate issued by the manufacturer of steel and aluminium structures in the scope of supply

The Contractor shall complete and submit the 'Technical file' established according to requirements in applicable directives, including MD (Annex VII) to the Employer. The Technical File shall include a 'Plan for CE marking'.

The Contractor shall submit the complete Technical File to the Employer in accordance with the reviewable design data detailed in appendix C1 *Reviewable Project and Design Data*.

1.9 ATEX

The Contractor's performance of the Works shall be in compliance with the ATEX regulations and enable the Employer to operate the Line in compliance with the ATEX regulations when put into operation.

The Contractor shall follow the basic principle of explosion protection to avoid or minimise the presence of an explosive atmosphere.

1.9.1 EXPLOSION PROPERTIES AND ASSUMPTIONS

The Contractor shall provide explosion properties for all flammable substances, including dust from waste. Data shall be issued for the Employer to approve prior to Hazardous Area Classification (HAC) and Ignition Source Assessment.

The Contractor shall submit the Documentation for explosion properties and assumption in accordance with the reviewable design data detailed in appendix C1 *Reviewable Project and Design Data*.

1.9.2 HAZARDOUS AREA CLASSIFICATION

HAC is an integrated part of a risk assessment to identify places where controls over ignition sources are needed. The purpose is to define the extent, frequency and duration of any occurrence of an explosive atmosphere resulting in zones. The zone defines the requirements for the selection and installation of equipment and protective systems to prevent sources of ignition. The Contractor shall deliver hazardous area classification for the Line to the Employer for approval. The Contractor shall adopt the HAC into the design only after receipt of the Employers approval. The complete assessment behind the HAC shall be recorded in a document and the HAC shall be shown in the 3D model and in 2D footprint plan(s).

The Contractor shall include appropriate warning signage indicating where hazardous areas occur. The Contractor shall submit the HAC in accordance with the reviewable design data detailed in appendix C1 *Reviewable Project and Design Data*.

1.9.3 IGNITION SOURCE ASSESSMENT

Ignition sources are divided into "equipment related ignition sources" and "non-equipment related ignition sources". Control of 'equipment related ignition sources' is achieved by selecting and installing equipment to the appropriate HAC.

All electrical and mechanical equipment placed and used in a hazardous area shall comply with ATEX and the MD. It shall be emphasised that this applies equally to assemblies and installations. The Contractor shall deliver a list of equipment in any of the identified hazardous areas with specification of the EX category of the equipment.

An ignition source assessment shall be carried out by the Contractor according to ČSN/EN 80079-36 and 80079-37 and ČSN/EN 60079 series for electrical equipment. A list of possible ignition sources can be found in ČSN/EN 1127-1. This will identify equipment related ignition sources.

"Non-equipment related ignition sources" related to other influences shall also be considered by the Contractor in accordance with MD EHSR 1.5.7 where the Contractor shall be required, to a reasonable extent, to take into account external ignition sources. The Contractor shall deliver an assessment and mitigating action plan of "non-equipment related ignition sources", if any.

The Contractor shall prioritise the utilisation of technical (e.g. design or equipment based) mitigation measures, where available, over the usage of procedural or other administrative mitigation measures, unless with the sole approval of the Employer.

The Contractor shall submit the Ignition Source Assessment for Employer review in accordance with the reviewable design data detailed in appendix C1 *Reviewable Project and Design Data*.

1.9.4 EXPLOSION PROTECTION

Should the risk assessment according to ATEX the MD, EHSR 1.5.7 show that explosion cannot be prevented, the Contractor shall mitigate the detrimental effects of a fire or explosion or the other harmful physical effects arising from dangerous substances. Mitigating measures include the avoidance of the propagation of fires or explosions, the provision of explosion pressure relief arrangements, the provision of explosion suppression equipment, the provision of Line which is constructed to withstand the pressure likely to be produced by an explosion.

1.9.5 VERIFICATION OF EXPLOSION SAFETY

The verification of explosion safety is a part of the Contract Object and shall be carried out before the Line is used for the first time. The verification should confirm that the Line, equipment, protective systems, safety devices, components and their combinations, and the building / structure housing them, are suitable for use with the dangerous substances that are to be used in the workplace and the classification(s) of potentially explosive atmosphere that may exist within this.

The initial verification of electrical equipment as well as installation and inspection requirements for electrical installations in hazardous areas shall be according to ČSN/EN 60079-14:2014 and ČSN/EN 60079-17:2014. Currently there is no standard covering this aspect of mechanical equipment, however the principles in both standards applies.

The Contractor shall submit a verification document for Employer review in accordance with the reviewable design data detailed in appendix C1 *Reviewable Project and Design Data*.

1.9.6 INFORMATION, INSTRUCTION AND TRAINING

Before the Line is put into operation for the first time, the Contractor shall provide class or group tuition to the Employer´s operators. The objective of the tuition is providing information and instruction to ensure that employees can work with dangerous substances without putting themselves or others at risk. The significant findings of the risk assessment will help to explain to employees what the risks are and how the control / mitigation measures are designed to protect their safety. It will also help employees to understand and use the safeguards that Contractor (on behalf of Employer) introduce.

1.10 Approval from Notified Body (NoBo)

A NoBo shall be appointed to make design verification and approve the Line according to the Legal regulation and the CE marking. The NoBo shall verify compliance with the standards used for design.

The NoBo shall be a certified NoBo and shall be completely independent from the Contractor, Subcontractors and Employer. The Employer and Contractor must jointly approve the appointment of any NoBo.

1.11 Use of work equipment

The Contract Object shall be in full compliance with national implementation of Directive 2009/104/EC – use of work equipment, and with all necessary installations, documentation, manuals and instructions etc. to enable the Employer to operate and maintain the Line in compliance with it.