# TENDER DOCUMENTATION FOR SELECTION OF THE CONTRACTOR

## Refurbishment of the Combined Heat and Power Plant in Mladá Boleslav

### Business Package OB 2

## BOILER HOUSES

# VOLUME III

## *TECHNICAL REQUIREMENTS*

### Annex A 4.1 Technological Part

# Contents

# 1 APPLICATION OF SOLUTION IN TENDER DOCUMENTS

The tender documentation determines the functional specification of the LOT OB 2, including the definition of the position of the maximum built-in dimensions which shall be met. In addition, the tender documents and the existing documentation for the building permit represent the proposed technical solution of the LOT OB 2, the CONTRACTOR´s flexibility in applying their technical solution, in the design and selection of specific equipment according to their technical practice, experience and habits is acceptable. The CONTRACTOR can also offer to the CLIENT the LOT OB 2 in more technically advanced and efficient execution which meets all requirements specified in the tender documents and the requirements, statements, and opinions of the State Administration Authorities.

The CONTRACTOR is always obliged to list the items that are different in the List of Deviations.

# 2 GENERAL INTRODUCTION

The OB 2 Business package (LOT OB 2) together with other OBs create one functional unit that will be implemented in the existing PLANT. See Annexes A3 and A1 for an overview of OBs.

The scope of delivery and activities is defined in Annex A 1.

# 3 GENERAL PROFESSIONAL REQUIREMENTS

## 3.1 Engineering principles

These technical requirements for the mechanical and technological part do not provide a detailed specification or description of all the equipment and services that the OB2 CONTRACTOR is obliged to supply as a part of the LOT OB 2. The OB 2 CONTRACTOR is obliged to provide a complete technical specification of the EQUIPMENT and SERVICES.

The UNIT is required to be of a modern technical solution, based on proven, safe, economic concepts, in accordance with BAT requirements, with good engineering practice to provide high efficiency and high availability and reliability with short downtimes and low failures rate.

The EQUIPMENT supplied must be designed, constructed, and manufactured in such a way as to ensure low degradation of parameters, efficiency, and performances during the entire lifetime of the UNIT. The UNIT must be designed to be fully complying with any applicable legislation, relevant emission requirements and applicable standards.

The CONTRACTOR must comply with the requirements of this Tender Documentation, if compliance with these requirements would not, for any reason, jeopardize safety, reliability, compliance with legal regulations and standards, or if compliance with these technical requirements would not cause the UNIT worse economic efficiency.

In that case, the BIDDER/CONTRACTOR will offer the CLIENT better EQUIPMENT that is in accordance with the optimal technical and economic solution, engineering practice and safety while respecting the applicable legislation and standards.

The equipment of all kinds must be suitable for the given purpose, operationally verified, high efficiency, safe, designed and implemented according to recognized standards.

All deviations from these technical requirements must be clearly stated and indicated by the BIDDER in their BID.

If deviations are not specifically stated and agreed upon by the CLIENT, it is considered that the CONTRACTOR undertook to comply with all these technical requirements.

**All agreed deviations from these technical requirements will be listed and attached to the subsequent CONTRACT as a separate change overriding the items of these technical annexes to the CONTRACT.**

## 3.2 Pumps

The following requirements shall be applied to the design of pumps:

- leakage of process fluids will be prevented,
- process pumps will have suitable mechanical seals in accordance with the process medium and operating conditions,
- standard performance reserve of 10percent above the balance value is required at the corresponding delivery height required by the system,
- the operating range will correspond to the range with the best efficiency,
- impellers with maximum or minimum diameters are not allowed (it does not apply to pumps controlled by changing the speed),
- installed reserves or spare pumps shall be designed to avoid reduction in the performance or efficiency of the relevant process section at all operating modes, unless otherwise prescribed,
- automatic start-up of the backup pump is required either in the event of malfunction of the basic pump, or in the event of a decrease in the control variables (flow, pressure, temperature, etc.) below a predetermined value,
- the pumps will be equipped with a recording of operating hours in the Distributed Control System (DCS), all pumps are required to be self-priming, their design shall conform to national and international standards,
- all pumps are required to be self-priming, their design shall conform to national and international standards,
- all pumps must be designed to withstand the discharge pressure developed during operation with the valve fully closed on the discharge side, the noise level must correspond to the requirements specified in this documentation,
- materials for all pumps sizing, as well as the calculation of all pumps sizing will be submitted to the CLIENT in the project phase.
- suspension pumps whose parts come into contact with abrasive and corrosive media must be made of high-alloy materials. Mechanical seals will be provided with flushing.

## 3.3 Compressors, blowers, fans, treatment of compressed air

All compressors and blowers must comply with the following conditions:

- leakage of operating fluids is excluded,
- the selected compressors will be of screw type, water-cooled with oil injection, or oil-free ones,
- the operating performance range must correspond to the range with the best efficiency without a control gap,
- installed spares or replacement compressors, blowers and fans must be designed by the CONTRACTOR to avoid reducing the UNIT's performance or efficiency in all operating modes,
- all drives of compressors, dryers and other equipment must be electric,

  - compressors and dryers will be delivered with a noise protection cover and their own control system,
  - if oil injected compressors are used, an oil separator from condensate will be supplied,
  - for applications where it is economically advantageous, air compressors will be supplied in a version with the use of waste heat,
- the technical design of drives must correspond to the given environment in which the equipment operates,
- automatic start-up of the reserve compressor/blower/ventilator is required,
- compressed air condensation dryers will use an ecological refrigerant with the lowest possible global warming potential (GWP),
- condensation dryers will be water-cooled,
- receivers will be installed in the compressor station to cover short-term consumption peaks.

## 3.4 Equipment drives

The following conditions must be considered for drives:

- all drives are electric, except valves and fittings in pneumatic transport and control of flue gas valves and fittings,
- engine power reserve for rotating machines is at least 10percent above the power input on the shaft required at the design (nominal) values of the driven machine, depending on the type of machine, break /starting torque, starting-up conditions, etc.,
- only three-phase motors are required for drives,
- for additional requirements for drives, see the section A4.3 Electro.

## 3.5 Valves and Fittings

- In the framework of the LOT OB 2, shut-off or control valves are preferred, if it is suitable from the point of view of pressure and temperature conditions, or ball valves.
- If valves are used, the valves with double or triple eccentricity will be used.
- In the case of fittings with a large pressure difference, these ones from DN 125 will be equipped with a reducer or a bypass.
- Piping systems of all media must be equipped with shut-off valves and fittings, so that maintenance works can be carried out during operation.
- All valves and fittings necessary for the offered level of automated operation will be equipped with servo drives.
- The new equipment will be provided with such a number of fittings as to ensure safe separation from the existing equipment.
- Control of valves and fittings must not cause pressure surges in the pipeline.
- The basis for the dimensioning of all control valves and fittings, as well as the calculation of the dimensioning of all control valves and fittings, will be submitted to the CLIENT in the project phase.
- The pressure level of the designed valves and fittings is assumed to be at least one degree higher according to ČSN 130010 than the corresponding classification according to the highest working pressure and temperature.

- In case of high-pressure distribution systems, it is required to separate parts being out of operation and designed for repair from parts being in operation can be separated using a double fitting. Either a drain or a vent will be designed between these fittings.
- Backflow and shut-off fittings shall be installed into the discharge pipeline of the pumps for each equipment.
- Fittings will be located to ensure easy access.
- All fittings used shall be of an approved type and from an approved producer.
- They will be selected according to the nature of media; in the open state they will ensure minimal pressure loss and will not be a source of increased noise level.
- Inspections of fittings will be possible without removing them from the piping, repairs and replacement of seals will be possible without removing the cover.
- All fittings will be provided with a local status indicator marking the open and closed positions.
- All fittings will be closed by turning in clock-wise direction. The selected valves and fittings will be lockable or provided with limit position sensors.
- The position of valves and fittings spindles in the pipeline will be according to the valves and fittings manufacturer´s recommendations.
- Ball valves and quick couplers will be used for compressed air distribution.
- Valves with electric drive will have a possibility of local manual mechanical control.
- The spindles of valves and fittings located in uncovered spaces will be provided with protective covers. Operating valves and fittings will be accessible from floors, gangways, and galleries.
- Packing and sealing materials based on Asbestos are unacceptable.
- Flanged fittings will be supplied including outlet counter-flanges with sealing and mounting material, if connected to the existing equipment.

## 3.6 Pipeline

### 3.6.1 Pipeline design

Piping systems will connect individual equipment and device according to their technological functions.

Piping systems will be dimensioned according to the rate of flow and parameters of the respective media. Their configuration and dimensions will be the optimum of an interconnected distance, pressure drop and forces and moments acting on the connection points.

The piping arrangement shall be in accordance with the general rules and with the CONTRACTOR´s best engineering practices and experience.

Ease operation and maintenance must be taken into consideration.

Nominal inside diameters of piping will be chosen according to ČSN EN ISO 6708.

Materials and design of piping will be chosen according to properties and parameters of a substance being transported.

Piping must be designed with minimum vibration.

The pipeline, including accessories, must meet all strength and dimensional requirements and conditions for the construction of all pipeline branches and routes being considered.

All pipes, including equipment, must be conductively connected along entire length of the pipe branches, and grounded properly.

The pipeline must be marked according to the medium used (paint colour, stripe colour, labels, and arrows).

Material creep control will be designed and implemented for all pipes larger than DN 100 and for temperatures of 400 °C and higher.

### 3.6.2 Materials

The relevant standards, regulations and experience of the manufacturer shall be applied when choosing any suitable materials and a type of inspection documents. Below in the text there are only the basic requirements of the CLIENT. In the event that these requirements are in conflict with standards or regulations (including the manufacturer's ones), the provisions that ensure a higher quality of the LOT OB 2 execution shall be applied.

The materials used for the production of the LOT OB2 will correspond to the relevant standards ČSN EN 12 952-2, ČSN EN 13 480-2, ČSN 69 0010-3.1, ČSN EN 13445.

If other materials are used, the CONTRACTOR shall use equivalent materials. If the equivalent material cannot be determined, the suitability of this material shall be proven to the CLIENT by some necessary tests before its use. The CLIENT will be provided with all documents related to the material used, such as material sheets, as well as technological procedures for welding, heat treatment, additional materials, etc.

### 3.6.3 Pipeline calculations

The pipeline design must be in accordance with ČSN EN 13480.

If a part of the pipeline system or equipment connected are outside the sphere of their authority, the OB 2 CONTRACTOR is obliged to verify the design of the entire pipeline system in accordance with the standard by calculation.

The forces and moments transmitted through pipeline systems to the necks of devices and machines must not exceed the forces and moments allowed by the Supplier of the respective equipment.

The pipeline must be marked according to the medium used according to the internal regulations of the CLIENT.

### 3.6.4 Servicing

Ease of operation and maintenance of the pipeline and its accessories must be respected. All technological elements (valves, servo drives, sensors) will be permanently accessible from the floor or service platforms.

### 3.6.5 Abrasive mixtures

In the case of transporting abrasive substances, the rate of flow designed for this pipeline will be chosen to minimize the abrasion of the pipeline. The pipeline will be lined with an abrasion-limiting material (basalt or an equivalent material) and its technical solution will allow the replacement of individual pipeline parts without the need for welded joints. In case of continuation to existing pipe distributions of a similar nature, the design will respect the existing conditions in the pipelines.

This pipeline must be flushable and stable accessories must be installed for flushing.

The pipeline must be designed for the least favourable conditions to which it may be exposed. Conditions arising during commissioning and cleaning the equipment must also be taken into account (pressure and temperature during steam curing, shock pressure, closing pressure of the pump, vacuum caused by cooling-down and condensation of the medium in the closed space and pressure during blowing with vapour, nitrogen, etc.).

### 3.6.6 Air piping

Piping that shall be subjected to negative pressure must be designed for a complete vacuum.

Piping for the distribution of instrument dried compressed air will be made of stainless steel. In cases well-grounded by the CONTRACTOR, distribution lines may be made of a different material, but quality or purity of this medium shall be preserved e.g. by fitting filters. The use of material other than stainless steel for the distribution of instrument air is subject to approval by the CLIENT, as a part of the preparation of the project documentation for the LOT OB 2.

### 3.6.7 Flange joints

Flanged joints may only be used when justified by maintenance or inspection requirements. The pipe branches of the instrument compressed air will be made of stainless steel.

Packings at joints that are disassembled during tests (pressure, etc.) must be replaced with new ones after the test. Threaded connections must not be used in process pipelines.

### 3.6.8 Pipeline passages

Seals for the pipeline passages – wall through to another fire section, following the requirements of the fire safety solution of the building construction or the Supplier´s requirements of the of building structures, are a part of the LOT OB 2 in building structures within LOT OB 2 or continuation of the exiting piping. Pipe passages through building floors / building structures must take into account the insulation diameter / insulation reduction is not allowed.

### 3.6.9 Blow-off, drainage

The pipeline will be properly sloped and provided with the necessary venting at the highest points, draining and discharging at the lowest points of the route and flooding indicators.

Venting/blowing-off, drainage and discharge will be introduced to the corresponding collection points, from where it will be returned to the cycle, or collected for disposal.

In the case of high-temperature pipelines, it will be ensured that the pipeline will allow proper controlled heating.

### 3.6.10 Bends, arcs

Pipe bends will be smooth, with a radius of at least R/D=3.

In well-grounded cases, where the pressure loss does not affect the technological process, pressed elbows can be used.

Segmental welded bends of DN<800 are not allowable.

#### 3.6.10.1 Pipeline laying

The pipeline will be provided with hangers and supports and will be properly compensated to prevent its overstressing and inadmissible forces and moments transmitting to its end points and to other equipment. Fixed points or lines will be located in suitable places to ensure the stability of the pipeline route. Pipe supports and hangers will be made according to ČSN standards.

Pipe supports and hangers must be made according to valid ČSN, TPG standards.

### 3.6.11 Quality Assurance

The pipeline as a whole will be approved by a notified body.

After the INSTALLATION is COMPLETED, the pipeline will be subjected to the prescribed tests (pressure, tightness, NDT, etc. and documented by means of these tests records, certificates on the material used, fittings, welding materials, qualification of welders).

## 3.7 Exchangers, tanks

The equipment must be equipped in such manner to allow easy operation and maintenance with the usual equipment and tools for:

- access for internal inspections, repairs, and cleaning (manholes with curtains, inspection openings, internal ladders),
- external access (operating platforms attached to equipment, ladders, etc.),
- assembly, lifting, disassembly, transport,
- storage structures and anchoring and the possibility of replacing any internal fillings and repairs of built-ins,
- fixing the insulation,
- safety equipment (safety valves, vacuum fuses of reservoirs for overpressure protection, etc.),
- filling-in status signalling,
- remote and local measurement and regulation (including local devices, level indicators),
- overflows,
- venting/blowing-up and draining,
- grounding,
- testing,
- marking,
- reinforcement of small necks,
- installation of built-ins,
- dismantling of lids and heads (mounting arms, hangers, etc.),
- anchoring (screws, nuts, anchoring irons for pouring into foundations),
- technical options for cleaning,
- the usable volume of the tanks must correspond to the requirements for the safe operation of the related equipment and the requirements for handling extraordinary operating conditions of the equipment.

## 3.8 Storage silos

In the case of material storage, where the possibility of spontaneous combustion cannot be excluded, the following principles are recommended for storage silos according to ČSN 44 1315 and ČSN ISO 8456:

- In the case of filling by blowing, safety pressure devices must be built in to prevent exceeding the safe working pressure in the system and a system of protection against under-pressure in the silo,
- the formation of adhesives and vaults must be prevented in silos, especially in corner locations, and therefore it is recommended to build in suitable equipment for their release and lining the walls with an anti-adhesive surface,

- explosion-proof electric lamps must be used to illuminate silos, which must be switched on and off outside the silo interior,
- the silos must be equipped with a device for measuring the level of filling,
- and the following measures are recommended for storing wood chips in containers:
  - for checking the temperature of the fuel in the silos it is necessary to place there permanently thermometers enable to be monitored from the operator's place,
  - equip the silo in its upper part with extraction points for determining whether there are flammable gases (CO, $CH_4$) in the silo,
  - insulate the silo with non-flammable thermal insulation to prevent condensation of water vapour on the walls inside the silo,
  - in the case of closed volumes, explosion protection elements must be installed, or the structure must be designed according to ČSN EN 14460 Equipment resistant to explosion pressure.

The equipment of silos will be implemented according to stored substances and their purpose:

- feed piping with throttle valves,
- technological and revision inlets,
- cones breaking,
- aeration equipment,
- vibrating bottoms,
- surface vibrators, shaking hammers,
- butterfly shut-off flaps,
- turnstile feeder,
- filters
- safety flaps,
- measuring probes,
- railings, ladders, transition and service platforms, incl. trench sheets.

## 3.9 Thermal insulation

Equipment and parts of equipment that have a surface temperature higher than 50 °C under any operating or exceptional operating conditions shall be provided with thermal insulation or a contact protection. The surface temperature of the thermal insulation will be a maximum of 25°C above the ambient air temperature if the ambient temperature is higher than 25 °C and will not exceed 50 °C if the ambient temperature is lower than 25°C.

The equipment and parts of equipment where thermal insulation is used for reasons of economy of operation will be insulated according to the manufacturer's instructions and regulations.

With the exception of special insulations of the manufacturer's standard design (the silo insulation, etc.), the insulations will be provided with aluminium sheathing.

- In outdoor areas, the impassable insulation will be protected by aluminium sheet covering of thickness. 0.8 mm, screwed with galvanized screws with sealing washers. The sheeting will be done in such a way to prevent water leaking.

- In indoor areas, the impassable insulation will be protected by galvanized sheet covering of thickness. 0.8 mm, screwed with galvanized screws with sealing washers. The sheeting will be done in such a way to prevent water leaking.
- Demountable parts will be insulated separately (removable version).
- Removable insulation will be made using casings, bags or in another way acceptable to the CLIENT.
- The insulation will be laid using staggered joints.
- Spatial design of thermally insulated surfaces must enable sufficient removal of the heat that has penetrated from the insulation surface.
- Passable and walkable insulation will be made with the loading performance of 200 kg/m$^2$ at least.

The thickness of insulation and the thermal conductivity of the thermal insulation used must be in accordance with ČSN 07 0620, ČSN 07 0302, ČSN 07 0305, ČSN EN 12952-15, Decree No. 193/2007 Coll., as amended.

- Positioning of equipment that shall be accessible for operation, maintenance, repairs, and inspections will be provided with durable removable insulation. The removable part of the insulation will be designed and made in such a way that it does not damage it and its surroundings during removal and that it can be easily remounted. Larger spaces of removable insulation will be divided into sections, so that each piece can be handled by only one worker. In the case of special insulation, where this division cannot be carried out, the possibility of handling the insulation will be solved with a suitable lifting mechanism.
- Vertical parts of the insulation will be provided with support elements to prevent it from ramming.

The supply of noise protection insulation will be solved in the same way as thermal insulation.

- The insulation sheathing will be tight and will prevent the penetration of water, moisture, oil, and other substances into the active insulation layer. Insulating materials shall be non-flammable and stable in the temperature range for which they are used and shall not be a source of noxious fumes.
- Insulating materials based on asbestos or fiberglass, or loosely packed insulation are not permitted.

## 3.10 Footbridges and stairs

In inaccessible places and in places where there is a risk of falling during manipulation, we require the construction of service platforms.

During production and assembly, the CONTRACTOR will proceed according to ČSN 73 2601 - Implementation of SS and ČSN 74 6930 - Steel floor grids. All manufactured and repaired platforms and ladders must meet the conditions of the ČSN EN ISO 14122 - 1, 2, 3 and ČSN 74 3282 standards.

All platforms and stairs will be provided with paint (structure - grey colour, railings and kick bars - yellow colour). For the implementation of the LOT OB 2, welded steel floor gratings will be used, if possible.

On all repaired or newly installed platforms, their loading performance in kg/m$^2$ will be indicated. The platforms will be marked with an identification number (specified by the CLIENT).

As a part of the LOT OB 2 there will be the "**laying plan of gratings**", prepared in *.dwg format.

Existing auxiliary steel structures, such as service platforms, ladders, support stands, etc., must be returned to their original state after all works completing.

Ensuring an access to emissions measurement and to extraction /bleeding points for periodic emissions measurement.

## 3.11 Welding

The contractor of welding works must meet the requirements of the quality system according to the standard ČSN EN ISO 9001 ed. 2.

The welding process is specified by the set of standards ČSN EN ISO 3834 defining the quality requirements for fusion welding of metallic materials. The welding of the material will be in accordance with ČSN EN 12952-5.

The relevant standards and regulations apply to welding.

Only the basic requirements of the CLIENT are listed below in the text.

In such a case that these requirements are in conflict with standards or regulations (including the manufacturer's ones), the provisions that ensure a higher quality of the OB2 PART will be valid.

The OB2 CONTRACTOR will submit to the CLIENT well in advance the start of welding works (at least 10 days in advance), the following measures:

- Specification of approved WPQR welding procedures according to the group of standards ČSN EN ISO 15607, ČSN EN ISO 15609-1 and ČSN EN ISO 15614-1 by an accredited organization for all welding activities, including intermittent welds and temporary connection welds, possibly supplemented by suitable work instructions and WPS before starting welding works.
- Corresponding and valid test certificates for welders according to the ČSN EN 287 set of standards, welding operators according to ČSN EN ISO 14732.
- Authorization and corresponding qualifications of welding supervisors according to ČSN EN ISO 14731.
- The OB 2 CONTRACTOR undertakes to allow the CLIENT's representative to inspect material storage, basic and additional materials, own welding, welding joints and welders, including their identity documents, upon request.
- Welded joints will be made according to ČSN EN ISO 5817 Welding - Welded joints of steel, nickel, titanium, and their alloys made by fusion welding (except electron and laser welding).
- All welding joints will be identifiable - marked with welders' numbers; the marking must agree with the drawing documentation and correspond to the relevant standards; for welds subject to NDT, the protocol number must also be stamped.
- The OB 2 CONTRACTOR's welders are obliged to keep the certificate and the relevant WPS with them at all times and present them for inspection at the request of the CLIENT´s representative. If it is proven that any uncertified welders are working on parts of the LOT OB 2, the CLIENT has the right to reject this part of the LOT OB 2. The OB 2 CONTRACTOR's welders are also obliged to undergo a work test at the CLIENT's request.
- The OB 2 CONTRACTOR undertakes to take corrective measures, including replacing welding personnel or stopping welding, in case of non-compliance with technological conditions and welding procedures.
- In the Final OB 2 CONTRACTOR´s Documentation, the OB 2 CONTRACTOR shall document the certificates of basic and additional materials, the evaluation of the performed non-destructive tests (NDT).
- In the isometric diagrams, the actual location of the welds will be drawn with a subsequent description (weld number, a welder, NDT protocol number - if issued).
- The CLIENT reserves the right to require the OB 2 CONTRACTOR's workers to perform a work test on the basis of the NDT results.

- Welders of pressure equipment and steel structures will perform a work test based on the CLIENT's request. It is only applied to the assembly.
- The CLIENT reserves the right to control the production process – re-evaluation of X-rays images.
- All welders will have their identification symbol to mark their weld.

## 3.12 Cleaning operations

### 3.12.1 Chemical cleaning

The purpose of chemical cleaning of the boiler is to remove oils, fats, and other impurities from the inner surface of the evaporator and the drum to the operating level and partially also the boiler economizer (boiler heat water system).

Acid boiling-out followed by passivation will be carried out during the Preparation for Comprehensive Testing.

A chemical cleaning project will be prepared to carry out the chemical boiling-out

a) Conditions for starting chemical cleaning of the boiler:

- The Project for putting the LOT OB 2 into operation (a part of chemical cleaning) was handed over,
- the boiler pressure test of was carried out,
- temporary boiler equipment is installed,
- feed water is available,
- the necessary chemicals are available.

b) Chemical cleaning procedure for boiler:

Acid cleaning will be carried out in the following steps:

- boiler flushing – with the aim of removing mechanical impurities from the boiler,
- acid cleaning phase - during this phase free oxide deposits, oils, fats and deposits containing silicon will be removed,
- heating and cooling are repeated twice,
- boiler flushing after the acid phase - at the end of the cleaning, the boiler is flushed in the same way as before the start of the acid boiling of the boiler. Flushing is finished when the water does not contain visible mechanical impurities.

A neutralization tank will be established to drain the cleaning solution.

The OB 2 CONTRACTOR shall arrange the discharge of cleaning solution into the sewerage system after reaching parameters suitable for discharge and after consultation with the CLIENT's chemical service (an environmental department staff) with observing local regulations for waste discharge or removal are observed.

c) Checking the results of chemical cleaning.

### 3.12.2 The boiler and boiler piping purging

The purging is to be performed by the OB 2 CONTRACTOR after completion of the boiler chemical cleaning.

Steam piping purging will be carried out exclusively with the use of a noise dumper.

The blow-through project must be prepared containing data according to Article 5.36 ČSN 07 0705, in particular:

- this project must be agreed in advance by the CLIENT and suppliers of individual technological parts intended for blow-through,
- to indicate the degree of cleanliness control plates with the dimensions of effective surface area shall be used,
- quality criteria for the end of blow-through.

Blow-through may be terminated if it was checked out that with connecting the pipe system for steam supply to the turbine the following criteria have been met:

- at least 5 steam blows were carried out and all conditions according to the elaborated project were observed,
- the value of the absolute quantity of the impurities flow (the degree of the control plate damage) during the last steam blow fell below 30percent of its maximum values detected during any of the previous steam blows,
- the value of the relative degree of impurities flow (the character of control plate damage - size of scratches) during the last steam blow reached its minimum value, compared to previous steam blows,
- the weight indicator of separated impurities during the last steam-blow is equal to or less than this one prescribed in the blow-through program,
- a decrease in the number of impact traces of 0.5 to 1 mm below 30percent of the detected maximum value from the previous steam blows in two immediately consecutive steam blows,
- the average number of impact traces larger than 1 mm in two immediately following steam blows is less than 1, evaluated separately for each pipe route measured.
- The decision to finish steam blows must be made with the participation of the CLIENT and the OB 2 CONTRACTOR, based on meeting the requirements of the subsequent technology.

## 3.13 Explosion protection measures

The entire process will be evaluated on the basis of the Documentation on explosion protection prepared by the OB 2 CONTRACTOR according to the Government Regulation (NV) 406/2004 Coll., and relevant standards and will be in accordance with the requirements for safety and health protection when working in an environment with a risk of explosion.

The OB 2 CONTRACTOR prepares the documentation for protection against explosion in cooperation with the Contractors of other OBs supplying other systems in their building object already in the design phase. On the basis of this document, they will provide their equipment within the scope of their supply with relevant protection systems, and the equipment will be designed for operation suitable for the given environment.

**Sources of Danger**

The source of fire and explosion danger is the technology of transport, storage and dosing of wood chips and plant pellets. Another source is natural gas.

Wood chip dust or dust from plant pellets can form an explosive mixture when mixed with air.

The risk of explosion during transport and storage is particularly high in closed technologies. These are operating storage tanks, pneumatic transport systems, screw conveyors, enclosed belt conveyors, elevators, in the area around overflow conveyors, sweepings from industrial vacuum cleaners, etc.

Storage facilities include silos and closed containers. Inside these technologies, dust particles are stirred up during handling, which can create an explosive atmosphere. If this explosive atmosphere comes into contact with a sufficiently effective initiation source, an explosion will occur.

For the transport of wood chips from silos, or from the bunker to the boiler a separate transport system will be used which will be sealed, so that no dust leaks into the boiler room.

**Measures**

Piping and equipment in which an explosion of flammable vapours or dust may occur will be provided with protective equipment (valves, diaphragms), if they are not designed to withstand explosion pressure.

Areas with a risk of explosion will be provided with permanent ventilation.

Spaces where natural gas is burned will be ventilated with a minimum frequency of air exchange according to the applicable regulations for the given environment. Gas leak detectors will be installed here which will close the main gas valve at the entrance to the building in the event of gas leak, thus shutting down the gas burning equipment. The OB 2 CONTRACTOR will especially respect ČSN 735120.

The equipment must be designed in accordance with Government Regulation No. 116/2016 Coll. - Requirements for equipment and protective systems intended for use in an environment with a risk of explosion and Decree of the Czech Occupational Safety Office (ČÚBP) and the Czech Mining Office (ČBÚ No. 407/2004 Coll.)

Areas with a risk of explosion must have a part of their outer casing (peripheral, roof) designed as an exhaust surface. Other surfaces must withstand the effects of a possible explosion.

In areas where there is a risk of spillage of substances endangering the health and life of workers, air analysers with alarm raising and automatic emergency ventilation must be installed.

**Ways of protecting storage tanks and transport systems**

If the structure itself has such a pressure resistance that it can withstand the explosion pressure without breaking it, it is not necessary to intervene against the structure in any way. Such tanks can be divided into two groups, namely tanks that can withstand the explosion pressure and those that can withstand the explosion impact.

This division is based on the requirement whether permanent deformations can occur on the container.

Depending on ČSN EN 14460 (blast proof structures), it will not be necessary to install a pressure relief device for tanks and containers resistant to explosion pressure or shock.

In the event that the tank/container is not designed as a tank/container resistant to explosion pressure or shocks, the solution of protecting the container must be approached with an explosion suppression or release device. Both systems reduce the maximum explosion pressure to the so-called reduced explosion pressure which is much lower than the maximum explosion pressure.

**Preventing explosion transfer to/from other parts of the technology**

Based on the evaluation within which the explosion prevention system will be installed, it is used as a measure against the spread of explosion from one device to another. e.g. rotary feeders, valves, quick-opening gate valves) according to ČSN EN 15089 or by means of prevention of transfer by a layer of material.

It is also possible to use a system of screw conveyors which prevent further transmission of the explosion to other parts of the technology.

# 4 TECHNOLOGICAL CONNECTIONS AND DESCRIPTION OF THE CURRENT STATE

## 4.1 General description of the existing combined heat and power plant

Six boilers are currently installed in the ŠKO-ENERGO CHP plant - two high-pressure steam fluid boilers K80 and K90, one high-pressure steam boiler burning natural gas or light heating oil K70, one hot water boiler burning light fuel oil (LFO) and natural gas K40, and two hot water boilers burning natural gas K50 and K60.

The total power input of the source according to Integrated Pollution Prevention and Control (IPPC) is 442 MW (K40, K50, K60 - 3 x 67 MW, K70 - 49 MW, K80, K90 - 2 x 102 MW).

The steam from the steam boilers is led to a common collector in the auxiliary machine room and further to two turbogenerators TG80 and TG90 with an intake steam performance of 2 x 162 t/h. The turbogenerators can work in both condensing and condensing extraction mode, when the Škoda Auto facilities and the city of Mladá Boleslav are supplied with heat.

The K80 and K90 boilers are in permanent operation with more than 7,500 operating hours per year (each), the K70 boiler is operated at times of peak consumption or shutdowns of fluid boilers. The operating hours of this boiler range from 600 to 3,000 hours/year, depending on the reason for its use.

Hot water boilers are operated only as standby boilers, possibly during winter peaks. The cumulative operating hours of all three hot water boilers together range between 600-900 hours.

## 4.2 Existing External Coal Handling

The existing external coaling consists of coal unloading into a deep dumper by railway wagons with subsequent transport to a coal dump with the help of a dumping machine or with direct underground belt transport to the crusher house and from there through one belt into the building of the bunker structure and to the storage tanks located in front of the boilers at the +36.00 m level in the K80/90 boiler house.

The deep dump building is also a de-freezing tunnel. From the coal dump, the stored coal is transported by a dump machine to a conveyor also leading to the existing crushing plant and from there to a belt transport to the bunker building.

Biomass - wood chips in a volume of up to 3percent of the heat input is dosed into boilers by internal carbonization together with coal, when homogenization occurs during transport on overflows from the coal dump to internal storage tanks, or to the boilers.

## 4.3 Existing internal fuel handling in the E1A boiler house

The coal technological equipment of the internal coal handling starts with the coal reservoirs (80/90HFG10/20BB001). Each boiler has two steel storage tanks, each one of the volume of 530 $m^3$ (useful volume 460 $m^3$), from each tank there is a fuel line to the boiler. The line consists of:

- Plate closure 80/90HFG20AA001/002/003 with a total dimension 0.8 x 3.0 m, composed of three plate closures 0.8 x 1.0 m; m=2,453 kg,
- Split chute / distributor 80/90HFG10/20BR001/002 with metal expansion joint; m=1,859 kg,
- Inclined chain conveyor 80/90HFB10/20AF001 for coal discharging from bunkers, m=14,015 kg,
- Pouring from an inclined to a horizontal conveyor,
- Horizontal coaling chain conveyor 80/90HHE10/a20AF001 for coal transport; m=6,070 kg,
- Delivery chute / distributor, m=5,100 kg.

The main fuel – coal is transported from the coal bunkers to the boiler via two independent routes using mechanical transport – drag-chain conveyor and it is dosed into the ash chutes of the internal ash circulation. Separation of the fuel lines from the boiler is done using a turnstile.

Coal handling equipment of fluid boilers K80 and K90 is located along the facade between the rows X15.9 (facade) and X14.6 and at a height between the platforms +15.00 to +36.00 m (coal storage tanks) and the subsequent transport by two inclined chain conveyors is conducted along the side walls of the combustion chamber.

This is followed by pouring into coal handling horizontal chain conveyors behind the back wall of the combustion chamber. There is one output from each conveyor to the fuel delivery chute, including a rotary feeder, manual and electrically operated plate closures, the necessary expansion joints, and its own delivery chute to the return ash chutes.

Each conveyor is equipped with a drive and a frequency converter, so that the speed of the conveyors can be effectively controlled, depending on the required steam output of the boiler.

**Line performance**

Each coal handling line is dimensioned for 100% of the volume delivered of guaranteed bituminous coal incl. overload at boiler output at 110% of rated power input to a value of 2x 15 t/h.

**Basic characteristics of coal handling lines**

| | |
| --- | --- |
| Number of storage bunkers for boiler | 2 |
| Total volume of one bunker | 530 $m^3$ |
| Bulk weight (bituminous coal) | 0.7 – 0.8 $t/m^3$ |
| Grain size | 0 – 10 mm |
| Number of coal handling lines (dimensioning) | 2 (2x 100%) |
| Transport performance, max. (for bituminous coal) | 15 t/h / 18.75 $m^3/h$ |

### 4.3.1 Handling of plant pellets

The device for dosing plant pellets which are co-combusted with coal with a share of up to 30% (energy share) on both boilers.

Pellets are transported to the ŠKO-ENERGO premises using trucks. In the E18 building, there is a steel discharge hopper into which lorries with pellets are unloaded. From there, the pellets are taken out by means of a screw conveyor and transported by mechanical transport to a cell feeder which uses compressed air to transport the pellets to the operating common storage tank in the boiler room. The filter for transported air dust removal with compressed air regeneration is located on the storage tank.

The operational pellet hopper is of cylindrical shape, with a flat bottom with 4 screw conveyors (with speed regulation by FC) which are used to transport the pellets from the silo through the screw conveyor to the separating rotary feeder – a turnstile, from where they fall into the mixer and are transported by low-pressure pneumatic transport to each of the two boilers routes. Entrances to the combustion chamber are made with stainless steel lancets located in the upper secondary air supply to the boiler.

DN80 routes with a nominal capaicty of approx. 7 t/h (according to specific gravity and the granulometry) are led to each boiler. In total, the power input supplied is limited to 30% of the boiler's nominal output power. For the technology of receiving, storing, and transporting plant pellets, the Company VST Engineering, spol. s.r.o. assessed the operation from the point of view of explosion hazard according to Government Regulation NV 406/2004 Coll. (TZ06-P0140-03-A "Combustion of pellets in ŠKO-ENERGO boilers"), where areas with a risk of explosion are determined.

Safety fittings against flush-back are placed on the piping, the storage tank is provided by the VST company active system with extinguishing powder and inert gas to suppress the explosion. The equipment works without any problems, the technological discipline of the pellet suppliers is essential (the presence of stones and other objects in the deliveries).

### 4.3.2 Existing handling of wood chips

Biomass-wood chips in a volume of up to 3% of the heat input is dosed into boilers by internal coal handling, together with coal, where homogenization occurs during transport within pouring from the coal dump to internal storage tanks, respectively. to the boilers.

### 4.3.3 Technological fuel

For composition of technological fuel see the A6 Annex. Fuel is burned campaign-wise in the amount of 250-650 kg/h.

## 4.4 Start-up fuel of K80/90

The main gas inlet piping of DN150 to the burners of the K80, K90 boilers are connected to the central compound distribution of DN300/0.25 MPa(g) outside the boiler house at the level of +4.5 m. In front of the boiler house the main gas shut-off valve (MGSV) and the emergency quick-closing device are installed. The gas control station itself is located in the boiler house.

The gas control station with filtration and a pressure reducing valve ensures the required pressure at the burner's inlets.

## 4.5 Existing boilers K80 a K90

Fluid boilers K80 and K90 with a circulating fluid bed with the following parameters: the steam output of 140 t/h, pressure 12.5 MPa, temperature 535 °C are located in a separate production unit, with a separate space for the boiler room and the machine room between the columns of the series Y40-X15.9-Y47 – X8.1. The boilers in a mirror design were intended for burning bituminous coal, with a planned lifetime of the boiler pressure part of 200,000 operating hours and were put into operation in the year 1998. By the end of the year 2022 the total operating hours were planned of 202,000 operating hours for the K80 boiler, and of 184,000 operating hours for the K90 boiler.

In the following chapters, only those devices are described, that are closely related to woodchip operation, or these ones affected by changes resulting from the transition to woodchip combustion.

### 4.5.1 Contemporary basic technical parameters of the boiler

| | |
| --- | --- |
| Supplier | Consortium EVT Stuttgart GmBH a Vítkovice a.s. |
| Commissioning | 1998 |
| Boiler type | fluid one, with a circulating layer and natural water circulation |
| Location | indoors |
| Nominal heat output of the boiler | 95.32 MWt |
| Nominal steam output | 139 t/h (designed and current state *) |
| Nominal operating pressure of superheated steam | 12.5 MPa (designed and current state*) |
| Nominal temperature of outlet superheated steam | Nominal temperature of outlet superheated steam - 535 °C (designed and current state*) |
| Nominal temperature of feed water | 210 °C (current state *) |

| | |
|---|---|
| Boiler efficiency (contractual value during construction) | 91.0 % during burning bituminous coal |
| Temperature of feed water | max. 210 °C, min. 140 °C sliding pressure in the tank according to the pressure in the TG intake |

* Note:

Projected condition = burning bituminous coal

Current status = burning brown coal (70%) and biomass pellets (30%)

brown coal - Bílina fuel with wood chips mixed into the fuel (input up to 3%)

The feed water temperature according to the boiler Passport is 230°C

See OB2_A121.01DesignKotel for original design values

### 4.5.2 Existing fuels

#### 4.5.2.1 Existing fuel I Bílina brown coal

| parametr | | | value | | |
|---|---|---|---|---|---|
| | | | min. | ref. | max. |
| Water content | $W^{(ar)}$ | %hm. | 5,9 | 18 | 24,5 |
| Ash content | $A^{(d)}$ | %hm. | 3,3 | 5,5 | 14 |
| Lower heating value | Qi | MJ/kg | 18,7 | 19 | 23,7 |
| Bulk density | ρ | $kg/m^3$ | 400 | 450 | 780 |
| Sulphur content | $S^{(ar)}$ | %hm. | 0,4 | 1,1 | 4,1 |
| Chlorine content | $Cl^{(ar)}$ | %hm. | 0,01 | 0,02 | 0,07 |

#### 4.5.2.2 Existing fuel II Plant pellets

| parametr | | | value | | |
|---|---|---|---|---|---|
| | | | min. | ref. | max. |
| Water content | $W^{(ar)}$ | %hm. | 8,5 | 12 | 16 |
| Ash content | $A^{(d)}$ | %hm. | 3 | 6 | 10 |
| Lower heating value | Qi | MJ/kg | 12 | 15,5 | 17,5 |
| Bulk density | ρ | kg/m$^3$ | 300 | 450 | 700 |
| Sulphur content | $S^{(ar)}$ | %hm. | 0,15 | 0,2 | 0,25 |
| Chlorine content | $Cl^{(ar)}$ | %hm. | 0,07 | 0,1 | 0,15 |

#### 4.5.2.3 Existing fuel III Wood chips

| parametr | | | value | | |
|---|---|---|---|---|---|
| | | | min. | ref. | max. |
| Water content | $W^{(ar)}$ | %hm. | 25 | 40 | 55 |
| Ash content | $A^{(d)}$ | %hm. | 0,3 | 4 | 11 |
| Lower heating value | Qi | MJ/kg | 7,8 | 10 | 12 |
| Bulk density | ρ | kg/m$^3$ | 200 | 250 | 380 |
| Sulphur content | $S^{(ar)}$ | %hm. | | < 0,1 | |
| Chlorine content | $Cl^{(ar)}$ | %hm. | 0,01 | 0,015 | 0,02 |

#### 4.5.2.4 Existing fuel IV Technological fuel

| parametr | | | value | | |
|---|---|---|---|---|---|
| | | | min. | ref. | max. |
| Water content | $W^{(ar)}$ | %hm. | 8 | 63 | 80 |
| Ash content | $A^{(d)}$ | %hm. | 1 | 1,5 | 5 |
| Lower heating value | Qi | MJ/kg | 8 | 14 | 25 |
| Sulphur content | $S^{(ar)}$ | %hm. | | 0,16 | |
| Chlorine content | $Cl^{(ar)}$ | mg/kg | | 0,04 | |

#### 4.5.2.5 Fuel V Natural gas

It serves as a start-up fuel.

The composition of existing fuels - see analyses: OB2_A121.02_PorovniPaliv - one of the protocols prepared for the Regional Office.

### 4.5.3 Existing boilers K80/90

#### 4.5.3.1 Basic description of data and development

The fluid boiler was designed for the combustion of bituminous energy coal in crushed form with a grain size of 0-10 mm and in the required granulometry which is dosed into the combustion chamber of the boiler, where it is burned in the air together with a dosed additive - ground limestone which ensures the desulphurization of the resulting flue gases.

Boilers K80 and K90 are fluid boilers with a circulating fluid bed. (The boiler is made as a vertical-tube, single-drum, with natural circulation, with a combustion chamber and the upper part of the second pass made of membrane walls, conventional reheaters in the second pass, with one cyclone with a heavy

refractories, with one external bottom ash cooler, with a tube heater of air in the third pass of the boiler. The boiler is located in an L-shaped boiler house, with the combustion chamber, the cyclone and the second pass are on the same axis, while K80 and K90 are mirror-symmetrical in the second pass. Between the combustion chamber and the second pass, an uncooled 1 cyclone with a heavy refractories is placed which ensures the separation of particles larger than 0.1 mm from the circulating fluidized bottom from the flue gas stream and the return of ash through the siphon with a delivery chute back to the combustion chamber. The cyclone is supported from below and placed firmly in the steel structure of the boiler house and it is separated from the combustion chamber and the second pass of the boiler by means of fabric expansion joints which ensure equalization of the expansion movements of the combustion chamber of the boiler, the cyclone and the second pass which are suspended in the steel structure of the boiler and dilatated downwards.

The boiler is provided with one fresh air fan which is located on the +33.50 m floor and one primary fan, which is located on the +0 m floor of the boiler room.

Combustion air is heated in a tubular air heater, forming the third pass of the boiler. Flue gas extraction is carried out by one flue gas fan located in the boiler house.

**Combustion system and back pass**

The entire combustion chamber contains solid particles of the fluidized bottom in uplift which is caused by the lower supply of primary air through the jet fluidized bottom. Flue gases in the combustion chamber which have a high concentration of solids in the lower part of the fluid layer, and their concentration decreases rapidly towards the top. The flue gases resulting from the combustion of the fuel flow upwards through the combustion chamber and carry the solid substances with them. The intensive movement of particles in the fluidized bottom causes very significant abrasion of all parts.

The solid particles are partially separated from the flue gas already in the combustion chamber, where intensive internal circulation takes place, a larger part of solid particles is carried through the outlet channel of a rectangular cross-section into the cyclone, where they are separated from the gas and are continuously returned through the siphon to the circulating fluid layer.

The flue gas passes through the first pass of the boiler-combustion chamber and enters through 1 window in the upper part of the back wall of the combustion chamber and through the flue gas outlet channel into the cyclone. The textile expansion joint is placed in this flue gas channel with a rectangular cross-section which ensures equalization of thermal expansion between the cyclone and the combustion chamber. The flue gases enter the cyclone tangentially and a part of the ash is separated by the centrifugal force and the separation ability of the Vortex. The separated ash falls through the conical hoppers of the cyclones and subsequent delivery chutes into siphon traps. All internal spaces of the inlet channel to the cyclone, the cyclone itself, the delivery chutes to the siphon traps, the siphon itself and the delivery chute from the siphons to the combustion chamber are walled with heat-resistant refractories. It is a heavy heat-resistant refractories, consisting of two layers - an insulating layer and a hard-working layer.

The flue gas exits the cyclone and enters the flue gas outlet channel and then the second pass. The textile expansion joint is placed in this flue gas channel of circular cross-section, and it ensures equalization of thermal expansions between the cyclone and the second pass. The flue gases pass through the heating surfaces located in the second pass - the outlet superheater, the first superheater and the economizer.

**Control**

In the area where flue gases enter the cyclone inlet channel near the ceiling of the combustion chamber, there are three pressure sampling devices measuring the vacuum in the combustion chamber, which is controlled by the power output of the flue gas fan. Changing its power output is done by turning the set of regulating vanes (regulating ring) on the fan intake which are controlled by the drive regulator.

The boiler output regulation is ensured by fuel conveyors with variable speeds, the amount of limestone is regulated depending on the measured $SO_2$ value with a correction concerning the power output.

**Boiler system**

The boiler system space, in which the gas exhaust pipes from the boiler to the fabric filter and the fabric filter itself are located, forms a common space with the boiler room. The induced pass fan with connecting gas exhaust pipes to the stack which are led side by side through the centre of the boiler room are already located in the boiler room itself.

**Adjustments concerning the fuel base of boilers**

In the year 2002, the fluid boilers were officially switched over to burning a mixture of bituminous and brown coal, on condition that the "ten's line" will always be used for brown coal (left for K80, right for K90), and then the "twenty's line" will always be used for bituminous coal.

In the course of years 2002–2009, a mixture of bituminous coal and brown coal was burned in boilers, with a gradually increased proportion of brown coal to 40 ÷ 100percent of the boiler's thermal input.

Due to the repeated ignition of brown coal, inertization of storage tanks and coal handling lines No. 10 was started in the year 2003, and the line 20 was then inerted in the year 2006.

Since the year 2010, both boilers have been converted to 100percent brown coal combustion. In the year 2006, a line for external pellet storage in the E18 building object and pneumatic transport of pellets to the operational storage tank in the boiler room was implemented, with a subsequent pneumatic transport line to each boiler for a biomass share of 15percent of the boiler's thermal input for nominal parameters.

In the year 2013, the storage performance of the operational pellet storage tank and pellet transport to both boilers was increased to a total biomass share of 30percent of the boiler's thermal input for nominal parameters. Currently, both boilers are operated with a 70/30percent ratio of brown coal and biomass fuel, the boilers are operated in the range of 90-100percent of nominal output.

Gradually, there was a complete transition to the burning of brown coal with the co-burning of 30percent of pellets with the operational pellet storage in the boiler house and the receiving point incl. storage and a pneumatic transport system with a chamber feeder to the boiler house.

**Measurement of flue gas emissions**

In view of the fact that the location of the gas exhaust pipe from both boilers between the induced pass fan and the 200m high stack itself, a device for continuous measurement of emissions in the flue gas is located in the boiler house before exiting to the outdoor area. Measuring cabinets 80/90HNA06GH100 are located at the perimeter wall in the row X15.9 at ±0 m in the boiler house.

Flue gases are sampled from the 2/3 discharging hopper for operational measurement of CO and $O_2$, while the measuring cabinet 80/90 HNA03GH100 for each boiler separately is located at ±0 at the column X11.8 Y41.9 (K80) or at the column X11.8 Y45.1 (K90).

The measurement of gaseous emissions itself consists of a sampling probe, a heated hose for taking samples and an analyzer cabinet located at ±0 in the K80/K90 boiler house.

#### 4.5.3.2 Combustion system

**Combustion air system**

The combustion air system consists of a fresh air fan with the possibility of intake from the boiler room outside and inside, a regulated fresh air fan equipped with a suction damper, a steam and flue gas air heater. The air is divided in front of the steam heater into the blowers of the ash separator and into the steam heater - then it is divided into a branch to the primary air fan with a damper on the discharge, with

insertion into the bottom of the reactor, where it is mixed with recirculated flue gas even before its entering and directly into the combustion chamber and ash delivery chute as secondary air. The ash separator blowers suck air from the fresh air fan discharge into the boiler ash separator, where it is mixed with the recirculated flue gas and then it is directed into the boiler.

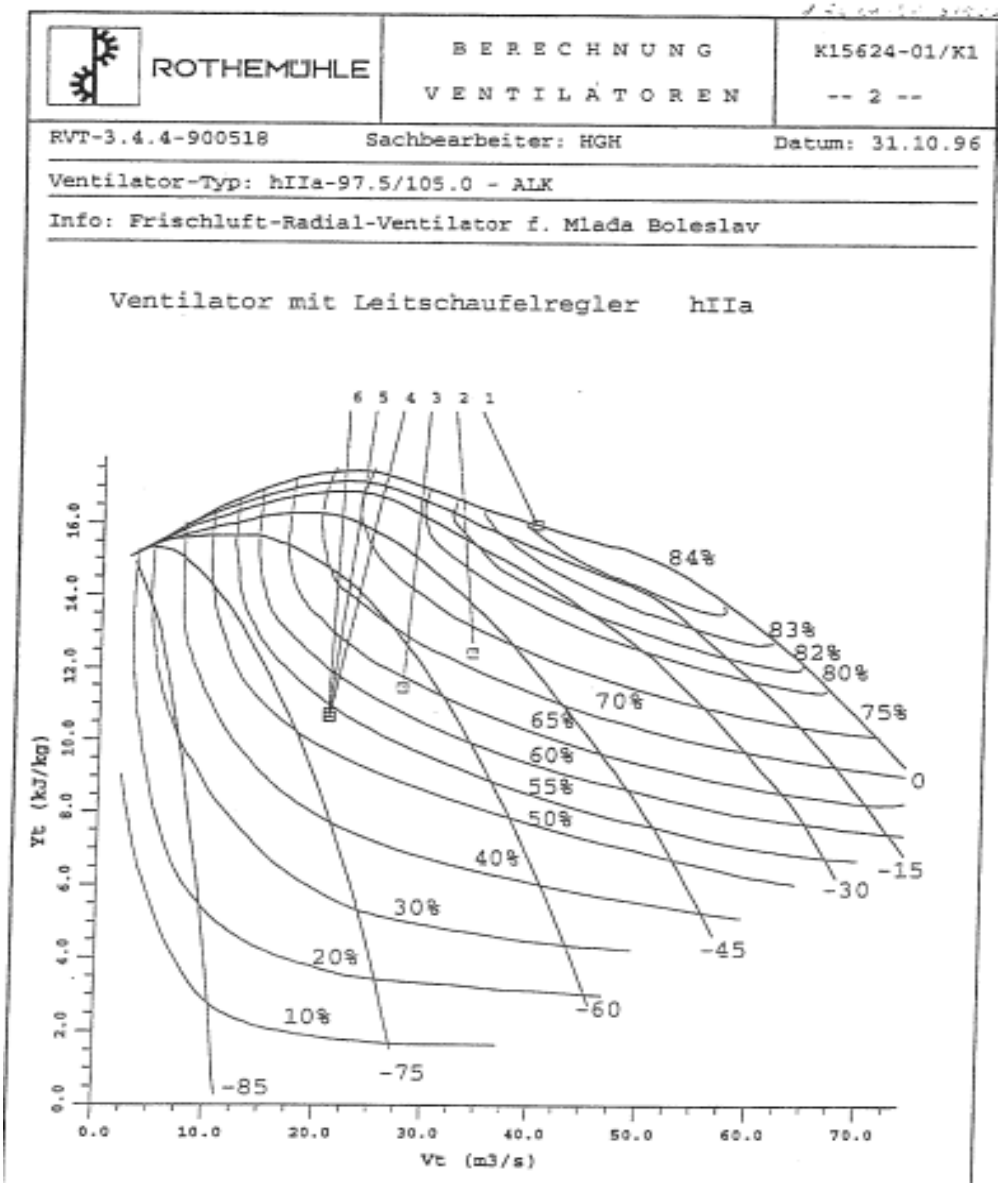
For the scheme of combustion air and flue gases of the boiler, see. OB2_A121.15_K80_Air-GasDiagram

### 1. Fresh air fan

The fresh air fan is fitted with a noise dumper on the suction side.

| | |
| --- | --- |
| Throttling governing on the fan suction side | Control ring |
| Fan control | Throttling on suction side |
| Volume delivered | 39.93 $m^3/s$ |
| Flue gas operating temperature | 40 °C |
| Density | 1.0964 $kg/m^3$ |
| Δ p | 18.634 kPa |
| Fan speed | 1,490 1/min |
| The power input required<br>Electric motor power output | 831 kW<br>950 kW/ 6kV/50Hz |
| The fan is provided with hydraulic clutch Voith 650 SVTL21.2 | chute at full power output 2.5%, i.e. 1450/1490 rev/min |

For fan characteristics see below


ROTHEMÜHLE
B E R E C H N U N G
V E N T I L A T O R E N
K15624-01/K1
-- 2 --
RVT-3.4.4-900518
Sachbearbeiter: HGH
Datum: 31.10.96
Ventilator-Typ: hIIa-97.5/105.0 - ALK
Info: Frischluft-Radial-Ventilator f. Mlada Boleslav
Ventilator mit Leitschaufelregler hIIa
6 5 4 3 2 1
84%
83%
82%
80%
75%
70%
65%
60%
55%
50%
40%
30%
20%
10%
0
-15
-30
-45
-60
-75
-85
Yt (kJ/kg)
Vt (m3/s)

ROTHEMÜHLE

B E R E C H N U N G
V E N T I L A T O R E N

K15624-01/K1
-- 3 --

RVT-3.4.4-900518 Sachbearbeiter: HGH Datum: 31.10.96

Ventilator-Typ: hIIa-97.5/105.0 - ALK

Info: Frischluft-Radial-Ventilator f. Mlada Boleslav

| | | | |
|---|---|---|---|
| Nenndrehzahl.....[1/min] | 1490 | Gehaeuse-Eintritt....(m2) | 1.155 |
| Motor-Leistung empf..[kW] | 950 | Laufrad-Eintritt.....(m2) | 0.747 |
| Barometr. Druck....(mbar) | 1000 | Gehaeuse-Austritt....(m2) | 1.226 |
| Laufrad-Aussendurchm.(mm) | 2120 | Diffusor-Austritt....(m2) | 1.155 |
| Zu isolier.Oberflae..(m2) | 49 | Erf.Regelgetriebemom.(Nm) | 900 |

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 1 Lastfall Nr. | | | | | |
| 2 Lastfall Bezeichnung | Ausl. 110.9% | Last 1 100% | Last 2 80% | Last 3 60% | Last 4 40% |
| 3 Volumenstrom effekt(m3/s) | 39.93 | 34.09 | 27.57 | 20.89 | 20.78 |
| 4 Temperatur EIN....(grdC) | 40 | 25 | 25 | 25 | 25 |
| 5 Temperatur AUS....(grdC) | 59 | 42 | 43 | 45 | 45 |
| 6 Dichte effekt..RHO(kg/m3) | 1.0964 | 1.1549 | 1.1583 | 1.1612 | 1.1612 |
| 7 Druck statisch EIN.(mbar) | 988.47 | 991.31 | 994.29 | 996.71 | 996.75 |
| 8 Druckerh. gefordert(mbar) | 184.31 | 149.45 | 138.08 | 128.62 | 128.48 |
| 9 Druckverlust SD EIN(mbar) | enthal. | enthal. | enthal. | enthal. | enthal. |
| 10 Druckverlust SD AUS(mbar) | enthal. | enthal. | enthal. | enthal. | enthal. |
| 11 Druckverlust Ansaug(mbar) | 1.88 | 1.44 | 0.95 | 0.55 | 0.54 |
| 12 Druckverlust Diffus(mbar) | 0.15 | 0.11 | 0.07 | 0.04 | 0.04 |
| 13 Druckh.tot.Vent.DPT(mbar) | 186.34 | 151.00 | 139.10 | 129.21 | 129.06 |
| 14 Adiabat.Faktor.....Fad(1) | 0.93906 | 0.94984 | 0.95364 | 0.95680 | 0.95686 |
| 15 Sp.tot.Frderarb.YT(kJ/kg) | 15.96 | 12.42 | 11.45 | 10.65 | 10.63 |
| 16 Wirkungsgrad.....(%) | 84 | 72 | 63 | 54 | 54 |
| 17 Leistung an der Welle(kW) | 832 | 679 | 581 | 478 | 475 |

| | 6 |
|---|---|
| 1 Lastfall Nr. | |
| 2 Lastfall Bezeichnung | Last 5 30% |
| 3 Volumenstrom effekt(m3/s) | 20.77 |
| 4 Temperatur EIN....(grdC) | 25 |
| 5 Temperatur AUS....(grdC) | 45 |
| 6 Dichte effekt..RHO(kg/m3) | 1.1612 |
| 7 Druck statisch EIN.(mbar) | 996.75 |
| 8 Druckerh. gefordert(mbar) | 129.82 |
| 9 Druckverlust SD EIN(mbar) | enthal. |
| 10 Druckverlust SD AUS(mbar) | enthal. |
| 11 Druckverlust Ansaug(mbar) | 0.54 |
| 12 Druckverlust Diffus(mbar) | 0.04 |
| 13 Druckh.tot.Vent.DPT(mbar) | 130.40 |
| 14 Adiabat.Faktor.....Fad(1) | 0.95644 |
| 15 Sp.tot.Frderarb.YT(kJ/kg) | 10.74 |
| 16 Wirkungsgrad.....(%) | 54 |
| 17 Leistung an der Welle(kW) | 480 |

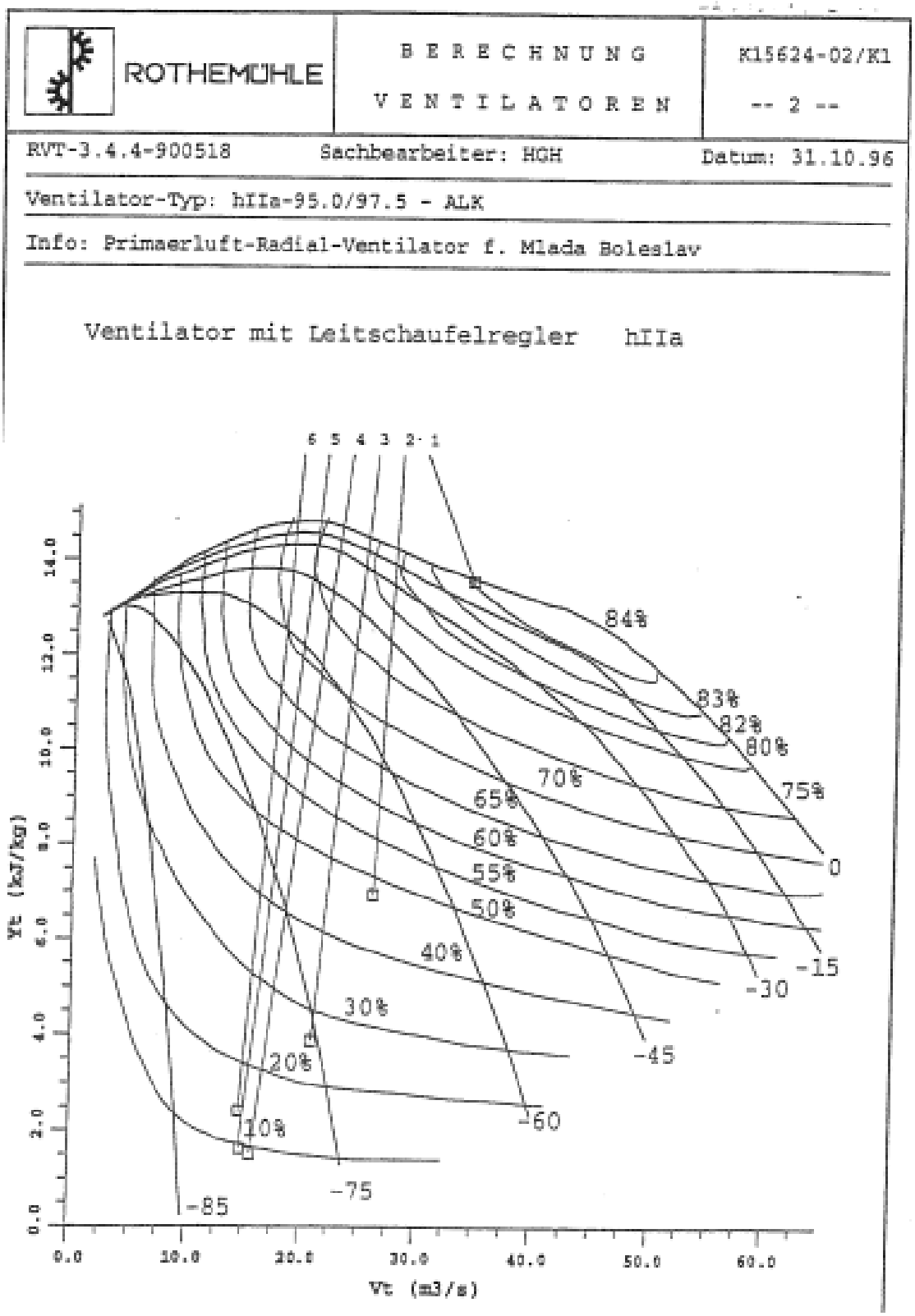
Spez.totale Foerderarbeit YT (kJ/kg) = DPT * Fad / (RHO*10)

2. **Primary air fan**

| | |
|---|---|
| Control | With throttling on the fan suction side – a regulating ring |
| Volume delivered | 34.45 $m^3/s$ |
| Flue gas operating temperature | 223 °C |

| | |
| --- | --- |
| Density | 0.7724 kg/m$^3$ |
| Δ p | 10.837 kPa |
| Fan speed | 1,490 1/min |
| Required power input | 430 kW |
| Electric motor power output | 500kW/ 6kV/50Hz |
| | The fan is provided with the hydraulic clutch Voith 650 SVTL21.4 |
| Chute at full power output | 2.5percent, i.e. 1,450/1,490 r.p.m. |

For the fan characteristic see below.




### 3. Fluidization blower and ash separator blowers

The boilers are provided RVJ 630 radial fans according to PM 123344.

**Ash separator air fan**

| | |
| --- | --- |
| Type | RVJ 630 -1 directly L 60 |
| Number of pieces | 1 |
| Volume delivered | 1.559 $m^3/s$ |
| Operating temperature on inlet/outlet | 55/62°C |
| Δ p | 60.63 hPa |
| Fan speed | 2,900 1/min |
| Electric motor power output | 11 kW /0.4kV/50Hz |

**Blower of fluidization air**

| | |
| --- | --- |
| Type | HAFI GM 50 L |
| Number of pieces | 1 |
| Volume delivered | 0.834 $m^3/s$ |
| Operating temperature on inlet/outlet | 25/80°C |
| Δ p | 600 hPa |
| Fan speed | 2,900 1/min |
| Power inlet on the clutch | 62.6 kW |

### 4. Combustion chamber

The combustion chamber of fluid boilers with dimensions of approx. 5.1 x 5.1 x 34.2 m is formed by gas-tight membrane walls. In the lower part there is a conical shaped combustion chamber. The fluid grate forming the bottom of the furnace is provided with primary fluidizing air nozzles, the secondary air is supplied above the grate in the inclined lower part of the furnace, thermally insulated by a ceramic refractories fixed on the MW steam generating tube / riser. The temperature in the whole furnace is approximately constant - approx. 850-880 °C. Combustion in a fluidized bed takes place first in a reduction atmosphere in the lower part of the combustion chamber (CC), then in higher positions of the combustion chamber (CC) in oxidation atmosphere. This phased combustion effectively reduces formation of gaseous emissions of CO and NOx (especially the formation of thermic NOx).

For flue gas desulfurization, limestone is pneumatically dosed into the combustion chamber. The performance of transport routes is 2 x 2.1 t/h.

The desulfurized flue gases are removed from the boiler through a fabric filter and a flue gas fan into the stack. The flue gas temperature is currently at 150°C (design temperature 140°C), which causes a higher stack loss.

To reduce NOx emissions, the Selective Non-Catalytic Reduction System (SNCR) is installed on the boilers, and these are only secondary SNCR measures, i.e. reagent injection into the flue gas stream in the inlet channel from the combustion chamber to the cyclone, DeNOx agent storage tanks are located under the K70 boiler.

Currently, the dosing of an aqueous solution of ammonium sulphate is being tested.

The boilers are fitted with a system for dosing the $Ca(OH)_2$ sorbent into the flue gas in front of the fabric filter to reduce the content of HF, HCl, $SO_2$ emissions in the flue gas.

The boilers are supplied with feed water from two feed water tanks, to which four feed pumps working to a common collecting header are connected. The K70 boiler is also fed from this collecting header. The degasification temperature is 160°C. The boilers can be fed either directly with feed water at this temperature, or by using regenerative heating of the feed water in the high-pressure heater (HPH) at a higher temperature - see Annex A6.

The sharp steam from these boilers, together with the steam from the K70 gas boiler, which is in operation at peak times or when the fluid boilers are shut down, is introduced into a common collecting header in the intermediate machine room on the +14.4 m floor. From there it is then led to the TG80 and TG90 condensing extraction turbines.

5. **Combustion of technological fuel in K80 and K90**

The combustion of technological fuel takes place on a start-up combined gas burner.

The burner serves as a start-up one – being operated with natural gas, or as a burner ensuring the burning of diluted oil emulsions.

The technological fuel is supplied through a pipeline from the storage tanks of the Z 25 oil emulsion building object and then through a return recirculation pipeline back to the tanks.

| | |
| --- | --- |
| Burner type | BFG-18-GO |
| Burner power output | max. 18.3 MW |
| Fuel for the burner: | natural gas max. 1,720 $Nm^3/h$ 0.25 MPa(g) |
| | oil emulsions – technological fuel |
| The amount of technological fuel burned | 250 - 650 kg/h, in the campaign according to operation needs |
| Viscosity in front of the burner | 20 cst |
| Fuel temperature | 40-65 °C |
| Fuel pressure in front of the control valve | 1 to 1.2 MPa |
| Fuel pressure in front of the burner | 0.4 MPa(g) |
| Spraying medium for the burner | air of 0.5 MPa |

Technological fuel is burned only during the period when there is no gas in operation and the temperature in the combustion chamber is at least 850°C.

The burner is provided with a flame watcher.

Auxiliary, the medium is the cooling air of the burner.

Preliminary provisional measures provided by the CLIENT before the project starting.

Currently, a temporary adjustment is being made during the K80 refurbishment to ensure combustion on the K90 boiler during the K80 refurbishment. These provisional measures deal with the introduction of technological fuel to the K90 and moving the combined burner to the K90. The original gas start-up burner from the K90 will be moved to the K80, including intervention in the electrical part and the measurement and control part.

1. **Flue gas fan**

| Basic parameters of the flue gas fan | |
| --- | --- |
| Fan control | Throttling on suction side + speed |
| Volume delivered | 64.86 $m^3/s$ |
| Flue gas operating temperature | 150°C |
| Density | 0.8032 $kg/m^3$ |
| Δ p | 6.045 kPa |
| Fan speed | 1,447 1/min |
| Required power input | 457 kW |
| Electric motor power output | 560kW/6kV/50Hz |
| The fan is provided with hydraulic clutch | Voith 650 SVTL21.2. |
| Chute at full power output | 2.5 percent, i.e. 1,450/1,490 r.p.m. |

The flue gas fan is provided with the noise dumper on the discharge side.

ROTHEMÜHLE

BERECHNUNG VENTILATOREN

K15624-04/K1

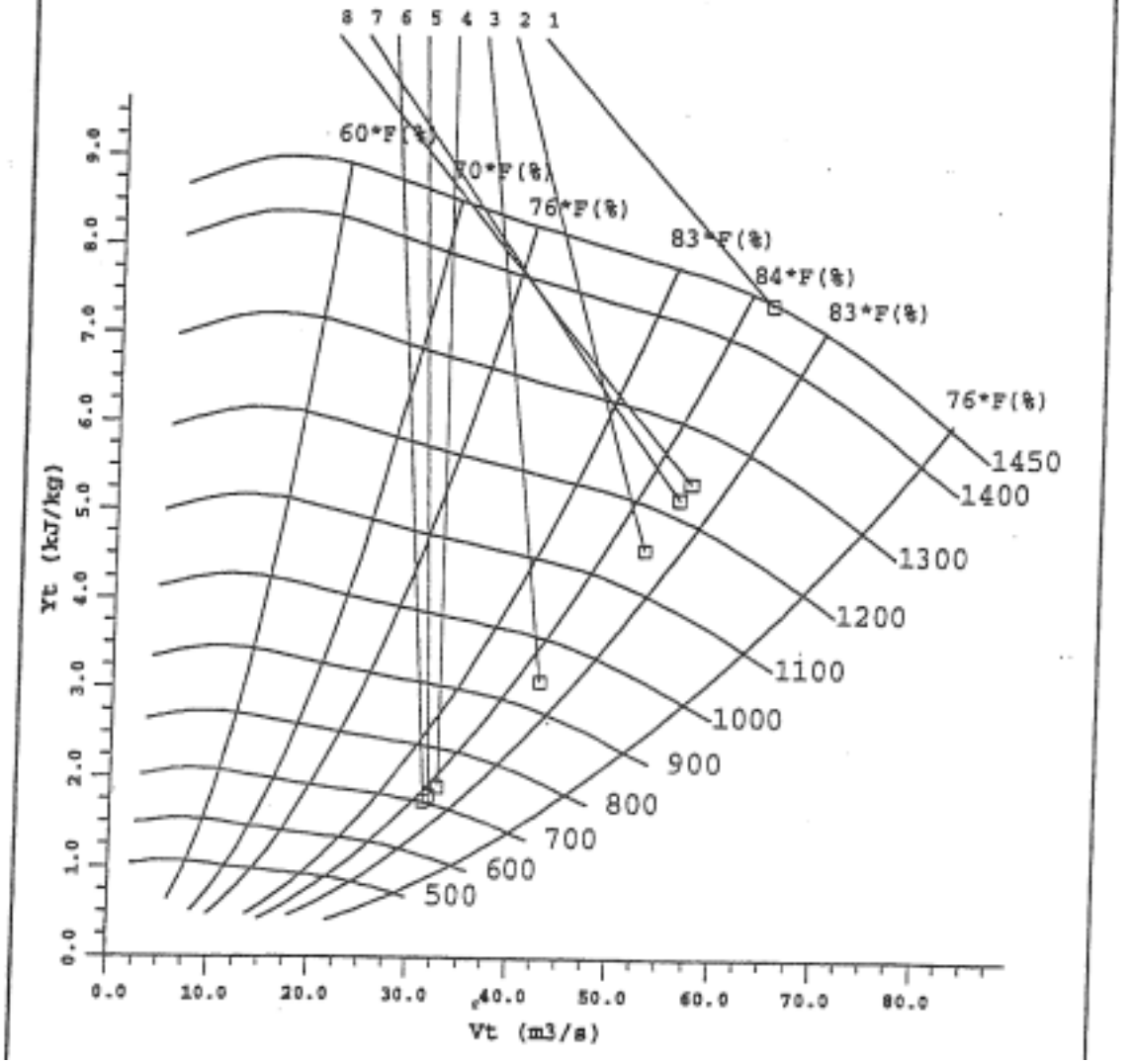
-- 2 --

RVT-3.4.4-900518 Sachbearbeiter: HGH Datum: 31.10.96

Ventilator-Typ: DIId-122.5 - A K

Info: Saugzug-Radial-Ventilator f. Mlada Boleslav

Ventilator mit Drehzahlregelung DIId



ROTHEMÜHLE

BERECHNUNG VENTILATOREN

K15624-04/K1

-- 3 --

RVT-3.4.4-900518 Sachbearbeiter: HGH Datum: 31.10.96

Ventilator-Typ: DIId-122.5 - A K

Info: Saugzug-Radial-Ventilator f. Mlada Boleslav

| | | | |
|---|---|---|---|
| Nenndrehzahl.....(1/min) | 1450 | Gehaeuse-Eintritt....(m2) | 1.532 |
| Motor-Leistung empf..(kW) | 560 | Laufrad-Eintritt.....(m2) | 1.179 |
| Barometr. Druck....(mbar) | 1000 | Gehaeuse-Austritt....(m2) | 1.116 |
| Laufrad-Aussendurchm.(mm) | 1670 | Diffusor-Austritt....(m2) | 1.532 |
| Zu isolier.Oberflae..(m2) | 42 | | |

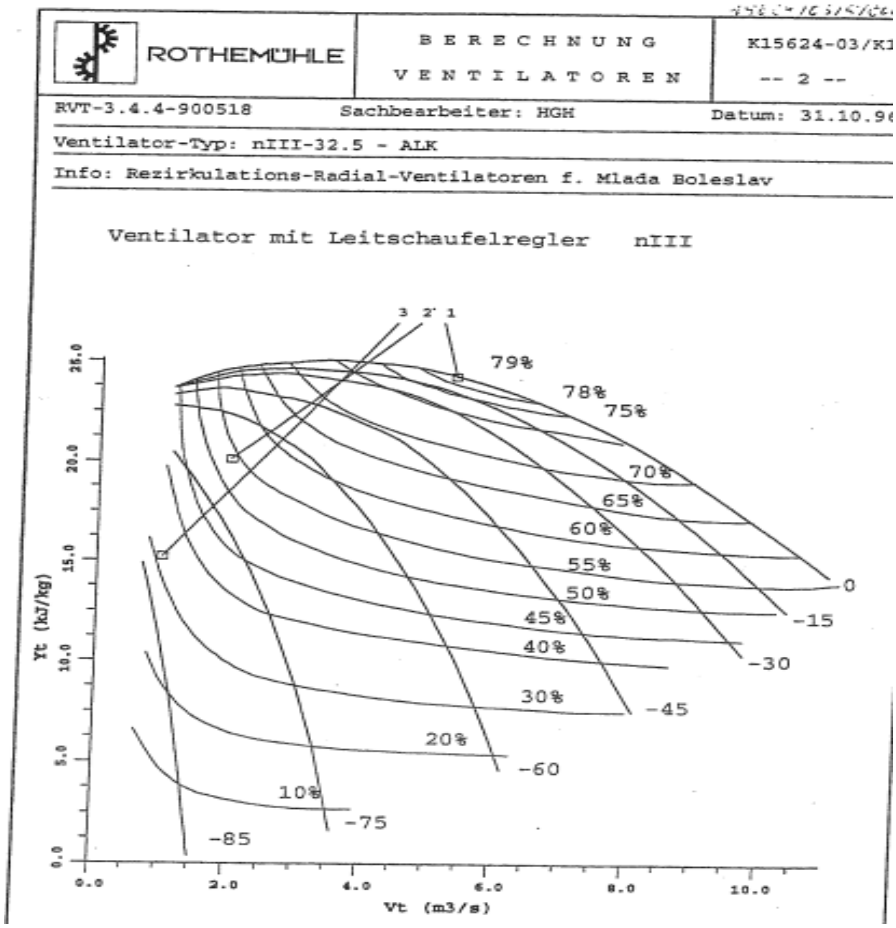
| 1 Lastfall Nr. | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 2 Lastfall Bezeichnung | Ausl. 112% | Last 1 100 % | Last 2 80% | Last 3 60% | Last 4 40 % |
| 3 Volumenstrom effekt(m3/s) | 64.86 | 52.95 | 42.79 | 32.76 | 31.90 |
| 4 Temperatur EIN....(grdC) | 150 | 130 | 127 | 124 | 120 |
| 5 Temperatur AUS....(grdC) | 159 | 136 | 131 | 126 | 122 |
| 6 Dichte effekt..RHO(kg/m3) | 0.8032 | 0.8603 | 0.8769 | 0.8918 | 0.8921 |
| 7 Druck statisch EIN.(mbar) | 946.32 | 964.19 | 975.46 | 984.64 | 985.42 |
| 8 Druckerh. gefordert(mbar) | 57.11 | 37.59 | 25.74 | 16.06 | 15.24 |
| 9 Druckverlust SD EIN(mbar) | entflt. | entflt. | entflt. | entflt. | entflt. |
| 10 Druckverlust SD AUS(mbar) | enthal. | enthal. | enthal. | enthal. | enthal. |
| 11 Druckverlust Ansaug(mbar) | 2.07 | 1.48 | 0.98 | 0.59 | 0.56 |
| 12 Druckverlust Diffus(mbar) | 1.27 | 0.91 | 0.60 | 0.36 | 0.34 |
| 13 Druckh.tot.Vent.DPT(mbar) | 60.45 | 39.97 | 27.33 | 17.01 | 16.14 |
| 14 Adiabat.Faktor.....Fad(1) | 0.97794 | 0.98548 | 0.99010 | 0.99384 | 0.99415 |
| 15 Sp.tot.Frderarb.YT(kJ/kg) | 7.36 | 4.58 | 3.09 | 1.90 | 1.80 |
| 16 Wirkungsgrad.....(%) | 84 | 83 | 83 | 82 | 82 |
| 19 Wirkungsgradfaktor... (1) | 0.99994 | 0.99419 | 0.98906 | 0.98257 | 0.98185 |
| 20 Drehzahl.....(1/min) | 1447 | 1149 | 940 | 733 | 714 |
| 17 Leistung an der Welle(kW) | 457 | 251 | 140 | 68 | 62 |

| 1 Lastfall Nr. | 6 | 7 | 8 |
|---|---|---|---|
| 2 Lastfall Bezeichnung | Last 5 30% | Last 6 100% ER | Last 7 100% ER |
| 3 Volumenstrom effekt(m3/s) | 31.36 | 56.24 | 57.31 |
| 4 Temperatur EIN....(grdC) | 115 | 150 | 150 |
| 5 Temperatur AUS....(grdC) | 117 | 156 | 157 |
| 6 Dichte effekt..RHO(kg/m3) | 0.8998 | 0.8175 | 0.8152 |
| 7 Druck statisch EIN.(mbar) | 985.78 | 961.68 | 960.41 |
| 8 Druckerh. gefordert(mbar) | 14.86 | 40.22 | 41.54 |
| 9 Druckverlust SD EIN(mbar) | entflt. | entflt. | entflt. |
| 10 Druckverlust SD AUS(mbar) | enthal. | enthal. | enthal. |
| 11 Druckverlust Ansaug(mbar) | 0.54 | 1.58 | 1.64 |
| 12 Druckverlust Diffus(mbar) | 0.33 | 0.97 | 1.01 |
| 13 Druckh.tot.Vent.DPT(mbar) | 15.73 | 42.78 | 44.19 |
| 14 Adiabat.Faktor.....Fad(1) | 0.99430 | 0.98446 | 0.98394 |
| 15 Sp.tot.Frderarb.YT(kJ/kg) | 1.74 | 5.15 | 5.33 |
| 16 Wirkungsgrad.....(%) | 82 | 83 | 83 |
| 19 Wirkungsgradfaktor... (1) | 0.98139 | 0.99569 | 0.99614 |
| 20 Drehzahl.....(1/min) | 702 | 1219 | 1241 |
| 17 Leistung an der Welle(kW) | 60 | 285 | 300 |

Spez.totale Foerderarbeit YT (kJ/kg) = DPT * Fad / (RHO*10)

2. **Recirculation fan**

| Fan basic parameters | |
| --- | --- |
| Fan control | Throttling on the suction side |
| Volume delivered | 5.34 $m^3/s$ |
| Flue gas operating temperature | 150°C |
| Density | 0.8435 $kg/m^3$ |
| Δ p | 21.985 kPa |
| Fan speed | 2,950 1/min |
| Electric motor power output | 200kW/0,4kV/50Hz |
| The fan is provided with the hydraulic clutch | Voith 650 SVTL21.2. |
| Chute at full power output | 2.5percent, i.e. 1450/1490 r.p.m. |



ROTHEMÜHLE

BERECHNUNG VENTILATOREN

K15624-03/K1

-- 3 --

RVT-3.4.4-900518 Sachbearbeiter: HGH Datum: 31.10.96

Ventilator-Typ: nIII-32.5 - ALK

Info: Rezirkulations-Radial-Ventilatoren f. Mlada Boleslav

| | | | |
| --- | --- | --- | --- |
| Nenndrehzahl.....(1/min) | 2950 | Gehaeuse-Eintritt....(m2) | 0.128 |
| Motor-Leistung empf..(kW) | 200 | Laufrad-Eintritt.....(m2) | 0.083 |
| Barometr. Druck....(mbar) | 1000 | Gehaeuse-Austritt....(m2) | 0.130 |
| Laufrad-Aussendurchm.(mm) | 1226 | Diffusor-Austritt....(m2) | 0.128 |
| Zu isolier.Oberflae..(m2) | 12 | Erf.Regelgetriebemom.(Nm) | 500 |

| | | 1 | 2 | 3 |
| --- | --- | --- | --- | --- |
| 1 | Lastfall Nr. | | | |
| 2 | Lastfall Bezeichnung | Ausl. | Last 2 | Last 2 |
| | | 100 % | 40 % | 19.51 |
| 3 | Volumenstrom effekt(m3/s) | 5.34 | 1.97 | 0.98 |
| 4 | Temperatur EIN....(grdC) | 150 | 130 | 130 |
| 5 | Temperatur AUS....(grdC) | 182 | 168 | 179 |
| 6 | Dichte effekt..RHO(kg/m3) | 0.8435 | 0.8932 | 0.8940 |
| 7 | Druck statisch EIN.(mbar) | 992.28 | 1001.05 | 1001.97 |
| 8 | Druckerh. gefordert(mbar) | 217.71 | 191.10 | 142.67 |
| 9 | Druckverlust SD EIN(mbar) | enthal. | enthal. | enthal. |
| 10 | Druckverlust SD AUS(mbar) | enthal. | enthal. | enthal. |
| 11 | Druckverlust Ansaug(mbar) | 2.09 | 0.30 | 0.08 |
| 12 | Druckverlust Diffus(mbar) | 0.04 | 0.01 | 0.00 |
| 13 | Druckh.tot.Vent.DPT(mbar) | 219.85 | 191.41 | 142.75 |
| 14 | Adiabat.Faktor.....Fad(1) | 0.92955 | 0.93828 | 0.95285 |
| 15 | Sp.tot.Frderarb.YT(kJ/kg) | 24.23 | 20.11 | 15.21 |
| 16 | Wirkungsgrad.....(%) | 79 | 54 | 32 |
| 17 | Leistung an der Welle(kW) | 138 | 65 | 42 |

Spez.totale Foerderarbeit YT (kJ/kg) = DPT * Fad / (RHO*10)

### 4.5.4 Existing ash handling

The equipment for removing bottom ash is situated horizontally around the axis of the boiler and vertically below the platform +7,500 m to ±0 m. The boiler is equipped with a fluid air cooler and an ash sorter with a fluid bottom and a heavy refractories which is located in front wall of the boiler combustion chamber. In the separator of air and reciprocating waste gases, the ash is sorted, finer particles are returned to the combustion chamber – on the one hand, and they are cooled to a temperature below 400°C – on the other hand.

The coarser ash grains are then discharged from the separator into a cooling screw conveyor, placed on a supporting steel structure (SS) at ±0 m which after ash cooling to approx. 130 °C, is then guided to a vibrating sieve (two sieves with meshes of 12 and 0.4 mm), where over-mesh grains (grains larger than 12 mm) are directed into the attached container. The mechanical removal of bottom ash ends with a breeches tube chute with pneumatic control. And furthermore, the system of pneumatic conveying chamber feeders continues in ash blowing both to external silos and to the internal storage tank of fluid layer material in case of the boiler cold starting or due to inventory replenishment during the boiler operation. The cooling screw conveyor is vented through the DN 150 piping into the fluidized bed material reservoir.

The bottom ash removal line consists of:

- Slide plate damper 80/90HDA11AA001, DN 300, m=255 kg
- Metal expansion joint 80/90HDA11BR001, DN 300,
- Inclined cooling screw conveyor 80/90HDA11AF001, DN 300/DN 400 (input/output), m=7,050 kg
- Vibrating screen 80/90HDA12AF001/002, 800 x 2000 x 300 mm, m=1,200 kg
- Breeches flap valve, pneumatically controlled 80/90HDA12AA001, DN 300, m=255 kg

**Basic characteristics of the ash removal line**

| | |
| --- | --- |
| Ash bulk weight | 1.0 t/m$^3$ |
| Number of ash removal lines (sizing) | 1 (1x 100%) |
| Transport performance, max | 2.5 t/h |

### 4.5.5 Fluidized bed material equipment

For the boiler first feeding (after its repair, summer shutdown, etc.) or even during the boiler operation it is necessary to supply inert material (ash, sand) to the combustion chamber in order to create a fluidized layer when the boiler is started up. For this, the system of fluidized bed material (MFB) is used, which consists of a part of pneumatic transport, a part of MFB storage and the mechanical transport to the combustion chamber. For the existing coal operation, own ash from the extraction behind the vibrating screen is used.

The technological equipment for MFB dosing into the boiler starts with the MFB reservoir (80/90HDA90BB001). Each boiler has one steel circular tank, from each tank there is an ash line to the boiler. The line consists of:

- Slide plate damper with pneumatic drive 80/90HDA90AA001, 300 x 300 mm,
- Hand-operated slide plate damper 80/90HDA90AA002, 300 x 300 mm,
- Textile expansion joint DN 300/DN 200 (inlet outlet),
- Horizontal take-out screw conveyor 80/90HDA93AF001,
- Slide plate damper with pneumatic drive 80/90HDA94AA001, 200 x 200 mm,
- Ash delivery chute DN 150.

The storage tank itself has textile aeration bags and a suction filter on the ceiling with an exhaust pipe leading up above the boiler house roof.

**Basic characteristics of MFB storage and transport facilities.**

| | |
| --- | --- |
| Number of storage tanks for the boiler | 1 |
| Storage tank total volume | 60 (netto volume 50) m$^3$ |
| Bulk weight (bituminous coal) | 0.8 – 1.5 t/m$^3$ |
| Number of dosing lines (sizing) | 1 (1 x 100 %) |
| Max. transport performance (for bituminous coal) | 12.5 t/h (when filling an empty boiler) |
| | 7 t/h (during the boiler operation) |
| Back pressure at the connection point on the boiler | 4 kPa |

### 4.5.6 Existing flue gas cleaning systems

#### 4.5.6.1 Existing DeNOx

The DeNOx systems were installed on boilers in the years 2019 (K80) and 2020 (K90).

The SNCR system consists of two storage tanks, with two booster pumps for transport of chemical agents from each tank to mixing modules. And further, a block-specific mixing module for each boiler for dilution and dosing reagenst into injection nozzles.

The SNCR injection system is adapted to enable the independent operation of both existing K80 and K90 boilers, i.e. in the part of controlling the dosing and injection of the additive into the individual boilers, it is in a block configuration. The output of the additive from one or the other tank is selectable from the boiler control system when only one pump is operating in the tank for both boilers. At the same time, re-pumping from one tank to another can be carried out, and vice versa according to the immediate situation (e.g. before the loading of a new tank, so that the necessary free volume is available in one tank). The system enables putting out of operation of a part of the equipment belonging only to the given block and enables maintenance interventions to be carried out during the operation of the second unit.

Storage tank, including distributing piping

The DeNOx agent storage tank 80/90HSJ10BB001 is located at a level of +0.150 m in the storage area below the K70 boiler.

The double-walled tank with a usable volume of 30 $m^3$ made of resin composite is equipped with a ladder to its ceiling, where the inlet and individual connection nozzles are located. DeNOx agent flows from the tank truck into the space between the pillars next to the entrance gate. The beginning of the DN65 distributing piping in the outdoor area is equipped with a hose coupling and a manual shut-off valve. Shut-off fittings with a pneumatic drive was placed in the pipeline passage to the boiler room. From the control room the operator can determine into which tank the DeNOx agent from the tank truck will be delivered without interrupting the pump operation in the tank for its own supply of DeNOx agent to the mixing module, or into the boiler. The distributing piping is thermally insulated and heated with an electric cable until it opens into the storage tank, so that the temperature of the DeNOx agent does not drop below +10 °C. The material of the distributing pipe is 1.4404.

Technical parameters of storage tank:

| | |
| --- | --- |
| KKS: | 80/90HSJ10BB01 |
| Number: | 2 pcs in total |
| Location: | internal |
| Tank type: | vertical (low pressure), double-walled |
| Internal diameter: | 3.200 mm |
| External diameter: | 3.345 mm |
| Height: | 4,556 mm (the tank without its accessories) |
| Total volume: | 34.8 $m^3$ |
| Effective volume: | 30.0 $m^3$ |
| Material: | glass fibre reinforced with plastic with a chemically resistant layer |

**Pump for reagent delivering:**

Pumps for reagent delivering a reagent to the mixing module.

| | |
| --- | --- |
| KKS: | 80/90HSJ10AP001/002 |
| Type: | March A1/18 |

| | |
| --- | --- |
| Number of pumps: | 2 /Unit |
| Type: | submersible pumps |
| Pump material : | stainless steel |
| Output: | ca 1 $m^3/h$ |
| Pump max. pressure: | ca 0.9 MPa |
| Pump power supply: | 0.75 kW, 3 x 400V, 50Hz |

For the necessary mixing of DeNOx agent to the required concentration and control of individual branches, a mixing module consisting of a glass case and pipe distribution with fittings on the frame is used. From the storage tank, the reagent is delivered in its original concentration to the mixing and measuring module (each boiler has its own mixing and measuring module). The mixing and measuring module is located along the footbridge on the platform + 33.50 m. In the mixing module, the reagent is diluted to the required concentration (or to the required amount of reagent) based on the instructions from the control system (CS) which is currently needed to comply with the required emission limit. If there is a different concentration of reagent at the inlet, the system will automatically adjust the amount of reagent which is needed for any set required concentration of NOx emissions, on the basis of the CS instruction. The module is equipped with a catch tank for possible reagent leaks inside the modules.

Technical parameters of the mixing module:

| | |
| --- | --- |
| KKS: | 80/90HSK10GH001 |
| Number of modules: | 1 for a boiler |
| Number of injection lances per module: | 3 |
| Material: | 1.4571 / St 37 / glass |
| Length: | 1,600 mm |
| Depth: | 600 mm |
| Height without base: | 2,000 mm |

Industrial water from the existing backbone distribution system was used to dilute the DeNOx agent. In view of the required water pressure in the module which is not available, the installation of pumps for pressure increase carried out on the +7,500 m platform.

A pair of pumps in 1 + 1 connection was placed next to the existing vertical collecting chamber of the high voltage drainage of heating surfaces.

Materials of the parts of pumps that are in contact with industrial water are made of stainless steel. With regard to the possible shutdown of one of the boilers, e.g. during the summer shutdown or failure and operation with only one nozzle, a gallery was built behind the pumps to the suction of the pumps with an inserted pressure regulator with an adjustable value, in order to ensure a range of volume delivered of 17 to 100percent.

**Technical parameters of booster pumps:**

| | |
| --- | --- |
| KKS: | 00LCE20AP001/00LCEAP002 |
| Manufacturer: | Grundfos |
| Type: | CR 1S-7-A-FGJ-A-E- HQQE |

| | |
| --- | --- |
| Number: | 2 |
| Connection: | 1 + 1 (100% reserve-backup) |
| Medium: | industrial water |
| Inlet pressure: | 0.6 MPa(g) |
| Outlet pressure | 0.93 MPa (g) |
| Nominal temperature of medium/max/min: | 20/30/10 °C |
| Nominal volume delivered/max/min: | 0.158/0,166/0.033 l/s |

Three pipeline routes DN20 of diluted reagent and one route of compressed (traffic) air DN15 were led from the module to be connected to the flue gas channel at the exit from the combustion chamber to the cyclone. In front of the flue gas duct, the compressed air pipe split into three DN10 routes for each nozzle lance. This is followed by the hose connection of the individual pipelines onto three lances inserted in the existing nozzles DN 50/80 along the channel height (axially 1.10 m apart) with a shut-off valve at the beginning of the nozzle.

The injection nozzle ensures a mixture spraying in lined boiler gas exhaust pipe and consists of the following parts:

- Protective tube,
- Clamping flange,
- Mixing part,
- Nozzle tip.

Technical parameters (spears):

| | |
| --- | --- |
| Number of injection levels: | 3 |
| Number of nozzles per level: | 1 |
| Number of nozzles per boiler: | 3 |
| Material: | 1.4571 / 1.4841/2.4602 |

**Reducing agent:**

The NOxAMID 40 urea solution is used as a reducing agent. The operator is also running the plant on ammonium sulfate on a trial basis.

Specification:

| | |
| --- | --- |
| Chemical characteristics: | 40percent urea solution |
| Density at 20 °C: | 1,110 kg/m$^3$ |
| pH: | weakly alkaline |
| Solidification temperature: | 0 °C (the beginning of crystallization) |
| Boiling point | 103 °C |
| Combustibility | non-flammable |
| Liquid hazard class | the solution is not dangerous according to Act No. 350/2011 Coll. |

**Dilution water - industrial water**

The reducing agent is mixed with water to achieve an efficient distribution of atomized reagent in the cross-section of the combustion chamber at any inlet NOx concentration. When urea is used as a reagent, industrial water is used.

Specification:

| | |
| --- | --- |
| Temperature: | ca 4 – 25 °C |
| Pressure at the branch point | 0.67 MPa (g) average value outside the short-term decline |
| Pressure required | 0.6 MPa (g) at the level of injection +35.640 m |
| Industrial water consumption: | ca 360 kg/h |

#### 4.5.6.2 Flue gas filtration

The existing K80/90 boilers are equipped with fabric filters for the separation of ash and related accompanying cleaning of flue gas from other pollutants.

The filter cabinet is divided into headers with clean and polluted sides. The cross-section of the channels is variable in the filter in order to keep the same velocity of the flue gas in it. The polluted gas channel is formed as a collecting and settling header for even distribution of ash between the filter chambers. The flow of polluted gas into the individual chambers is in a downward direction, in the direction of the discharging hopper to avoid settling.

The inlet part is provided with a deflection plate facing upwards serving as a pre-separator. On the side of clean gas, the headers are accessible by lids. Each discharging hopper is heated by a heating cable with thermoregulators.

The filter is cleaned with pulsed air based on the pressure difference in flue gases with air from the air compressor station.

Parameters:

| | |
| --- | --- |
| Number of pieces per unit: | 1 |
| Filter type | hose FTR -D6x 14-5.8 (16) |
| Nominal amount of flue gases | 147,000 $Nm^3/h$ |
| Constant temperature of flue gases | 160°C |
| Fault temperature max, 2 h | 190°C |
| Concentration in front of filter | k max= 145 $g/Nm^3$ (bituminous coal – project value) |
| Filtration surface | 3,669 $m^2$ |
| Number of hoses | 1,344 pcs |
| Filter loading | 1.06 $m^3/m^2$/minute *) |
| Load when the chamber is shut down | 1.28 $m^3/m^2$/minute *) |
| Basket dimensions | Ø 145 mm, 5,800 mm in length |
| Ø of filtration hose | 150 mm |
| Material of filtration hoses | PPS/PPS - commercial designation RY060RY12S1.000 |
| Output concentration guaranteed | 20 mg/ $Nm^3$ for reference flue gases *) |

Differential pressure between the inlet and outlet of the filter 1,300 -1,700 Pa

| | |
| --- | --- |
| Cleaning with compressed air | pressure 0.55 MPa |
| | water pressure dew point -40°C |
| | oil content max. 0.0002 g/Nm$^3$. |

The filter hoppers are heated by a two-ring heating element 10 kW/discharge hopper.

The filter is provided with the 3.2 t pulley block to open the inspection cover.

*) Current data must be verified

For the filter drawings see: OB2_A121.07_TKF-Podl.0,0mRez A-A a OB2_A121.08_TKF_RezB-B

Filter cartridge condition:

OB2_A121.09_TKF_LabReport_Filtr_K80; OB2_A121.10_TKF_LabReport_Filtr_K90

#### 4.5.6.3 Existing capture of HCl – K80/90

In the year 2021, the equipment for capturing HCl was added. Sorbent is based on calcium hydroxide ($Ca(OH)_2$) was used in the form of a powder pneumatically dosed in front of the fabric filters.

The installed sorbent dosing technology is carried out separately for the K80 boiler and separately for the K90 boiler. This technology includes two operating silos (one silo for each boiler) with a volume of 2x60 m$^3$, a new steel structure, incl. service platforms, transport routes for filling silos from tank trucks, technology for removing sorbent from silos and dosing it into low-pressure pneumatic transport, and our own low-pressure pneumatic transport into flue gas ducting. The operation also includes the production and distribution of transport air for this transport.

Sorbent unloading

The sorbent is delivered to the combined heat and power plant in tanker trucks. The unloading point is located near the existing entrance to the boiler house. From there, the sorbent is conveyed pneumatically to storage silos located in the boiler house in the space between columns X8.1-X10.3 and Y43-Y44 (near the machine room).

The filling pipe route is led at a height of +4.35 m to the silo area where it rises to a height of approx. 18.4 m and enters the silo via a vortex separator. The silos themselves are of rolled steel, with their outside diameter of 4.35 m with a conical discharging hopper.

Each boiler is equipped with one silo of its volume of 60 m$^3$, two intermediate storage tanks of their volume of approx. 1 m$^3$ and two separate pneumatic transport lines for flue gases of their performance of 40-120 kg/h each, i.e., in total of 240 kg/h/boiler.

The bottom flange of the silo is equipped with a double-sided split closure, which is followed by a double-sided multi-screw extractor with a performance of 2x500 kg/h, which allows the material flow to be divided into two separate routes. The material from the discharge multi-screw is fed into two intermediate tanks with a volume of approx. 1 m3, on the outlets of which dosing multi-screws with power regulation using frequency modulation (FC) are installed. The regulation range is in the range of 40-150 kg/h.

The completely separate sorbent transport route leads to the flue gas ducting from each intermediate storage tank – the dosing screw system. Under normal operating conditions, only one route should always be in operation of the boiler, but, if necessary, both routes can be in operation.

Pneumatic transport

A separation turnstile is installed under the dosing multi-screw, under which there is a pneumatic transport mixer. Compressed air with parameters of approx. 400 Nm$^3$/h and 15 kPa for pneumatic transport of

sorbent to flue gas ducting is produced in Roots blowers and led to mixers through DN 80 pipelines, where sorbent in determined amount is mixed into the air flow. From the mixer, the sorbent entrained by the transport air is led up the route by the DN65 hose and then it is divided into two DN50 hoses which are then led to the flue gas ducting in which they are inserted via the remote-controlled shut-off ball valves via the +18.0 m platform.

The actual dose of sorbent is adjusted depending on the outlet concentration of HCl in the flue gas in front of the stack.

#### 4.5.6.4 Existing handling of limestone

The boiler room is equipped with an existing system for dosing limestone into the fluidized bed of the boilers. The systems are designed in units, with the option of introducing limestone into the second boiler as well and include the filling of limestone and pneumatic transport to the storage silo, dosing and transport using two screw conveyors to the boiler.

Air for pneumatic transport is provided by its own blower.

## 4.6 Existing feed water system

### 4.6.1 Feed water tanks

The interconnected feed water tanks FWT1 and FWT2 are heated from the turbine unregulated take-off, at lower power output levels it is operated with a fixed pressure and heated via a stepdown station from the collecting vessel of its own consumption. The tanks and the feed water pumps discharge can be operationally separated.

| | |
| --- | --- |
| Volume of interconnected feed water tanks | 2x 100 $m^3$ |
| Feed water nominal temperature | 160 °C (fixed pressure operation) |
| Pressure in feed water tank | 0.6 MPa(g) (fixed pressure operation) |
| Operating pressure during current operation | 0.2 to 0.4 MPa(g) |
| Operating temperature (FW) | 135 -160 °C |

The feed water tanks are located on the +13.75 m floor in the intermediate machine room.

### 4.6.2 Existing feed water pumps

High-pressure feed water pumps located on the 0.0 m floor serve to ensuring the supply of feed water via the collecting vessel to the high-pressure (HP) regeneration of the T80 and T90 turbines and then to the K80/90 boilers and, without regenerative heating, to the K70 gas steam boiler.

**1. Feed water pumps – basic parameters**

Number: 4 pcs + 1pc as emergency one

Basic parameters of the main feed pumps:

KSB HGC 3/13, basic parameters:

Feed water pump powered by electric motor via a hydraulic clutch

Operating data from the data sheet:

| | |
| --- | --- |
| Temperature of feed water | 150 °C |
| Density | 916.9 kg/$m^3$ |
| Rate of flow on the discharge side | 156 $m^3$/h |
| Pressure on the suction side | 0.8 MPa(a) |
| Pressure on the pump discharge side | 17.5 MPa(a) |

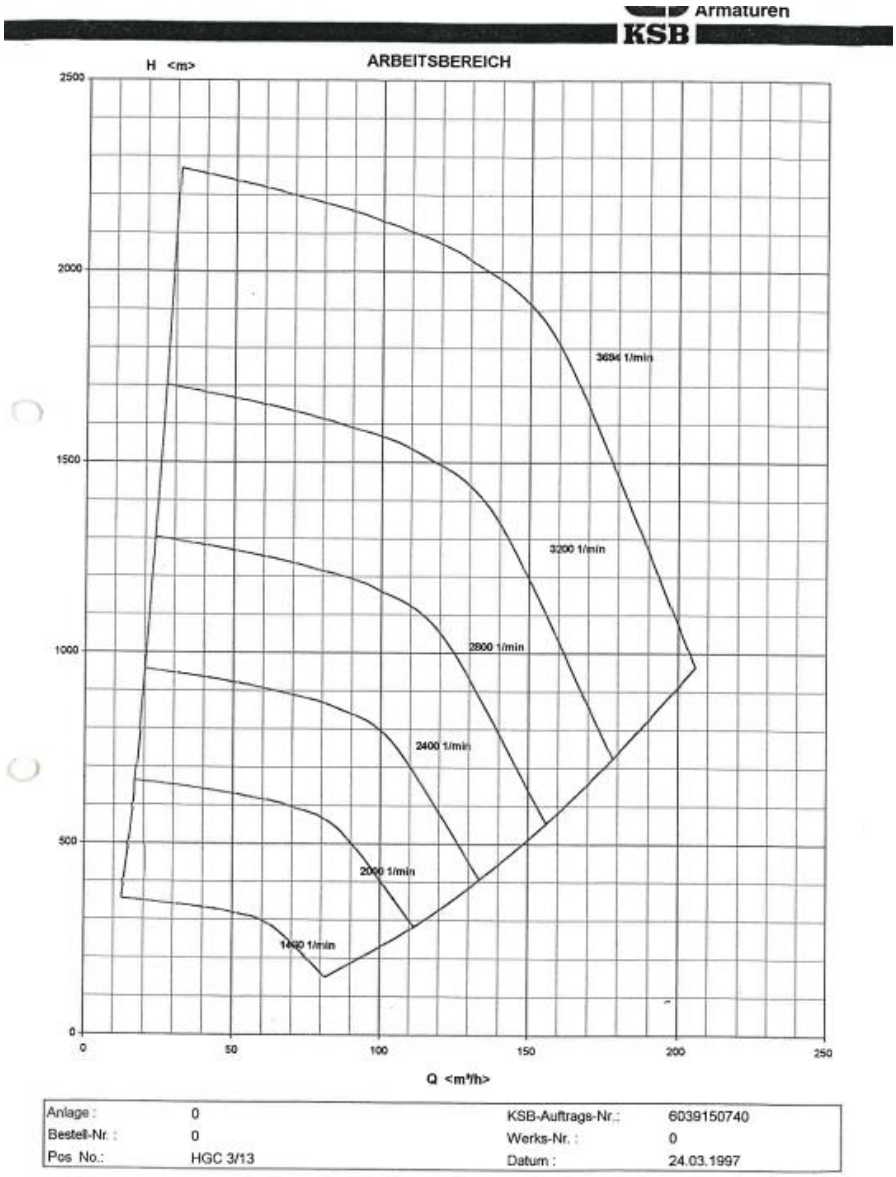
| | |
| --- | --- |
| Pump set description: | Multistage segmented type turbine pump with mechanical seals |
| Motor Siemens | 1.2 MW |
| | Hydrodynamic control clutch VOITH 487 SVTL 22.2 |
| | Gearbox HÜEBER i=1.2 (the pump having ca 3,600 r.p.m.) |

The pump is equipped with an intermediate extraction system for supplying the injections of the reduction stations.

During the operation of the K80+K90+K70 boilers, 3 units will cover the operating requirements, 1 in addition is a stand-by one.

The suction and discharge collecting vessel for feed water are common to all pumps, they can be divided into units, but they are operated almost continuously as common ones, with open split fittings.

For the K80/90 boiler, the regulation of feed water level in the boiler drum is done by throttling through the WellandTuxhorn feed valve, the VOITH control clutch reacts to the differential pressure of the feed valve.




**2. Emergency feed water pump**

| | |
|---|---|
| Number of pieces | 1 |
| Feed water temperature | 150 °C |
| Density | 916.9 kg/m$^3$ |
| Rate of flow on the discharge side | 27.3 m$^3$/h |
| Pressure on the suction side | 0.8 MPa(a) |
| Pressure on the pump discharge side | 17.5 MPa(a) |

## 4.7 Existing stack

The existing stack is a monolithic reinforced concrete one, with a height of 200 m, with a walled ceramic casing with an inner diameter of the shaft at its base of 13.57 m.

The reinforced concrete foundation consists of a concrete slab with a diameter of 29 m, with a foundation joint level of -5.8 m.

The flue gas ducting from the north of boilers K80, K90, K70, and from the south side of boilers K40, K50, K60 are connected to the stack by two rectangular stack flues from the south and north directions, with dimensions of 8 x 3.2 m and a bottom edge of 7.3 m.

For stack drawings – see OB2_121.13_komin; OB2_121.12_E24-SESTAVAKOMINA1; OB2_A121.11_E24-SESTAVAKOMINA 2

## 4.8 Water Handling

### 4.8.1 Cooling Tower Circuit

Within the combined heat and power plant, a cooling tower circuit with wet cooling towers is operated as an end heat collector. The cooled water is pumped by pumps to cooled appliances which are turbine condensers and coolers of the existing internal cooling circuit.

The circuit re-filling is ensured from industrial water – for the chemical mode see B2_A121.14_ChemickyRezim.

### 4.8.2 Existing auxiliary cooling system

It is designed as a pressure-separated from the tower cooling circuit by two tubular heat exchangers, with forced circulation by 3 x 50% pumps, with suction pressure ensured by a gravity expansion tank. The circuit is not regulated.

The internal cooling circuit itself ensures the removal of heat from these components

a) Machine room

a-1 – cooling of the turbogenerator lubricating oil

a-2 – air cooling for the generator winding

a-3 – cooling of feed pumps bearings

a-4 – cooling of feed pumps hydraulic clutch

a-5 – condenser cooling the turbine waste vapour

a-6 – cooling of taken samples in the sampling room

a-7 – cooling of the K50 and K60 boilers recirculation pumps stuffing boxes and seals

b) Boiler House

b-1 – cooling of the HD coupling of the flue gas fan

b-2 – cooling of the KÖLLEMANN screw conveyor

b-3 – cooling of transport and control air compressors

1. pumps of the internal cooling circuit

| | |
| --- | --- |
| volume delivered | 313 $m^3/h$ |
| delivered head | 40 m |
| pump electric motor power output | 55 kW |

The units can be interconnected. Refilling is carried out with demi-water.

## 4.9 Pressure air

### 4.9.1 Existing compressor station of transport air in the E1A boiler room

At the present time, two 0.6 MPa transport air compressor stations, the pressure dew point +3°C for the Combined heat and power plant are operated in the E1A boiler house.

The compressor stations are located on the +7.5 m floor.

The main equipment of the compressor station (CS) for one boiler:

- Screw compressor, water-cooled, lubricated - TAMROTOR L450-8 EWNA

| | |
| --- | --- |
| performance | 4,416 $m^3/hod$ |
| nominal discharge overpressure | 0.75 MPa(g) |
| power input at nominal overpressure | 431 kW |

- compressed air filter with a condensate draining MTA B600 M
- water-cooled compressed air condensing dryer MTA DMN 120/W

| | |
| --- | --- |
| performance at an inlet air temperature of +40°C | 5,777 $m^3/hod$ |
| nominal power input | 14.8 kW |

- 2 x receiver 10 $m^3$ (in front of the dryer and behind it)

### 4.9.2 Existing consumption of pressure air

#### 4.9.2.1 Projected consumption

Overview of transport air extraction 0.6 MPa (g), pressure dew point 3°C – projected consumption.

| Serial number | Equipment name | Air through flow | Pressure dew point | Air overpressure |
| --- | --- | --- | --- | --- |
| | | $Nm^3/h$ | °C | MPa(g) |
| 1 | Control of the pneumatic cylinder of the breeches chute | 0.015 | 3 | 0.6 |
| 2 | Control of the pneumatic cylinder of plates, the closure of the MFB storage tank | 0.1 | 3 | 0.6 |

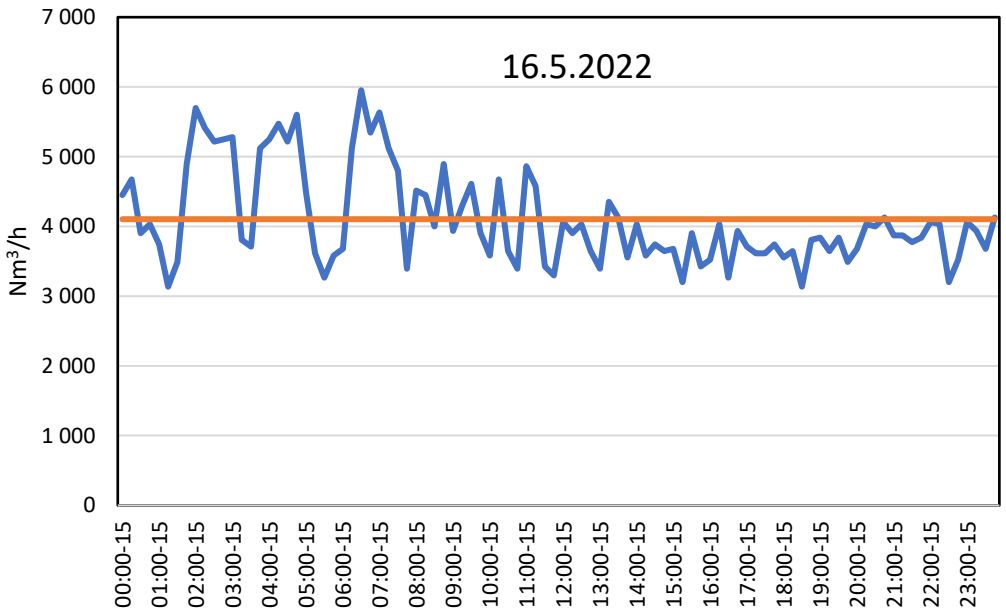
| Serial number | Equipment name | Air through flow | Pressure dew point | Air overpressure |
| --- | --- | --- | --- | --- |
| | | $Nm^3/h$ | °C | MPa(g) |
| 3 | Control of the pneumatic cylinder of slide-plate damper in front of the MFB chute | 0.1 | 3 | 0.6 |
| 4 | Control of the pneumatic cylinder of slide-plate damper in front of the MFB chute | 0,1 | 3 | 0.6 |
| 5 | Sealing air | 5 | 3 | 0.6 |
| 6 | Fabric filter regeneration | 9 | 3 | 0.6 |
| 7 | ETG 30AF001 - Rotofed | 300 | 3 | 0.6 |
| 8 | Aeration of the measuring vessel for limestone | 60 | 3 | 0.6 |
| 9 | Cooled auger for ash transport | 440 | 3 | 0.6 |
| 10 | Clarification of MFB silo | 200 | 3 | 0.6 |
| 11 | Coal handling turnistile | 400 | 3 | 0,6 |
| 12 | Manual closure of the coal delivery chute / distributor | 200 | 3 | 0.6 |
| 13 | Distance piece/ the spacer between manual and electric closures | 100 | 3 | 0.6 |
| 14 | Electric closure of the coal delivery chute | 200 | 3 | 0,6 |
| 15 | Talc extraction on the bypass | 20 | 3 | 0.6 |
| 16 | Talc extraction in coal handling shaft | 20 | 3 | 0.6 |
| 17 | Coal handling turnstile | 400 | 3 | 0.6 |
| 18 | Manual closure of the coal delivery chute | 200 | 3 | 0.6 |
| 19 | Distance piece/ the spacer between manual and electric closures of coal handling chute | 100 | 3 | 0.6 |
| 20 | Electric closure of the coal handling chute | 200 | 3 | 0.6 |
| 21 | Pressure extraction on the bypass | 20 | 3 | 0.6 |

| Serial number | Equipment name | Air through flow | Pressure dew point | Air overpressure |
|---|---|---|---|---|
| | | Nm³/h | °C | MPa(g) |
| 22 | Recirculation valve packing | 100 | 3 | 0.6 |
| 23 | Pressure extraction in coal handling shaft | 20 | 3 | 0.6 |
| 24 | Pellets for 45s - peak offtake | 3,180 | 3 | 0.6 |
| 25 | Pellets – average offtake (in case of a blower failure) | 138 | 3 | 0.6 |
| 26 | SNCR Transport air | 234 | 3 | 0.6 |
| 27 | Transport air – all ash removal | 2,927 | 3 | 0.6 |
| 28 | Bedding material dosing | 9 | 3 | 0.6 |

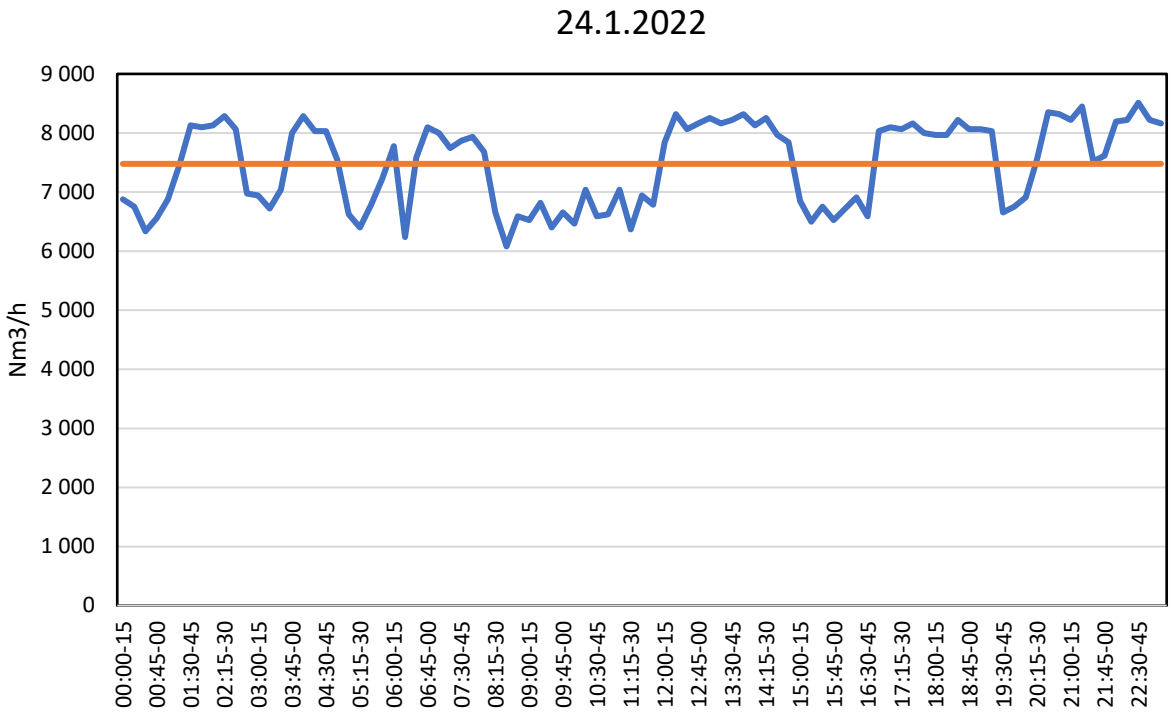
#### 4.9.2.2 Actual measured consumption

The history of measured transport air consumption of 0.6 MPa during one day of the K80, K90 operation during average and extraordinary days in the existing heating plant technology are given below in the text.

1. The average day (15-minute measurement intervals)



2. The extraordinary day (15-minute measurement intervals)




Measured values of pressure:

- maximal 0.62 MPa (g)
- average 0.599 MPa (g)

The above consumption measurements were carried out at the point of connection of the E1A Combined heat and power plant to the central area distribution of air 0.6MPa(g) in the pipe collector, which is now the main source of transport air for the combined heat and power plant.

### 4.9.3 Existing instrumentation air compressor station

Currently, two 0.8 MPa instrumentation air compressor stations with TRB -40°C for K80 and K90 are operated in the E1A boiler house.

The compressor stations are located on the +7.5 m floor.

The main equipment of the compressor station (CS) for one boiler:

- Screw compressor, water-cooled, lubricated TAMROTOR S90-10/W
  - performance 714 m³/hod
  - nominal discharge overpressure 1.1 MPa(g)
  - power input at nominal overpressure 82 kW
- compressed air filter of adsorption dryer MTA F094S, F 094P
- compressed air adsorption dryer with cold regeneration MTA DA 008
  - performance at 1 MPa overpressure 938 m³/hod

pressure dew point -40°C

max. working pressure 1.2 MPa

- 1 x receiver 6.3 m³
- automatic condensate drains (filters, air box)
- water/oil separator BEKO ÖWAMAT 8
  (the condensate from the transport air compressor station (CS) is also connected to the separator)

### 4.9.4 Existing consumption of transport air

Overview of control air extraction of 0.8 MPa, pressure dew point -40°C

| Serial number | Equipment name | Rate of flow | Dew point | Air overpressure |
|---|---|---|---|---|
| | | Nm³/h | °C | MPa |
| 1 | Fabric filter of exp. silo | 20 | -20 | 0.6 -0.8 |
| 2 | Fabric filter of exp. silo | 20 | -20 | 0.6 -0.8 |
| 3 | Control of pneumatic drives and control elements of pneumatic transport | 50 | -20 | 0.6 -0.7 |
| 4 | Fabric filter regeneration on the lime tank | 70 | -20 | 0.6 -0.8 |
| 5 | Pneumatic transport of limestone - control | 10 | -40 | 0.8 |
| 6 | Air for pulse flushing of the limestone storage tank filter | 15 | -40 | 0.8 |
| 7 | Regeneration of boiler fabric filters | 322 | -20 | 0.6 -0.8 |
| 8 | Sealing air for pressure measurement | 40 | -20 | 0.6 -0.8 |
| 9 | Safety valve K70 | 50 | -40 | 0.6 -0.8 |
| 10 | Safety valve K80 | 50 | -40 | 0.6 -0.8 |
| 11 | Heating plant other appliances | 50 | -40 | 0.6 -0.8 |
| 12 | Ash removing | 70 | -40 | 0.6 -0.8 |
| 13 | Bedding material dosing | 16 | -20 | 0.7 |
| 14 | SNCR Transport air | - | -40 | 0.8 |

Consumption and control air pressure 0.8 MPa for K80, K90 determined by orientation measurement:

air consumption 557 m³/hod (a day with max. extraction)

- pressure min. 0.735 MPa(g)
  diameter 0.753 MPa(g)
  max. 0.772 MPa(g)- measured

One of the compressors installed covers the consumption of both boilers (K80+K90).

### 4.9.5 Connection to the Škoda Auto distribution

The connection of the transport air distribution of the E1A Combined heat and power plant to the Škoda Auto site distribution in the collector is located on the -3.8 m floor of the E1A building.

For air quality see Annex A6.

### 4.9.6 Existing explosion-proof equipment

A part of the pellet handling is equipped with explosion protection systems – the Antidet system with action elements, pressure sensors and a control unit with a pre-loader and a sorter protection from the Company VST engineering.

### 4.9.7 Industrial vacuum cleaner

In the E1A boiler house an industrial vacuum cleaner distributions are currently installed. This system is connected to a mobile vacuum cleaner with which the premises are periodically cleaned. Sweepings are taken away and then disposed of as a waste.

### 4.9.8 Inertization system

The goal of inertization with nitrogen is to prevent the spread of possible burning of brown coal, its gradual extinguishment thanks to reduction of the oxygen content below the level of 8% oxygen content and the possibility of removing any fire foci in an inert atmosphere through coal handling lines into the combustion chamber.

As a source of nitrogen there is a set of 6 pressure gas cylinders installed in a common receiver in the boiler house at 0.0m being located under a light shelter on a concreted area after the demolished old boiler system. The pressure in the pressure gas cylinders is up to 30 MPa, this pressure is reduced to 4-8 MPa and subsequently to 1.3 MPa with using a cylinder pressure regulator on each pressure gas cylinders sets.

Starting the inertization system is carried out based on the evaluation of the measured CO content above the coal storage tanks or two intermediate temperatures on the coal storage tanks or on the carrying redler by the boiler operator.

# 5 TECHNICAL SPECIFICATION AND DESCRIPTION OF A POSSIBLE TECHNICAL SOLUTION OF THE K20 BOILER HOUSE

## 5.1 K20 Boiler house – General Description

The steam boiler will be designed to burn wood chips and to achieve the power output of 80 t/h of steam, at parameters of 12.5 MPa / 535 °C and feed water temperature according to A6.

The boiler will be supplied with fuel - wood chips - belt conveyor transport system (within OB 1) to the operating silos in the K20 boiler house.

The flue gas from the boiler will be led into the existing stack. The ash will be introduced pneumatically into the existing expedition silos.

The concept assumes the location of the boiler house in the area defined on the general as the building objects SO 201 and SO 202 with the introduction of flue gas into the existing stack - the existing entrance from the hot water boiler house.

### 5.1.1 Scope of boiler house equipment - boiler unit

The equipment and systems of the K20 boiler include mainly:

1. **The boiler and its accessories**

- boiler pressure system incl. of air heaters, feed water, an evaporator, superheaters, steam coolers, a drum, boiler chambers, the boiler connecting pipes, valves and fittings, the overflow system, safety valves including noise dampers
- system for controlling the temperature of superheated steam
- combustion system incl. the fluidization equipment / a grate incl. of the primary NOx reduction systems
- combustion air systems; fans, air piping, flap valves, noise dumpers, air heaters, gas heaters, steam heaters of air
- secondary reduction system NOx
- heating surface cleaning system
- drainage systems and the boiler starting-up
- equipment for removal of ash, slag, clinker
- chemical preparation and dosing system
- boiler and burners control system
- system for measuring operational quantities
- samples taking system
- load-bearing steel structures of the boiler, structural closure of the boiler house (the boiler house lining room, roof, filling, etc.)
- insulation and refractories

2. **Internal fuel handling of the K20 boiler house**

- internal fuel system consisting of two operating storage tanks, two fuel transport routes to the boiler
- system of start-up and stabilization burners with flame monitoring
- fuel piping systems

- fuel scales

3. **Flue gas system**

- flue gas systems; flue gas fans, flue gas recirculation fan, piping, flap valves, noise dumper; possibly ash separators, flue gas shut-off fittings into the stack
- flue gas cleaning systems to meet emission limits
- storage and dosing of sorbents for flue gas cleaning
- gas exhaust pipes for the discharge of flue gases into the existing stack, including any modifications to the existing bricked up opening to the stack and noise dumpers to the stack, if they are needed
- continuous emissions measurement system

**4. Ash and dust handling system**

- system of intermediate storage and transport of ash to expedition forces
- ash sorting system and use of the fraction as material of the fluid bed
- system of bottling, transport, storage of fluid layer material
- distributions of an industrial vacuum cleaner for vacuuming with a mobile vacuum cleaner (the mobile vacuum cleaner is not a part of the delivery)

**5. Air compressor station**

- compressor station for the production of compressed transport and control air of the necessary quality for the PLANT, incl. piping

**6. Auxilliary cooling circuit in the K20 boiler house**

- exchangers
- circulation pumps
- tower circuit water support pumps (if needed)
- circuit expansion and replenishment system, piping

**7. Interconnecting pipeline systems**

Internal and external interconnecting pipeline systems for connecting the K20 boiler house to the existing distribution of steam in the machine room, feed water, cooling water and other necessary water, compressed air, and natural gas.

**8. General and common items for the systems aforementioned**

- service platforms, foot bridges and stairs; for easy access to service points and handling during service, maintenance, and repairs
- hangers and supports
- lifting equipment
- connection to the main steel structures and foundations
- insulation
- coatings and steel encasing
- all other systems for safe and reliable boiler operation defined by connection points
- grounding systems
- boiler house ventilation and aeration systems

## 5.2 Internal fuel handling of the K20 boiler room

### 5.2.1 Fuel supply to the K20

The fuel to the K20 boiler room will be loaded by three belt conveyors – the end one, with a chute onto the vertical belt conveyors and two continuous ones which also supply the K80/90 boiler house, using a V-shaped chute onto the lower distribution conveyor (OB 1 delivery).

### 5.2.2 Fuel supply and transport

Due to the maximum operational reliability of the UNIT, it is required to maximize the operational stock of wood chips in the boiler houses. The largest possible stock in the boiler house is preferred.

Two operating storage tanks are required.

The minimum required total fuel supply in the operating storage tanks for the K20 boiler is 5 hours of operation at the boiler's nominal power output and reference fuel 1 (wood chips).

The internal transport of fuel from each of these operating storage tanks will ensure the nominal power output of the K20 boiler with the following conditions:

1. The internal transport of fuel from each of these storage tanks will ensure the nominal power output of the K20 boiler with the following conditions.
2. Each of the lines is equipped with a scale for online measurement of the amount of fuel into the boiler. The specific type of scale is not prescribed, but it must be a solution that respects the limited space and the space for maintenance.
3. The conceptual solution for transporting wood chips to the boiler is not prescribed and is chosen based on the technical solution of the boiler's combustion system.
4. The nominal output of the boiler must be ensured for the worst fuel in terms of transport performance even in the event of failure of one of the fuel pathways.
5. The performance of the transport routes - from the wood chip silo to the boiler it is required at least at the level of 120% of the nominal power output of the boiler for fuel with the lowest heating value or the worst in terms of transport performance when the traffic section is filled to a maximum of 75percent.
6. The performance of the fuel lines will be controlled by changing the speed of the fuel transport by frequency converters; each of the transport lines will be able to ensure the supply of fuel for the nominal power output of the boiler at the worst fuel.

## 5.3 Boiler K20

### 5.3.1 Boiler Design

The boiler will be of proven design, suitable for operation with a constant load, as well as for operation in support services, both in summer and winter heating seasons.

All equipment will be dimensioned with sufficient reserves for all real operating conditions.

When designing the boiler, it is also required to respect BAT requirements.

### 5.3.2 Required main technical parameters

- Steam boiler — single-fuel fluid drum with natural water circulation
- boiler combustion system — BFB or CFB
- fuel — wood chips
- nominal steam power output — 80 t/h

- superheated steam nominal pressure 12.5±0,3 MPa(g)
- superheated steam nominal temperature 535±5 °C
- operating power output range of the boiler nominal power output for the reference fuel 40–100%
- minimum steam temperature at the connection point at the minimum power output 515°C
- feed water temperature - range see Annex A6

For the nominal feed water temperature see the Appendix A 6 Reference temperature of feed water.
The minimum efficiency of the boiler for the production of thermal energy must meet the conditions of Decree No. 441/2012Coll. and the Implementing decision of the Commission BAT 2017/1442.

The minimum power output means a stable power output without the use of stabilizer fuel with keeping the minimum steam temperature and steam pressure at the connection point.

### 5.3.3 Fuel

#### 5.3.3.1 Operation fuel

- Fuel –wood chips, for specification see Annex A6.

#### 5.3.3.2 Start-up fuel

Start-up fuel: Natural gas

Fuel specification – see Annex A6, Chapter 2

### 5.3.4 Method of Operation

See Annex A3.

## 5.4 Construction design of K20 boiler

### 5.4.1 Combustion System

1. The combustion system will be fluidized, and all technical and economic and operationally reliable, and proven and suitable types of fluidized combustion systems are allowed, meeting the emission requirements suitable for the given output, given fuel and boiler parameters.
2. The amount, other parameters and distribution of combustion air will be controlled according to the calculated fuel / air ratio, depending on the required boiler power output.
3. The combustion control circuits will control the combustion temperature in such a way that the formation of atmospheric nitrogen oxides does not occur and that the production of NOx and CO is limited to the maximum extent.
4. The refractories in a lower part of the combustion chamber and in other parts will be solved as thermal insulation and protection of the metal parts of these spaces from abrasion to the necessary extent, so as to ensure a sufficient service life of the boiler parts, where the area of high flow speeds of abrasive material is located.
5. According to BAT requirements, the boiler will be equipped with:
   - an advanced combustion process control system and an automated combustion efficiency control system and the prevention or reduction of emissions using powerful monitoring of operational parameters and emissions,
   - optimization of the boiler combustion process,
   - optimization of temperature, flow, and combustion air inlets, in order to effectively oxidize the organic component and reduce NOx formation.

6. For heating surfaces, clogging, sticking and the formation of hard deposits, corrosion and abrasion on the inner walls must be minimized. A suitable covering of the heat transfer surface material will be made on the most loaded tubes of the heating surfaces.
7. If corrosion protection of the air heater is required, a pre-heater (steam or water/air) will be installed as part of the boiler.
8. The suction of air fans will be combined, from the boiler room area and from the outside area and will be located under boiler house roof.
9. The boiler must be designed in such a manner to be resistant to all types of corrosion related to its operation. Deposits of alkaline glass on the heat exchange parts of the boiler are considered an undesirable phenomenon, therefore a designed solution is required that will either prevent them or effectively eliminate them.

### 5.4.2 Combustion air system

It consists of primary and secondary air systems.

The combustion air system will allow suction from the outside as well as from the inside spaces of the boiler house.

The new air piping will be made of sheet steel, reinforced, and equipped with compensating pieces to prevent vibrations, shut-off and control fittings, inlet holes, suspensions, supports, lines, sealing and connecting material.

If square channels are used, reinforcement is required due to the structure stiffness.

Fans, or the air supply will be equipped with an effective noise reduction system in accordance with the acoustic requirements.

### 5.4.3 Fluidized Bed Material

Fluidized bed material handling (MFB) will be installed, serving for the initial filling of the fluidized bed or replenishment of the fluidized bed during operation to the required value. The MFB handling will be provided with equipment for transporting inert material from lorries.

### 5.4.4 Boiler Pressure Part of the K20 Boiler

#### 5.4.4.1 General requirements for the boiler

The boiler pressure part will be water pipe, with natural circulation, and with only one drum.

All heating surfaces will be drainable, and collectors/chambers will be located outside the flue gas stream.

Heating surfaces/bundles, collectors will allow free dilation to prevent inadmissible stresses.

The parts of the water pipe boiler subjected to pressure must be designed in accordance with the requirements of ČSN EN 12952-3.

The final designs will be expanded to ensure that the project requirements are met during production and inspection.

The materials used for the execution of the LOT OB2 will correspond to the relevant standards ČSN EN 12 952-2.

Loss of metal material for the purpose of compressive-stressed boiler parts construction in accordance with ČSN EN 12952-3 includes oxidation, corrosion, erosion, and abrasion.

The shortest suggested technical lifetime of compressive-stressed parts is 200,000 hours.

#### 5.4.4.2 Evaporator

The evaporator with natural circulation will consist of:

- watering pipes,
- distribution and collection headers,
- membrane walls and riser pipes for transferring the steam-water mixture into the drum,
- transfer pipes from the drum to the superheaters.

The membrane wall of the evaporator will be made with lateral deflections (holes) for the necessary openings into the combustion chamber.

The design and dimensioning of the evaporator must ensure a stable and uniform flow of water to minimize the unevenness of the temperatures of the individual pipes.

A continuous and uniform flow of cooling medium to the heating surfaces must be ensured.

The evaporator will allow free expansion, so that no unacceptable stresses can occur.

All heating surfaces of the convectional evaporator will be drainable, and collectors will be located outside the flue gas stream.

#### 5.4.4.3 Superheaters

The steam superheater will be multi-stage and will consist of individual superheater stages, a transfer pipe and collection and distribution headers with a system of multi-stage steam temperature regulation with injection water.

#### 5.4.4.1 Steam drum

The drum must include internals and accessories, such as a moisture trap, sieves, moisture separation, feed water distribution system in the drum, connections for chemical dosing, pipes of continuously and intermittent blowdown, and possibly starting-up draining from the drum.

The drum volume must be sufficient for the safe shutdown of the boiler in the event of an interruption of the electricity supply.

The drum must be equipped with manholes of a minimum size of 450 mm at both ends.

The drum must be equipped with legal fittings including level measurement in the drum, in accordance with the requirements of ČSN EN 12952.

#### 5.4.4.2 Economizer

Economizer will be designed in such a way that there will be no clogging, sticking, no hard deposits and no corrosion and abrasion on the heat exchange surfaces.

#### 5.4.4.3 Air heater (air/air, flue gas/air or feed water/air)

The air heater ensures preheating of the combustion air using flue gas or feed water. The air heater will be designed in such a way that there will be no clogging, no sticking, no hard deposits and no corrosion and abrasion on the heat exchange surfaces.

#### 5.4.4.4 Air preheating

If necessary, the OB 2 CONTRACTOR can equip the boiler with a steam preheater of air.

The steam reduction station or steam interconnection, condensate handling and connection points in the PLANT are within the scope of the OB 2 CONTRACTOR.

The OB 2 CONTRACTOR will propose a suitable connection to the existing condensate system, depending on the nature and frequency of ensuring the maximum rational use of heat.

The steam side of the preheater must not have an operating pressure in vacuum.

#### 5.4.4.5 Boiler equipment

The boiler assembly will be equipped with valves and measuring elements in accordance with ČSN EN 12952.

The boiler will be equipped with fittings in accordance with ČSN EN 12952 which will allow manual and remote control of the boiler within its standard operation.

Ensuring the equipment safety and protection against overpressure in the combustion chamber will also be a part of the obligatory equipment.

The boiler will be equipped on its steam side with a sufficient number of full-stroke impulse safety valves with additional load, noise dumper will be installed at the outlet of the safety valves for steam.

The fine fittings will be supplied, including output counter-flanges (it does not apply to fittings that are part of the boiler's internal wiring) and connecting and sealing material.

#### 5.4.4.6 Outlet steam piping

The outlet steam piping starts at the superheater outlet chamber and ends in the existing steam distributor of steam piping in the machine room. There are branches on the steam piping for entering the sky valves and the entering of the reduction station, or the reduction station to the mains water heater.

Appropriately located drainage and venting pipes are included.

The drainage of the steam line (clean condensate) will be connected to the expander of operating and start-up condensates and the boiler continuously blowdown water tank located in the boiler house.

As a part of the LOT OB 2 there is the steel creep measurement on steam piping installed on high-temperature steam piping.

In the case of running the steam pipe outside the building, it is also necessary to ensure suitable weather protection and protection against freezing of the steam piping parts.

#### 5.4.4.7 Openings

The boiler will be equipped with all the necessary access and inspection doors to the internal space of the boiler - types and dimensions according to ČSN EN 12952 which will allow easy access for visual inspection, measurement, maintenance, cleaning, and revisions in:

- steam space,
- water space,
- combustion chamber and flue gas tract
- air tract (the windbox, LUVO)

A minimum of 1 main access opening to the combustion chamber space of 500 mm width and 1,000 mm height is required.

All penetrations through the wall of the boiler for the placement of individual parts of the openings will be sealed and thermally insulated with internal refractories or insulation. Individual entrances and manholes must correspond in size to their purpose.

To monitor the progress of combustion in the combustion chamber, the boiler will be equipped with several inspection openings (sight holes). As for the inspection openings, their easy opening and closing will be ensured, as well as their appropriate service life and a sealing function.

On the water side, the lower chambers of the walls of the evaporator will be equipped with inspection extensions (holes) or blinded flanges to check the cleanliness of the chambers.

### 5.4.5 Cleaning of heat exchange surfaces

- The boiler must be equipped with an automatic device for cleaning the heating surfaces from solid combustion residues during the boiler operation.
- No technological principle of the heating surface cleaning system is predetermined, all technical and economic, and operationally reliable and proven systems are allowed.
- The OB 2 CONTRACTOR must provide references for the selected boiler cleaning system upon request.
- The system will be used to remove ash deposits on the beam heating surfaces, or a catalyst (if installed), to ensure the required availability of the LOT OB 2.
- Released deposits of ash leave with the flue gas and are collected in hoppers and a filter.
- Continuous or periodic discharge (depending on the amount and frequency) of ash from other boiler passes will be ensured in order to prevent the accumulation of ash in the flue pipes and in such a way that the flue gas conditions in the flue pipe/boiler are not disturbed.
- In case of using steam soot blowers, the entire steam and condensate system is a part of the scope of the LOT OB 2, or steam from the unit's own consumption can be used, if it is possible and efficient.
- If steam soot blowers are used, these will be placed in front of the heating surfaces in the direction of the flue gas flow. Pull-out soot blowers will be installed for cleaning the steam superheater, fixed soot blowers are allowed for cleaning the water heater and air heater. For blowing, steam with suitable parameters designed by the OB2 CONTRACTOR will be used.
- Installation of each blower includes drive mechanism, complete el. connection, necessary fittings, control elements, blowing steam supply, possible reduction of blowing steam pressure, drainage, insulation, service platforms.
- The blowers will be placed in such a way to ensure the greatest possible service life and simultaneously the efficiency of cleaning (they will be installed in places of clogging, so that they do not limit the operation of the boiler and simultaneously they are protected against damage).
- Installation of each blower includes drive mechanism, complete el. connection, necessary fittings, control elements, blowing steam supply, possible reduction of blowing steam pressure, drainage, insulation, service platforms.

### 5.4.6 DeNOX – K20 Secondary Measures

#### 5.4.6.1 General requirements

1. In order to determine the required NOx emissions (for limits see Appendix A 6), the application of primary and secondary measures - reduction of NOx on the boiler - are assumed.
2. As a part of the secondary measures, the SNCR type system in the boiler is preferred.
3. The possibility of using urea, an aqueous solution of ammonium sulphate, an aqueous solution of ammonia or another suitable reagent is required, depending on the overall concept of reducing pollutants in the flue gas and protecting the boiler from corrosion.
4. It is required to use the same reagent for all boilers.
5. Depending on the selected dilution medium in the DeNOx injection module, the OB 2 CONTRACTOR will check the sufficiency of the pressure and temperature characteristics of the medium (demi-water/industrial water) and ensure appropriate measures.

**Other technical conditions**

- In order to properly manage the process for all types of NOx reduction temperature windows will be designed according to individual conditions on the boiler with the aim of ensuring the minimum permissible temperature for dosing the reagent into the flue gas at all operating loads of the boiler and keeping the maximum temperature at maximum load and the full range of fuels.
- A suitable control mechanism will be installed, either based on the measurement of temperature fields or another for the optimization of $NH_3$ chute and the minimization of NOx.
- When applying SNCR, a sufficient number of nozzles and tiers of injection nozzles will be designed to cover the entire cross-section of the boiler passes in a suitable temperature field / a window that varies depending on the boiler load.
- The mixing module will be located near the boiler injection nozzles.
- An appropriate method of controlling the operation of individual SNCR nozzles will be applied in order to optimize the NOx level and not to exceed the permissible NH3 chute, or a safety catalyst equipped with a cleaning device will be installed.
- Cooling/flushing of injection nozzles will be provided to protect them.

#### 5.4.6.2 Possibility of additional installation of an SCR catalyst

In case of using the SNCR system, the supplier must design the boiler in such a way to enable simple retrofitting of the SCR catalyst system in a suitable temperature field in the future, including ensuring the future serviceability of this unit.

In case of using the SCR method of flue gas denitrification, the boiler supplier must ensure the space and conditions for the additional installation of another catalytic layer, including an access and serviceability and replaceability.

This catalytic layer will be dimensioned to achieving the recommended NOx limits according to BAT. In both cases, the boiler supplier must already account for this additional increase in pressure loss in terms of boiler resistances on the air-flue gas paths.

#### 5.4.6.3 External handling of DeNOx agent

The OB 2 CONTRACTOR will check the dimensioning and suitability of the existing pumps, the tank, and the relevant part of piping for the future joint operation of the new K20 boiler and the existing modernized boilers K80 and K90. They will make some adjustments as a part of the LOT OB 2, if needed.

## 5.5 Start-up systems of the K20 boiler

### 5.5.1 Natural gas distribution

The DN150 branch with MGSV, emergency quick-operating valve and ventilation will be newly led from the on-site natural gas distribution on the pipeline bridge. The branch is installed in the K20 boiler house, where a control station is located (if needed) which ensures the required gas pressure for the new boiler burners.

The gas reduction station consists of the following elements:

Number of control rows: 1

- gas filter with pressure loss measurement
- gas reduction valve,
- safety valve,
- shut-off valves and fittings,

- venting piping,
- branch for inertization,
- sensors of operating variables (flow, pressure, position),
- local measurement of operating quantities

gas inlet pressure to the control station 0.25±0.2 MPa(g)

From the control station output the gas is further distributed to the valve sets of the K20 boiler burners. The gas pipeline will be made of carbon steel pipes and fittings and will be coated.

### 5.5.2 Start-up burners of the K20 boiler

The boiler will be equipped with natural gas start-up burners, while it is possible to start the boiler even if one burner failed, both from the cold and warm states of the boiler.

As a part of the LOT OB 2, the CONTRACTOR will supply start-up burners with all the necessary accessories, i.e. in particular:

- burners with control and automatic handling,
- fire and safety equipment, blockades,
- fire and safety equipment,
    - burner accessories
    - gas filter,
    - gas meter for measuring the amount of natural gas used in the burner,
    - a burner putting out of action with shutdown of the burner with a locking closure,
    - deaeration of individual gas pipeline sections,
    - gas reduction device (if needed), etc.

The security device must ensure the interruption of the natural gas supply to the burners due to:

- loss of flame,
- interruption of electric energy supply,
- a drop in the overpressure of the combustion air below the permissible limit,
- increase in gas pressure above the specified limit,
- interruption of the forced flue gas exhaust function,
- a drop in the level in the drum,
- a boiler shutdown,
- activation of $H_2$, CO and $CH_4$ leakage signalling in the boiler house.

The burner equipment will include cooling fans to cool the main flame detectors and igniters.

### 5.5.3 Start-up System – K20 Steam

1. The Sky Valve

The boiler start-up into the atmosphere will be ensured into the atmosphere through the bellows, the system will be equipped with a noise dumper.

The capacity of the sky valve must be sufficient to run the boiler to full steam parameters for connection to the high pressure (HP) distributor.

2. Low pressure steam reducing station.

   It will be used operationally to increase the energy efficiency of the start-up in case of sufficient heat consumption in the collector, or mains water in case of reduction to the backup heater.

The high-pressure (HP) steam boiler connection will be made to the reduction station.

a) RS 2 (00LBF84) – the high pressure (HP) reduction and cooling station / auxiliary steam 12/1.4 MPa(g) 500/300 °C, with a capacity of 30 t/h. The inlet pipe is according to DN 100.RS 2 (00LBF84) –100.

b) RS 3 (00LBF82) – the reduction and cooling station for the backup heating water heater – 12/0.5 MPa(g) 530/260°C, with a capacity of 80 t/h. Note: This system can only be used if there is sufficient heat extraction. The inlet pipe is of DN 150.

The system may be used after reaching at least the parameters in the steam header of the low-pressure distributor, or an exchanger.

## 5.6 K20 Boiler – feed water system

The new boiler will be supplied with feed water from the existing high-pressure (HP) boiler supply system. Due to the fact that when the K80 and K90 boilers are switched over to biomass burning, the power output of the K80 and K90 boilers will decrease, and a sufficient reserve will be created in the existing power supply system to the K20 boiler feeding. And thereto, the feed water pumps currently work into a common bus from which the individual high-pressure (HP) boilers are fed, so the system of heating and degassing the feed water in the degasifiers, feed water pumps and the feed water heaters in the high-pressure regeneration (HPH) in the intermediate machine room of the existing boilers will thus remain without changes. The degassing temperature is 130-160°C, the temperature of the feed water after the high-pressure heater (HPH) is then 210°C at the nominal power of the turbines, decreasing with the power output.

The actual feed water piping of the K20 boiler is assumed to be a DN125/150 piping that will be led to the K20 boiler, where a classic feed head will be installed.

It is required:

1. Connecting the K20 boiler to the pipeline behind the HPH TG 80 and TG 90 will enable the operation of the K20 boiler on one or both of these feed water branches. At the same time, it must be possible to safely separate these pressure units from the feed route to the K20.
2. Connecting the boiler to the discharge of the existing feed pumps, from both halves of the header to enable operation on any pump separated from other pumps - this is the operation of the K20 boiler with the feed water temperature identical to the water temperature in the feed water tank.
3. Make a connection to the existing emergency feed water pump (if needed for operation) and at the same time check the sufficiency of the performance of the emergency feed water pump in relation to the operation of the K80 and K90 boilers.
4. To feed the boiler, the existing system of feed water and feed pumps, including pipe systems up to the connection point, will be used to the maximum extent.
5. The feed water system itself will be equipped with an electric shut-off and control valve and will allow smooth and stable regulation of the pressure/flow rate of the feed water.
6. The feed control valve system with 100percent redundancy is required - this requirement does not apply to the starting-up control valve.

Further conditions:

- The backup method, possibly the use of the starting-up valve to ensure high reliability and accuracy of the control and to ensure the overall availability of the UNIT, depending on the design solution of the OB 2 CONTRACTOR.
- The regulation of feed water is assumed only by control valves on the boiler feed head, even for the boiler start-up.
- The feed water will be used as a cooling medium for steam temperature regulation.

## 5.7 Handling of the K20 bottom ash

### 5.7.1 Introductory Requirements

The ash removal system in the fluidized bed in the boiler, in combination with the possible replenishment of fluidized bed material, must ensure the appropriate quality and quantity of bed material, so as to prevent the formation of agglomerate on the bottom bed grate.

The bed material will be discharged from the boiler into the cooling screw conveyors and then passed through the screen to separate the coarse fraction into the fluidized bed layer deposition (MFB) silos or into the combustion chamber of the boiler or into the dispatch silos.

### 5.7.2 Technical Requirements

#### 5.7.2.1 Ash cooling screw conveyors

- The bottom ash removal system consisting of a system of cooled screw conveyors of sufficient performance with at least a 20percent reserve will be placed under the boiler to ensure ash removal when the worst fuel is charged for the purpose of ash removal from the boiler.
- In order to determine the transport performance of screw conveyors, the effective transport cross-section of the conveyor is 75 percent of the maximum project performance.
- Cooling screw conveyors must ensure sufficient cooling for further handling.
- Water from a new auxiliary cooling circuit will be used as cooling water.
- Their location must allow easy removal of shafts during maintenance, and they will also be equipped with an auxiliary device for their removal.

#### 5.7.2.2 Sorting Screen Separator

If an ash sorting screen separator/crusher is installed, the appropriate fraction of ash from it will be transported to the storage silo of the fluidized bed material/boiler.

The rest of the fraction will be transported pneumatically to the existing ash silos.

#### 5.7.2.3 MFB Silo

In the event of not well-balanced material of the fluid layer, the installation of a MFB silo with sufficient performance to replenish the material for at least 5 days of operation is assumed.

It also includes the supply of material from tank tracks.

Ensuring transport air is a part of the OB 2 CONTRACTOR's obligations.

In this case, the silo will also serve as a storage silo for the first filling of fluid layer material.

The additional material of the fluid layer (if needed) is not specified, but it must be normally available in sufficient quantities, the OB 2 CONTRACTOR shall specify its quality and quantity.

#### 5.7.2.4 Transport of subscreen fraction

Depending on the total ash balance of the boiler, the over-balance subscreen ash will be transported pneumatically to the existing ash dispatch silos (the E18 Object) by pneumatic transport.

Depending on the OB 2 CONTRACTOR´s consideration, the technical solution - due to the distances and height of dispatch silos - an installation of an intermediate dispatch silo in the area of the K90 boiler house or a direct transport to the dispatch expeditionary silos. As a part of the LOT OB 2 there are possible certain modifications of existing ash routes and equipment of dispatch silos.

As for further requirements, see the chapter Pneumatic transport of ash given below in the text.

#### 5.7.2.5 Removal of the K20 Coarse Fraction

As a part of the design solution, a suitable place for handling coarse fractions of ash will be provided, which will be easily accessible for cars. The volume of the container will be for at least 72 hours of operation of the reference fuel.

Two containers are included in the OB2 CONTRACTOR's scope of delivery.

#### 5.7.2.6 Other common requirements

1. Bottom ash extractors will be sufficiently dimensioned even for fuel with the highest ash content with a 20percent reserve and sufficient cooling performance in all operating and fault conditions.
2. The material of parts in contact with a transported medium will guarantee a high service life of the extractors. Failure or repair of one lift extractor and one ash transport line will not limit the boiler performance. The extractors will be located in such a manner to be easily accessible for maintenance and possible repairs (the rotor removing).
3. The system will be sealed so that the boiler house is never smoky.
4. In the area of the cooling screws and the subsequent transport of bottom ash, CO concentration measurement system will be installed in suitable places (because of the possible ignition of the unburnt wood chips mesh material).

## 5.8 The K20 Boiler downstream systems

### 5.8.1 Filtration

#### 5.8.1.1 General requirements

1. The installation of a fabric filter is required to meet the emission limits listed in A6.
2. The filter will be designed as a multi-section one, with a possibility of operation with one section of the filter shut down, and even at the nominal power output of the boiler and the worst fuel.
3. All sections of the filter will be independent of each other, i.e., during operation they can be shut down arbitrarily, according to the operation requirements, and if necessary, it is possible to replace the filter hoses gradually and separately in each individual section within the full operation of the other sections.
4. In the case of a fabric filter, it must be ensured that any unburnt rests are separated or extinguished in the flue gas stream from the boiler before entering the fabric filter, or a material must be used on the filter sleeve that will have sufficient resistance to damage and ignition by unburnt fuel.
5. The minimum operational guaranteed temperature of textile materials must be 200°C.
6. The fully automatic system of filter operation is required, including cleaning of filter elements with a protective function in the event of an unauthorized increase in temperature.

7. The design of the filter and filter elements must respect both the type of fuel and the concentration of ash in front of the filter and its granulometry, possibly the electrical conductivity and uneven distribution in the gas exhaust pipe and its other variability, as well as the boiler start-up conditions.
8. The design of the filter and ash removal system must be suitable for the possible use of various reagents for capturing the monitored pollutants.
9. The service life of the filter cartridge is required for at least 40,000 hours of operation.
10. The filter must also be enable:
    - to regenerate filter hoses with short pulses of compressed air during operation (so-called pulse-jet),
    - in case of sudden air consumption, it must be equipped with a receiver of an appropriate performance,
    - regeneration of filter hoses during continuous operation, when cleaned flue gases flow through filter hoses that are regenerated (so-called on-line) - gradual regeneration of individual rows of hoses in a section depending on the pressure loss of the filter or in a fixed time mode.
11. Filter hoppers will be equipped with heated hoppers, or other equipment limiting the sticking of ash, and they will also be equipped with a level measurement with a protective function.

#### 5.8.1.2 Layout solution

There is no layout restriction in terms of the filter installation which must fit into the overall layout of the K20.

However, from the layout point of view, it is required to place the filter for suspended particulate matters (SP) and flue gas fan(s) inside the K20 boiler house.

### 5.8.2 Systems for ensuring pollutant limits for the K20 boiler

As a part of requirements for meeting the K20 boiler emission limits, the necessary pollutant reduction systems will be installed, so that these limits are met, within the entire range of input fuel quality defined in A6. The following measures should be respected:

- The proposed equipment, methods and a sorbent are not stipulated.
- Any reagent used must be commercially available in the Czech Republic.
- A reagent must already be specified in the OB 2 CONTRACTOR´s Offer.

### 5.8.3 K20 Flue Gas Piping

The subject of the LOT OB 2 are the pipelines between the flue gas outlet flange from the boiler to a new filter, and further, from the filter to the existing stack – the connection on the south side above the level of the existing connections of K40, K50 and K60 boilers.

All connection modifications are of the OB2 CONTRACTOR´s responsibility.

The flue gas pipes will be designed in accordance with EN ČSN EN 1993.

The flue gas pipes must facilitate the installation of emission monitoring (especially with regard to the necessary calming lengths of the pipes) and associated with other measurements and bleeding points for periodic pollutant measurements, including access to these measurements and the bleeding points.

The tightness of the welds will be verified by a suitable leakage test.

Inspection holes must be installed in the necessary places, especially near the shut-off flaps and expansion joints, incidence wings and other built-in elements to ensure laminar flow and prevent turbulence and increased abrasion.

The materials used, storage and fastening, internal insulation and compensation must take into account the maximum temperatures in the gas exhaust pipes and in abnormal operating conditions of the boiler. The internal surface will be protected with a suitable coating/spray as a protection against corrosion.

The local deposition of solid particles must be prevented in the gas exhaust pipes.

The thermal expansion of flue gas ducting will be compensated by the optimal number of gas exhaust pipes expansion joints.

The pipeline will be equipped with inspection holes, compensating pieces, hinges, supports, guides, sealing and connecting material.

A corrosive allowance of at least 2 mm is proposed for gas exhaust pipes of raw (uncleaned) flue gases.

The flue gas piping will be made of sheet steel, which, in the case of using square channels, requires reinforcement due to the rigidity of the structure.

The flue gas piping will be equipped with shut-off valve insulating the flue gas piping system from the stack.

Valves on the flue gas piping will be equipped with sealing air fans, if necessary.

### 5.8.4 ID Fan

The main part of the system is the gas ID fan which creates a negative pressure and keep it at the required level in the combustion chamber, in the boiler back passes and the filter. The discharge piping of the ID fan is introduced into the existing stack.

- The ID fan must ensure a safe and reliable discharge of flue gas. The ID fan must withstand operating temperatures, abrasion, corrosion and combustion products of all types of specified fuels.
- The fan will be equipped with a safety device, shock and vibration damper, noise damper, expansion joints, thermal insulation. The design of the fan shall allow easy inspection and maintenance (cleaning) and drainage of any condensate.
- The fan power output regulation will be either with mechanical regulation on the fan suction/discharge sides or by a frequency converter to ensure regulatory capabilities and maximum efficiency.
- The CLIENT requests the fan operation even in the event of a frequency converter failure.
- If necessary, the OB 2 CONTRACTOR will equip a new flue gas piping between the ID fan and the boiler stack with a noise dumper.

### 5.8.5 Flue Gas Recirculation Fan

- The flue gas recirculation fan will transport the cleaned flue gas back from the flue gas pipe to the combustion chamber of the boiler.
- The flue gas recirculation fan must withstand operating temperatures, abrasion, corrosion and combustion products of all types of specified fuels.
- The fan will be equipped with a safety device, a shock and vibration damper, a noise dumper, expansion joints, a shut-off flap (it is closed when there is no power output, or when needed), thermal insulations. The fan design must allow easy inspection and maintenance (cleaning).
- The fan will be regulated by controlling the speed of the fan drive with a frequency converter.

- The flue gas recirculation pipe will be led out behind the flue gas fan and connected to the boiler's air handling.
- The flue gas recirculation route will be designed to exclude any local ash depositions.
- The flue gas recirculation pipe will be made of steel sheet with a thickness of at least 5 mm. If square channels are used, reinforcement is required due to the rigidity of the structure.
- The pipeline will be equipped with inspection holes, compensating pieces, hinges, supports, lines, sealing and connecting material and measurement of the amount of recirculated flue gas. It will be protected with a suitable coating/spraying as a protection against corrosion.

## 5.9 Pneumatic Transport of the K20 Ash

As a part of the LOT OB 2, there is the construction and modification of the existing pneumatic ash transport system from the K20 boiler (or the K80/90) to the existing dispatch silos.

This system provides:

- pneumatic transport of the fine fraction of K20 boiler ash to the MFB silo,
- transport of K20 boiler bottom ash to dispatch silos,
- transport of fly ash from the K20 systems to existing dispatch silos.

### 5.9.1 Scope of pneumatic transport and modifications

The part of the LOT OB 2 is the installation of all new systems for reliable and efficient transport operation, as well as the necessary modifications to the existing pneumatic transport systems, including dispatch silos and their unloading.

Due to the assumed different granulometry of the ash, the need to change the existing pneumatic transport and storage of ash will be assessed, including checking the venting/filtering stations at the silos, the possibility of ash sticking in the silos, and the OB 2 CONTRACTOR will take the necessary measures.

### 5.9.2 Assumed Solution

#### 5.9.2.1 Bottom ash

In the case of balance surpluses, the ash from the K20 will be transported pneumatically to the expedition silos with partial use of the existing transport. Due to the distance and properties of the bottom ash, if necessary, the system will be equipped with a new operating intermediate silo located at a suitable place in the E1A boiler house or one of the existing systems will be used, according to the design proposal of the OB 2 CONTRACTOR.

In order to ensure the necessary granulometry, the installation of a bottom ash crusher (if needed) is assumed for its homogenization.

#### 5.9.2.2 Fly ash

The proposed solution is that a separated fly ash will be removed from the filter hoppers, via rotary feeders and chamber feeders and transported via a new pneumatic route to the existing ash transport branches from the K80 and the K90, from where it is then transported to external ash silos - E18.

- Transport routes will be dimensioned for maximum ash removal for the "worst" fuel with sufficient reserve. Dimensioning of these routes will be subject to approval by the CLIENT.
- The pneumatic transport pipelines will be sufficiently backed up to each other, they will respect the requirement of the least fragmented route, and their material and design will ensure high operational reliability and the service life of bends with protective lining.

- All components of the overall installation shall be designed and arranged, so that they can be inspected, repaired, cleaned and replaced with minimum time and labour costs. Parts that need to be replaced must be able to be easily dismantled and reinstalled without extensive assembly work, without assembly of mounting platforms and without modification of other installations.
- All new piping must be constructed with flanged joints, with the ability to inspect the flanged joints. Pipe lengths must not exceed 6 m.
- The service life of new pipelines is required to be 10 years, at least.
- Within the scope of the LOT OB 2, there are all necessary modifications to the existing pneumatic transport systems from the K80/90 boilers and the equipment of the E18 dispatch silos for the transport of ash from the K20.
- In the case of very different qualitative parameters of bed and fly ash (especially a composition), the possibility of separate handling for these types of ash should be considered. The CLIENT intends to certify the resulting ash for use as a fertilizer or building material.

#### 5.9.2.3 Ash dispatch silos

The external dispatch silo is used to store fly ash and bottom ash and transported pneumatically from the E1A. Subsequently, the material is delivered into a tank truck, using loading nozzles.

| | |
| --- | --- |
| Number of silos | 2 |
| The total volume of the silo | 450 $m^3$ |
| The useful volume of silo | 400 $m^3$ |
| Max. overpressure/neg. pressure in the silo | +/-3,000 Pa |
| Stocked material | bottom ash and fly ash |
| Bulk density | 300 -1,600 $kg/m^3$ |
| Max. temperature | 160 °C |
| Silo material | steel |
| Cone heating | water heating coil |
| Cone apex angle | 60° finished with a domed bottom – diameter 2,000 mm |
| Hopper aeration | air spray nozzles |
| Silo air venting | filter with regeneration, 65 $Nm^3/h$ |

The building object is air-conditioned under its own silos.

## 5.10 Steel Structures of Pipeline Bridges

The LOT OB 2 includes all steel overhead structures of pipeline bridges and flue gas routes, access, and service platforms.

## 5.11 New air compressor station and distributions

### 5.11.1 Concept

The new air compressor station in the K20 must be able to cover the consumption of instrumentation and transport air of the K20/80/90 boilers, the air consumers in the E1A and E1 building and all other UNITS of other OBs.

**a) Instrumentation air**

Existing appliances in the K80/90 and newly installed ones as a part of the LOT OB 2 in this boiler house and existing connected systems will be operated at an instrumentation air pressure of 0.8 MPa(g).

As a part of the LOT OB 2, an interconnection between these systems will be provided.

The OB 2 CONTRACTOR will increase the storage performance of the air tank in the system according to its design solution, so that the function of downstream equipment is reliable.

**b) Transport air**

It includes the transport air supply from the Škoda Auto which will be used primarily for the K20, K80/90 operation and all other UNITS of other OBs.

The new transport air compressor station in the K20 will serve as a back-up of transport air from the Škoda Auto.

**c) Compressed air sources**

The following compressed air sources are considered:

1. Transport air from the Škoda Auto

   The K20 boiler house will be supplied with transport air from the existing Škoda Auto distribution with a connection to the existing distribution in the E14 boiler house. It is required to ensure the compressed air supply from the E1A to the K20 boiler house. The pressure dew point +3 to 7 °C; pressure 0.6 MPa.

   The existing boiler house E1 and E1A has been already supplied from this air distribution.

2. New compressor station as a back-up of transport air from the Škoda Auto

   The newly built back-up compressor station of transport air in the K20 boiler house will function as a back-up of transport air from the Škoda Auto in the operating configuration 1+0 (preferred) or 2+0. This back-up compressor station for transport air for the K20, K80 and K90 covers the future common consumption of pressure air in the Combined heat and power plant.

   Transport air quality - pressure dew point +3 to 7 °C; pressure 0.6 MPa.

3. Instrumentation air compressor station

   The new compressor station in the K20 boiler house which will provide instrumentation air for K20/80/90 boiler houses and existing operation in the E1A and the E1 in the 1+1 working configuration. One of the compressors will be existing one (newly purchased) and moved from E1A boiler house. The E1A boiler house will be connected to this source.

### 5.11.2 Technical Requirements for the Compressor Station

#### 5.11.2.1 Common requirements for compressed air sources

1. The operation of all air sources will be fully automatic, allowing remote monitoring and instrumentation, as well as monitoring and control from the control room.

2. The equipment operation will also allow a local control.
3. Air receivers shall be able to cover pressure drops caused by intermittent air consumption without negatively affecting the reliability of the appliances' function and must optimize the number of a compressor start-ups.
4. The compressors will be cooled by water from the auxiliary cooling circuit.
5. The compressors will also include an equipment for heat recovery for the heating system.

#### 5.11.2.2 Transport Air from the Škoda Auto

Transport air from Škoda Auto will be used primarily for the operation of all technological equipment.

The CHP plant is currently supplied with transport air from the Škoda Auto distribution system with a connection in the E1A turbine hall. As part of the modernisation of the CHP plant, it is necessary to provide a connection between the transport air of boiler room K20 and building E1A. All transport air from Škoda Auto will be equipped with local measurement (pressure, temperature, flow).

This transport air source, the nominal pressure 0.6 MPa (g), is intended for the needs of the new K20 boiler.

The transport air of 0.6 MPa from the Škoda Auto distribution is brought to the connection point of the LOT OB 2 in the E14 turbine hall.

Local measurements and sensors (pressure, temperature, flow) will be installed on the pipeline.

The basic design parameters of the resource

- nominal air pressure in the ŠKODA distribution system 0.6 MPa(g)
- max. air pressure in the ŠKODA distribution at the connection point 0.62 MPa(g)
- pressure dew point +3 to 7°C from the ŠKODA distribution system
- A receiver will be installed to cover an intermittent consumption within the K20 boiler house.
- An adsorption air dryer will be installed for the pressurized air distribution lines that will be used to supply the air consumers installed within all other OB UNITS. The outlet quality of the air pressure dew point is required to be -40°C. The connection of the dryer shall allow for air supply from the transport air backup (see section 5.11.2.3). The Contractor OB 1 shall investigate the possibility of lowering the TRB to -20°C and notify OB 2 CONTRACTOR in case of change.

#### 5.11.2.3 Transport Air Back-up

The transport air 0.6MPa for the K20, K80 and K90 will be primarily taken off from the ŠKODA central air distribution.

In case of need (e.g. failure of the supply of transport air from Škoda Auto), the supply of transport air will be ensured from a new compressor station in K20, where one or alternatively two compressors with air treatment (drying and filtration) will serve as a source of compressed air for this purpose to achieve the required parameters (see above parameters of transport air in the Škoda Auto distribution system). The new transport air compressor(s) located in the compressor room of building K20 will serve as a backup for the transport air from ŠKODA. Only one compressor is preferred, the design should be coordinated with the electrical design see section A4.2.

The compressors will be of a screw-type, water-cooled, with speed control by a frequency converter. Compressed air is treated by a water-cooled condensation dryer with filtration at the outlet. The condensate is discharged directly into the sewerage. Fluctuations in consumption will be covered by air recievers of the required capacity.

Local measurement devices and sensors (pressure, temperature, flow) will be installed on the pipeline.

The compressed air distribution piping will be made of carbon steel. The air pipe between the compressors and the dryer will be of stainless steel. Cooling and heating water pipes will be made of materials of the class 11.

Basic design parameters of the resource

- Transport air consumption of the K80+K90 2,100 – 6,200 $Nm^3$/hod *)
- Transport air consumption of the K20 900 – 2,500 $Nm^3$/hod **)
- Expected consumption of the UNITS of other OBs 630 $Nm^3$/hod ***)
- Average air pressure in the distribution 0.6 MPa(g)
- Maximum air pressure in the distribution 0.62 MPa(g)
- Required air quality according to ČSN ISO 8573- as a minimum 1: 1 – 4 – 2 (particles-water-oil)
- Compressed air for OB 1 according to ČSN ISO 8573- as a minimum 2 – 2 – 2 (particles-water-oil)

*) The OB 2 CONTRACTOR OB 2 is obliged to verify and adjust this value as a part of the Bid and a project preparation in such a manner it corresponds to the OB 2 needs, as well as all needs of the K20/80/90 boilers and air consumers in the E1 and the E1A.

**) The value is determined by the Bidder in their offer, or by the CONTRACTOR during execution of the LOT OB 2.

***) OB 2 CONTRACTOR is required to verify and adjust this value to meet the needs of OB 1 during bid preparation and project development. The OB 1 Contractor is responsible for coordination with other OBs.

The overview of the main equipment of the resource

The air source No. 3 consists of the following main equipment and devices:

- The oil-free screw compressor, water-cooled (2+0) or (1+0), a drive with a frequency converter
- The water-cooled condensation dryer with outlet filtration (1+ 0),
- The receiver 10 $m^3$, 1.6 MPa (2x).
- The receiver 6,3 $m^3$
- The adsorption air dryer (for outdoor buildings),
- The water/oil separator 1x (depending on the technical solution of the OB 2 CONTRACTOR)

#### 5.11.2.4 New instrumentation air compressor station

New compressor station in boiler room K20, which will provide instrumentation air of 0.8 MPa(g) for boiler house K20 and buildings E1 and E1A.

As part of LOT OB 2, the instrumentation air from the new compressor station in building K20 will be connected to the existing air consumers.

OB 2 CONTRACTOR OB 2 shall, according to its design, increase the storage capacity of the ai reciever to ensure reliable operation of the system.

To ensure instrumentation air consumption, a compressor configuration of 1 (operation) + 1 (backup) is required. One of the compressors will be relocated from the existing compressor room as this is a newly purchased piece of equipment (2023). An identical backup compressor solution is preferred.

Overview of the main source devices:

a) Water-cooled screw compressors with oil injection will be used to produce compressed air. The desired quality of the compressed air is ensured by an adsorption dryer with filtration.

b) The oily condensate is taken to an oil/water separator.

c) Fluctuations in consumption are covered by a receiver.

d) Compressors will be delivered in a version that enables the recovery of waste heat in the form of heating water

e) Local measurement systems and sensors (pressure, temperature, flow) will be installed on the pipeline.

f) Compressed air distribution will be made of stainless-steel pipes, fittings and valves. Cooling and heating water pipes will be made of the materials of the class 11.

Basic design parameters

- Estimated consumption of the K80/90/K20 instrumentation air 1,100 $Nm^3$/hod *)
- Nominal air pressure in the distribution 0.75 MPa(g)
- Expected air consumption for LOT OB 1 100 $Nm^3$/hod **)
- Max. air pressure in the air distribution 0.83 MPa(g)
- Pressure air dew point -40°C
- Required air quality according to ČSN ISO 8573-1: 2 – 2 – 2 (particles-water-oil)

*) The OB 2 CONTRACTOR is obliged to verify and adjust this value as a part of preparation of the Bid and the design in such a manner it corresponds to the needs of the K20/80/90 boiler houses and air consumers in the E1 and the E1A. Losses in the required air treatment are not included in the estimated amount. At the same time, it supplements the consumption of the K20.

**) During the implementation it is necessary to check the balance with the OB 1 Contractor - Fuel handling system.

Overview of the main equipment of the instrumentation air compressor station

The resource will consist of these main devices”

- 2pcs of a screw compressor (the one of which is already existing – moved) with oil injection, water-cooled with waste heat recovery (1+1) *),
- 1pc of the adsorption dryer with cold regeneration, incl. filtration (the K80/90 existing equipment)
- The air receiver - at least 6.3 $m^3$, PN 16 (according to the OB 2 CONTRACTOR technical solution)
- 1pc of the separator water / oil.

*) 1pc of the instrumentation air compressor including air treatment will be relocated from the existing K80/90 operation. This relocation and connection and interconnection is a part of the OB 2 scope.

The OB 2 CONTRACTOR will check all capacities of the existing equipment and will propose possible changes.

## 5.12 Phosphate handling (if needed)

According to the chemical regime as a part of the LOT OB 2 there is the delivery and dosing of $Na_3PO_4$ solution into the K20 boiler water, including preparation of the solution and the solution pumping/dosing

into the circuit. Alternatively, according to the OB 2 CONTRACTOR´s choice, other chemical reagents to protect the circuit may be used, however, with maintaining compatibility with existing operation.

The required quality of the steam on turbines is the obligatory parameter.

## 5.13 Auxiliary cooling system

### 5.13.1 Concept of the K20 Cooling

A new auxiliary cooling system will be installed within the K20 boiler house. The system is used to cool auxiliary boiler systems, for example bottom ash screw conveyors, air compressors, samples, or a frequency converter (FC).

The cooling system consists of individual circuits separated from each other by exchangers. The type of exchangers has not been specified.

The system is cooled by tower water which is taken from the inlet and outlet pipes of the tower cooling water in the basement of the machine room. The water is led to the coolers of the auxiliary cooling system located in the K20 boiler house.

To cover pressure losses, two booster pumps will be installed (if needed) – an operational one and another as a standby one. The water from the coolers of the auxiliary cooling system in the K20 boiler house will be led back to the drainage pipe of the tower circuit in the machine room. The circuit will be filled with demi-water.

The performance of the circuit will be designed depending on the conceptual solution for cooling the compressor station, take-off screws, etc.

The auxiliary cooling system will be installed in the boiler house and will be equipped as follows:

- Two exchangers – as a minimum - tower water /water of the auxiliary cooling system (1+1),
- Two circulating pumps – as a minimum (1+1, or 2+1),
- a pressure expansion vessel for maintaining pressure in the system,
- a system of automatic filling/draining of water in the circuit,
- an inlet for maintaining circuit chemistry and sampling,
- the tower circuit booster pumps (1+1 or 2+1) (if needed),
- a frequency converter is required for circulation and booster pumps,
- connecting pipes of the circuit incl. of the connecting pipe to the tower cooling water in the machine room.

The design of these coolers must allow a possibility of cleaning the space of the cooler filled with tower water with clean industrial water entering the cooler.

The cooling water pipes led outside the buildings will be insulated and heated. It does not apply to pipelines laid in the ground.

## 5.14 K20 Cleaning

### 5.14.1 K20 industrial vacuum cleaner distributions

Since the settlement and dust piles are considered a potential source of hazardous explosive atmospheres, their generation must be controlled and any releases of material beyond the technology must be continuously removed.

The installation of industrial central vacuum cleaner distribution with connection to a mobile vacuum cleaner is required. Distribution lines will be installed to ensure cleaning throughout the production

premises of the K20 boiler room, with an emphasis on cleaning in the area of wood chip handling and transport.

1. The removal of dust within the boiler house by mixing it into the fuel while respecting the safety requirements. The entire system must be solved as a system with a risk of wood dust explosion and equipped with the necessary protective equipment, according to the applicable legislation and in accordance with the prepared explosion protection document.
2. The dimensions and material of the piping will be suitable for vacuuming, according to dust characteristics.
3. The connections of the pipe parts will be dismountable.
4. Sockets will be equipped with microswitches for remote switching on.
5. The system must allow cleaning in several places at the same time with a sufficient number of connection points with gravity flaps. The circles described around the individual connection points on the pipe system with a radius of 12 m (two suction hoses) must overlap each other.
6. Specific emissions of dust in the exhaust into the atmosphere during operation must not exceed 10 mg/Nm$^3$.
7. The delivery will include the relevant cleaning accessories of suitable characteristics, according to the cleaned surface and material.

### 5.14.2 Wet method of cleaning

Cleaning the floor in the internal rooms of the boiler house and a filtration on the floor at the level of ±0.000 m - the floor will be adjusted and sloped for wet cleaning. At the same time, the equipment location on the 0.0 m floor shall be taken into consideration, so it will be equipped with a suitable (e.g. epoxy) protective anti-slip coating.

The available industrial vacuum cleaner with fixed distributions will be used on the upper floors.

## 5.15 Interconnection pipeline

Within the LOT OB 2 all technological pipe interconnections of the new or the rebuilt boiler house technology to existing PLANT systems, as far as to the connection points, i.e. both internal and external pipe routes are included.

Above all, it is a case of:

- the pipeline of high-pressure steam from the K20 boiler house to the steam collector and reduction stations in the intermediate machine room,
- the feed water pipes from feed pumps, high-pressure heaters of both turbines, etc.,
- demi-water piping,
- the piping of tower cooling water,
- pressure air pipes of all qualities to the PLANT and UNITS of all other OBs,
- ash discharge piping.

# 6 TECHNICAL SPECIFICATION AND DESCRIPTION OF A POSSIBLE TECHNICAL SOLUTION OF THE K80/90 BOILER PLANT

**Work Phasing:**

In case of the E1A boiler house - the first stage of the K80 boiler refurbishment is expected, while ensuring the full operation of the K90 boiler on coal, and possibly also on wood chips or pellets.

Modifications of both boilers, auxiliary systems including flue gas cleaning, ash removal up to the delivery limits will include all modifications and implementation of new systems that are necessary for the transition to new fuels, achieving the required performance and guaranteed values within the framework of Annex A6. Modifications include, but are not limited to, the systems listed below. The purpose is to ensure a functional unit connected to the UNITS parts of other OBs.

## 6.1 Total range of modifications of K80/90 units

### 6.1.1 Required main technical parameters and characteristics of K80/90 boilers

The reconstruction of the K80/90 existing steam fluid boilers with natural circulation to a boiler burning the following fuels and complying with the following parameters.

| | |
| --- | --- |
| Fuel 1 | Wood chips |
| The required range of the fuel burned - for the fuel 1 | 0-100percent of the boiler nominal power input |
| Fuel 2 | Plant pellets |
| The required range of the fuel burned – for the fuel 2 | co-combustion with wood chips 0-40percent of the boiler's nominal power input |
| Fuel 3 (boilers K80 and K90) | technological fuel 0 or in the range of 250 to 650 kg/hour - rate of flow. |
| Fuel 4 Natural gas – start-up fuel | |
| Required number of operating forces on the boiler | 2pcs with the goal of storage performance maximizing |
| Nominal steam power output | 100 t/h |
| Nominal pressure of superheated steam | 12.5±0.3 MPa(g) |
| Nominal temperature of superheated steam | 535±5 °C |
| Nominal temperature of feed water – the turbogenerator nominal power output | According to Annex A6 |
| The boiler must be capable of long-term operation in case of failure of the high-pressure heater (HPH), i.e. the temperature of the feed water | 160 °C |
| Characteristic of feed pumps | see the description of the current state |
| Boiler operating power range for reference fuel 1 - without stabilization | 50–100percent – of nominal power output |
| Minimum steam temperature at the connection point at minimum power output | 515°C |

From the point of view of minimizing investment costs and saving time, the CLIENT prefers the use of existing components wherever it is technically possible, but in accordance with the concept of the expected minimum service life and reliability of non-replaced components and their suitability for future operation.

The minimum efficiency of the boiler for the production of thermal energy must meet the conditions of Decree No. 441/2012Coll., respectively BAT 2017/1442.

For fuel composition see Annex A6.

For required service life see Annex A3.

### 6.1.2 Assessment of Condition

As a part of their offer and on the basis of available information given in the demand documentation and in its Annexes, the CLIENT will submit a technical solution, including the expected repairs and replacements of individual equipment of the boiler house and the boiler system placed behind the boiler, including modifications to the relevant supporting structures of the E1A boiler house.

The OB 2 CONTRACTOR, within the scope of the OB 2 WORK, and on the basis of a detailed analysis of the equipment, selects further necessary modifications to downstream equipment that do not meet the required characteristics listed below and that exceed the modifications specified by them in their offer.

As a part of the OB 2 CONTRACTOR's scope of work there is a technical assessment of the condition of the entire blocks and the boiler system behind the boiler – the boiler aggregates, fuel transport, ash transport, filtration and other flue gas cleaning systems, including an assessment of their expected service life, existing technical condition and suitability for burning future fuels and achieving the required performance parameters of the boiler and associated equipment, operating characteristics, and reliability.

It is required to check the internal deposits of the evaporator and the economizer or the shot superheaters, at least.

As a part of the assessment, the OB 2 CONTRACTOR will prepare a report where they will propose some new or additional measures compared to the Offer. The implementation of these measures is subject to the approval of the CLIENT.

### 6.1.3 Assessment of the condition of K80/K90 boilers with respect in terms of maintenance works

The scope of the assessment is not completely exhaustive, it is based on submitted revision reports, takes into account the existing operating conditions (burning pellets) and experience from other, similar fluid boilers, especially experience with the service life of the main parts of boilers in the environment of fluid boilers. The overall condition of both boilers is very similar and from the point of view of quality maintenance, it can be evaluated as very good. And further, we shall assess a condition of selected main parts of boilers, where a greater wear and increased demands for future maintenance can be assumed.

#### a) Air Heater

The boiler is equipped with a steam air heater at the entrance to the air tract -no technical evaluation is available.

The flue gas - air heater - 4th bundle was replaced with stainless steel material in the case of K80/K90 boilers – the tube plate and pipes. The results of the condition assessment of other parts are given in Appendix A121.22. Before starting the contractor's work, the 3rd bundles of the air heaters K80/90 will be replaced. The CONTRACTOR is obliged to assess the remaining bundles with regard to the service life of another 120,000 operating hours or replace them with new ones.

#### b) Boiler pressure part – the Evaporator

Pipes thickness is measured every two years on the pressure unit of the evaporator, using ultrasonic measurement. The measurement is repeated at the same selected points, where the greatest abrasive effect of the fluidized bed on the pipes of the evaporator pressure unit is assumed, primarily above the end of the refractories, above the shot superheater and further along the height of the combustion chamber at intervals of approx. 2m.

The obtained values show that the abrasive processes take place slowly and evenly, i.e. that there are no places with increased local wear. The losses of the membrane walls (hereafter referred to as MW) range up to 0.8 mm, with an average of around 0.4 mm.

From that point of view, it is possible to evaluate the state of the MW as good, not requiring immediate intervention or replacement of some parts. However, it is necessary to take into account that on some pipes, larger wall thicknesses than they have from production were measured, and therefore it is necessary to assume the existence of deposits inside the tubes of the membrane walls of the evaporator, which can affect the evaluation of the decrease in wall thickness and which significantly affect the heat transfer and increase the thermal load on the pipes, which can lead to failure cracks.

Corrosion is noticeable and visible on the evaporator tubes, which can also affect the overall life of the tubes. For a more accurate evaluation of the condition of the evaporator tubes, it will be necessary to cut out tube samples for their comprehensive analysis (material and metallographic ones, verification, and analysis of internal deposits).

Forced replacements of parts of the evaporator in the vicinity of the fluidized bed remain a separate chapter related to its replacement or necessary modifications, especially to the ash removal system from the combustion chamber. Since the refractories of the lower part of the combustion chamber are made of blocks of cast refractory concrete fixed on the MW evaporator on welded pins, removing the refractories due to the replacement of the evaporator tubes is quite problematic. When using air breakers, there is a significant risk of serious mechanical damage to the evaporator tubes. Even when using a gentler method of hydro-demolition of the refractories (removing the refractories using a high-pressure water jet), damage (breaking) of the mandrels holding the refractories to the MW occurs. If the mandrel breaks, there is a risk of microcracks in the place where the mandrel is welded to the evaporator tube, the possibility of its subsequent development and the appearance of a failure crack and a compression loss of the pressure unit. The part of the evaporator pipe above the refractories is additionally equipped with a ceramic-based protective coating.

### c) Boiler pressure part - heating surfaces in the 2nd pass

On the parts of the pressure unit in the second pass, tube thickness is measured repeatedly after two years using ultrasonic measurement. The measurement is repeated at the same selected points, namely on the MW superheater, pipe bundles 3.PP and 1.PP, on suspension pipes, on ECO bundles.

The measured values do not show a decrease in the thickness of the pipe walls, on the contrary, the measured values are often greater than at the pipes from production. There is a lot of deposits on all parts of the pressure unit, especially on the 3.PP pipes, which partially protect these pipes from abrasion. Corrosion is visible on all pipes here. It is not possible to completely remove external deposits from the pipes before the measurement, a layer of deposits inside the pipe is also assumed, therefore the results of these measurements do not give a big picture of the condition of these parts of the pressure unit. The superheater 3 spiral tubes are most at risk of wall thickness weakening due to chlorine corrosion.

The CLIENT requests the replacement of all transverse heating pipes in the second pass due to poor condition (1st and 3rd superheaters) including hanging pipes and the whole ECO.

### d) Vortexes

Vortexes on K80/K90 boilers have already shown significant structural problems leading to the state of collapse of the lower part of the Vortexes. From the analysis of the causes of the lower part deformation it follows that the Vortexes casings are stressed both with cyclic mechanical stress arising from the unevenness of the flue gas flow and by cyclic high-temperature stress which can cause thermal degradation of the material of the Vortex and the anchors during which the materials lose their elasticity, become brittle, and their strength and these manifestations of flue gas flow can lead to deformation and collapse of the material.

Vortexes on K80/K90 boilers were replaced in 2014-2015, so they have been in operation for 8-9 years. Experience from the operation of similar fluid boilers with similar Vortexes speaks of a service life of the material at the level of 12 years (this is based on previously performed metallographic analyses and material tests on similar boilers).

The effect of alkaline corrosion on the steel structure of the Vortex is evident.

The deposits stuck to the anchors and in the space between the refractories and the steel structure, which can cause corrosion under the deposits.

The CLIENT requests a complete replacement of both Vortexes.

### e) Fluidized bottom

As several cracked or clogged primary nozzles are replaced each year, it will be necessary to think hard about changing the layout and flow in the primary box below the fluid bed. Experience from the operation of similar boilers shows a direct connection between the uniformity of the flow and the low or almost zero drop of bottom ash into the windbox which then cannot cause an abrasive effect on the fluid nozzles from the inside.

With the assumption of a change or a reconstruction of the primary bottom due to a change in fuel and its different properties in terms of putting the fuel into uplift, a complete replacement of the fluid nozzles and a change of the system of lifting the bottom ash from the combustion chamber are assumed.

### f) The K80 Refractories

### Combustion chamber:

The walls of the combustion chamber are without any damage after the replacement of the refractories. The refractory concrete is compact under the adhesive layer. The ceiling of the combustion chamber is undamaged, the entrance window to the cyclone is slightly damaged, the bottom ash return chutes (slides) are completely new.

- The ceiling, side walls, floor show no damage.
- The refractories' nose is damaged, a complete replacement is required.
- The refractories of the refractories edge on the side of the combustion chamber is damaged, a repair is required.
- There is no damage on walls with deposits
- As a part of retrofitting, the insulation of the combustion chamber of both boilers is required to be replaced.

#### Cyclone and Chutes Cyclone- Siphon

The ceiling part and the cone part show no damage.

The chute cyclone-siphon show no damages.

Most refractories have significant baked-on deposits that need to be removed.

At the end of the project, all refractories must be resistant to chlorine in the flue gas. Most of the refractories in the fuel downpipes, the siphon and the conical part of the cyclone are already made of this material. It is assumed that the refractories in the cylindrical part of the cyclone and in the part of the flue pipe between the cyclone and the 2nd draft will be replaced.

### g) The K90 Refractories

#### Combustion chamber

The walls of the combustion chamber are undamaged, there are significant deposits, the entrance window to the cyclone is slightly damaged.

**Inlet gas exhaust pipe**

The ceiling, side walls, floor show no damage.

The refractories of the refractories edge on the side of the combustion chamber is damaged, a repair is required.

There is no damage on walls with deposits.

**Cyclone and Chutes Cyclone- Siphon**

The ceiling part is damaged at the point where the straight and round walls with deposits joins. Here, the ash penetrated into the insulation layers above the side wall and subsequently the casing burned through. This part must be repaired and the steel jacket replaced.

The round part of the cyclone walls made of prefabricated fittings shows no damage.

The conical part shows a strong adhesion of biomass layers, especially in the area of the upper console supporting. Console supports are damaged.

The chute cyclone-siphon show no damages.

Most refractories have significant baked-on deposits that need to be removed.

At the end of the project, all refractories must be resistant to chlorine in the flue gas. Most of the refractories in the fuel downpipes, the siphon and the conical part of the cyclone are already made of this material. It is assumed that the refractories in the cylindrical part of the cyclone and in the part of the flue pipe between the cyclone and the 2nd draft will be replaced.

**The Fabric filter**

The hoses on the fabric filters of the boilers were replaced: K80 – the hose replacement in the year 2011, K90 – the hose replacement in the year 2012.

According to the results of the technical reports on the condition of sleeves which are elaborated every year, it follows that the hoses are beyond their service life, but they are still capable of operation without affecting the emissions of particulate matters (PM). The Operator plans to replace them at that moment they have serious problems with SP emissions (replacement hoses are ready in stock).

he exhausted life of the sleeves is evidenced by the results of laboratory analyses, from which it follows that the material of the sleeves is penetrated by ash throughout the structure, has reduced breathability and the ability to regenerate. So far, however, the material shows sufficient strength in the longitudinal and transverse directions, so there is no risk of the sleeves tearing off.

### 6.1.4 Preliminary considered scope of expected modifications of boiler houses

The scope of the changes considered below in the text is based on the materials that the CLIENT had prepared in previous years and that corresponds to the given time and scope framework. They cannot be considered exhaustive, all modifications outlined below must be assessed by the CLIENT / the OB 2 CONTRACTOR OB 2 and the CLIENT or the OB 2 CONTRACTOR shall proceed in accordance with their best engineering practice in determining the extent of modifications to ensure the required properties of the OB 2 WORK.

## 6.2 Dismantling and rearrangements

As a part of the LOT OB 2 OB 2 there are all disassembles and rearrangements necessary for the execution of the LOT OB 2, clearing the construction site and a place for the installation of new equipment, its proper assembly, and subsequent operation.

The following work specification cannot be considered exhaustive and will depends on the specific requirements of the newly installed technology and works progress.

### 6.2.1 Dismantling

#### 6.2.1.1 Dismantling of the internal coal fuel system

#### 6.2.1.2 Coal bunkers

As a part of the modifications to the internal fuel handling of the OB 2, the existing coal bunkers will be dismantled, incl. related technological equipment and constructions to create a space for the installation of new operational wood chip storage tanks.

The coal bunkers in the E1A bunker building between the floor +36.0 m and the floor +15 m – the bunker technology and the bunker itself will be dismantled, including hoppers, subsequent technological elements of fuel transport to the boiler, depending on the technical solution of the OB 2 CONTRACTOR.

Ground Plan dimensions of the cell: 7,430x7,440 mm, the chamber height 8,500 mm, the hopper 90,000 mm. The cell theoretical volume is 530 $m^3$.

The bunker weight, incl. reinforcement is 142t.

These are storage tanks, one of which is intended for the K80 and another one for the K90 boiler. Each storage tank consists of two cells. The ceiling of the storage tanks is covered with sheet metal at the level of +36.0 m. The vertical wall passes to the level of +27 m into the sloped walls of discharging hoppers, with the exception of walls between the two cells.

Construction

The walls of the storage tanks are made of reinforced sheets and welded to the columns transferring the load to the columns. **The walls of the storage tanks between 36.0 m and 27.5 m perform the function of vertical bracing of the building.**

For more detailed description see the Annexes A121.04 and 05.

#### 6.2.1.3 Limestone handling

The limestone handling systems are preserved for further unspecified use by the CLIENT, if they are not used by the OB 2 CONTRACTOR. The CLIENT allows their modification:

- volume reduction.

#### 6.2.1.4 Parts of Ash Handling

The existing ash handling will be dismantled to an extent depending on the design solution of the boiler. The CONTRACTOR will carry out a review of the existing ash handling and replace conceptually or technically unsatisfactory parts, we prefer to keep the others.

#### 6.2.1.5 Parts of boilers

Unspecified parts of boiler units, fuel and ash handling, auxiliary equipment and systems will be dismantled, if necessary for the proper functioning of the OB 2 UNIT, depending on the specific technical solution of the OB 2 CONTRACTOR.

#### 6.2.1.6 Parts of flue gas cleaning equipment

In order to meet the requirements of Annex A6 “Guaranteed values”, correct functions of the OB 2 UNIT, the CLIENT will assess the need of reconstruction, replacement or other modifications of the existing flue gas cleaning systems and the resulting need for dismantling as a part of the OFFER. Equipment that will

not be needed for the operation of the OB 2 UNIT or of the other OB UNITS will be dismantled, with the exception of the limestone handling.

#### 6.2.1.7 Air compressor station

The following items shall be dismantled:

- 2pcs of transport air compressor 5,000 kg + a freeze dryer 1,500 kg and associated piping,
- 2pcs of the control air compressor 1,750 kg + the adsorptive dryer 550 kg and associated piping. In case of one of the compressors, its relocation to the K20 including subsequent installation is being negotiated.

The compressors are installed on the +7.5 m floor.

## 6.3 Modifications of the internal fuel handling

The OB2 follows up the external fuel handling carried out as a part of the OB1 which ensures the transport of wood chips to the E1A Unit and a distribution to the new operational wood chips storage tanks (WCh) below the +36.0 m floor.

As a part of modifications to the internal fuel handling of the OB 2, the existing coal bunkers will be dismantled, incl. related technological equipment and structures to create a space for the installation of new operational wood chips storage tanks. See Annex A121.04 for a description.

### 6.3.1 Wood chips handling

As a part of the LOT OB2, there is a solution of biomass storage in the boiler house area, as the existing shape of the coal storage tanks is not functionally suitable for wood chips (according to experience from other locations, there is such a strong bridgewall, that it can only be broken mechanically during a shutdown), and with the existing shape it cannot be used for wood chips storage and the complete replacement of existing transport lines, because the fuel chain conveyors and turnstiles do not have enough performance.

#### 6.3.1.1 Required fuel supply in operational tanks

Due to the concept of external fuel transport to the boilers, it is required to maximize the operating supply of wood chips. The largest possible supply is preferred.

The minimum required total supply of fuel in the operating storage tanks is for one boiler 3 hours of operation at the nominal output of the boiler and the reference fuel 1 - wood chips.

#### 6.3.1.2 Location of operational reservoirs and their components

Two operating storage tanks are required for each boiler.

The placement of operational storage tanks or their parts, or equipment for carrying fuel outside the existing floor plan of the E1A building is not allowed.

#### 6.3.1.3 Transport of fuel 1 to the boiler

1. Two independent transport lines for fuel 1 to the boiler are required, at least - one or more from each operating storage tank.
2. Each of the lines is equipped with a scale for online measurement of the input amount of fuel into the boiler. The specific type of scale is not prescribed, but it must be a solution that respects the limited space and the space for maintenance.

3. The conceptual solution of the fuel 1 transport routes to the boiler is not determined and it is chosen based on the concept of modifications to the boiler's combustion system. It is required to minimize the transport lengths of fuel paths and free pouring over to storage tanks.
4. The nominal power output of the boiler must be ensured for the worst fuel in terms of transport performance in the event of failure of one of the fuel paths from the operating silo to the boiler.
5. The performance of transport routes - from the wood chips silo to the boiler - is required at least at the level of 120% of the boiler's nominal power output for the fuel of the lowest heating value, when the transport cross-section achieves a maximum of 75percent. Conveyor augers are preferred, depending on suitability for the given function.
6. The performance of the fuel lines will be controlled by changing the speed of the fuel transport by frequency converters, each of the transport lines will be able to ensure the fuel supply for the nominal power output of the boiler at the worst fuel.
7. It is also necessary to assess the suitability of these places where the fuel enters the bottom ash return chutes from the cyclone to the combustion chambers, i.e., in places with high temperature, taking into account the higher rate of release of volatile combustibles from the biomass, so that to prevent the fuel burning already in the bottom ash return chutes with subsequent sticking and clinging.

#### 6.3.1.4 General technical requirements

1. The location of the operational combustion chambers is assumed to be in the places of the existing coal bunkers - the height of the location is fully within the competence of the OB 2 CONTRACTOR, in accordance with their concept of retrofitting the K80 and K90 boilers and the K20 boiler solution.
2. The shape, method of removing fuel from the storage tank, or the design of the operational storage tank are not prescribed.
3. The operating storage tank will be designed in such a way that the biomass crowning / roofing inside the storage tank will be prevented.
4. The tank will be equipped with a fuel level measurement system.
5. In order to put the fuel line out of operation safely and to separate it from the boiler, at least two closing members will be installed in the chute, which will allow safe maintenance works on the line.
6. Depending on the evaluation, fuel lines will be equipped with explosion suppression equipment and will be handled in accordance with Government Regulation 406/2004 Coll. for protection against explosion transmission prevention.
7. Wood chips as an organic material are prone to biological processes with the generation of heat with the subsequent possibility of self-ignition. For that reason, it is necessary to take into account spontaneous combustion as a potential source of ignition.

#### 6.3.1.5 Possible solution concept for internal fuel handling

**Operational storage tanks – performance requirements:**

- Steel construction of storage tanks - adjust the size, position, and a shape, possibly a completely new storage tank, according to the conditions of the boiler, it must be documented by a static calculation.
- The hole with a door for the installation and revision of the discharge equipment (with a space for removal of material in case of opening the door in an accident) – The assumption is 2.0 x 2.0 m according to the equipment for material picking and transporting.

- The bottom rotary discharge equipment - min. 147 m³/hour in the 1 + 1 version for the boiler.
- A sufficient space under the operating storage tanks for maintenance and service of the drives and wood chips discharge.
- Keep the upper viewing opening with a protection against falling into the operating storage tank.
- Set up minimum and maximum level monitoring and continuous level monitoring.
- Install the emergency sensor of a possible collapsing.

Changes to the fuel concept on the K80/90 have an impact on the K 20 boiler house.

**Description of the proposed possible solution**

The chipping of all operating storage tanks will be with the help of two new mobile reverse belts at the +36m level in the existing coal handling area which are supplied with pouring-over from the external transport directly from the roof level.

In the outline of the dismantled existing coal storage tanks with a rectangular floor plan, with a volume of 2x 530 m³ per boiler, new operating storage tanks for wood chips - cylindrical shaped tanks with a volume of 2 x 300 -350 m³, i.e., 2 storage tanks per boiler with a diameter of 6.5 m and a height of 10 (max. 12 m).

From a lower part of the operating storage tank, the wood chips will be brought out by a rotating screw to a new capacitated place, with a conveying screw of fuel to new chutes in the head of the boiler (K80/90).

A variant solution is possibly to reduce the height level without a roof shelter. In this case, a possible solution is the minimization of free space for fuel handling (long spills by free fall) and the minimization of subsequent conveyors. For these purposes, it is possible to use the platform at +15 m, where the compressor stations will be dismantled. For these purposes, it seems ideal to place the bottom of the silo just at the +15m level.

Note: In the case of a different disposition of the boiler chutes, it is necessary to observe the same serviceability and equipment backup, as a minimum.

### 6.3.2 Start-up fuel

As a start-up fuel there is natural gas, for parameters see Annex A6 from the existing internal natural gas distribution.

### 6.3.3 Technological fuel – The Boilers K80 and K90

The K90 boiler is provisionally equipped with a burner moved from the K80 for burning technological fuel. The system will be in operation during the K80 reconstruction. Moving and installation are carried out in advance by the CLIENT outside the framework of the investment event.

The technological fuel combustion function for both K80 and K90 boilers must be maintained even when burning fuels 1 and 2, including compliance with the guaranteed emission limits.

I.e., after completion, both boilers must be equipped with a technological fuel combustion system, including a burner.

## 6.4 Adaptation of K80/90 boilers

The CONTRACTOR will perform an overall assessment of the boiler and auxiliary systems, their existing condition and propose an optimized method of changes to the boiler, including required replacements.

As for the boilers, no major changes are expected on the boiler itself, i.e. the dimensions of the basic parts of the boiler will not change (the combustion chamber, 2nd pass, tubular LUVO, ash circulation system, i.e., the cyclone with a return chute, a siphon and a pair of return ash chutes to the combustion chamber, an outlet channel from the cyclone to the 2nd pass).

In the same way, there will be no fundamental change in the volume and speed of the flue gas in the combustion chamber, in the 2nd pass and at the entrance to the fabric filter when burning 100percent biomass at a steam output of 100 t/h.

For the existing fans and a fabric filter, the OB 2 CONTRACTOR will assess the necessity of modifications.

Modifications and adaptations of boilers mainly includes the systems mentioned in the following chapters, all based on the assessment of the OB 2 CONTRACTOR.

### 6.4.1 Combustion system

The OB 2 CONTRACTOR will modify the combustion system for the purposes of burning wood chips, co-combustion of plant pellets up to 40percent of the boiler´s heating input and - thermal utilization of the technological fuel of both boilers.

In connection with the change of fuel, the OB 2 CONTRACTOR will make the necessary adjustments to the combustion system, including the following:

1. Exact adjustments to the combustion system are not specified, and all technical-economical, operationally reliable, proven and suitable solutions for adjusting the systems for the given fuel, meeting the emission requirements, suitable for the given performance and parameters of the boiler and placement in the existing space of the boiler room are allowed.
2. The amount and other parameters and distribution of combustion air will be controlled according to the calculated fuel / air ratio, depending on the required boiler performance.
3. The combustion control circuits will control the combustion temperature in such a way that the formation of atmospheric nitrogen oxides does not occur and that the production of NOx and CO is limited to the maximum extent.
4. According to BAT requirements, the boiler will be equipped with:
    - an advanced combustion process control system, an automated combustion efficiency control system and the prevention,
    - optimization of the boiler combustion process,
    - optimization of temperature, flow and combustion air inlets, in order to effectively oxidize the organic component and reduce NOx formation.
5. As for heating surfaces, clogging, sticking, the formation of hard deposits, corrosion and abrasion of the inner walls must be minimized. The most heavily loaded pipes of the heating surfaces will be covered with the material of the heat exchange surfaces.

The following proposed changes are based on the proven technical design of the boiler nodes incl. experience in the operation of biomass boilers, from the evaluation of the existing technical condition of the boiler components, their expected residual service life, and the requirement for the safe operation of the boilers after reconstruction for the next 15 years. The proposed changes not quite and completely describe all the necessary technical modifications to ensure a functional unit capable of further operation for a period of 15 years, i.e. another approx. 110,000 operating hours.

It is the responsibility of the OB 2 CONTRACTOR to assess the condition, technical suitability, and residual service life of all parts of the boiler units, fuel and ash handling, auxiliary equipment and systems, insulation, if necessary for the proper functioning of the OB 2 UNIT, depending on the specific technical solution of the OB 2 CONTRACTOR. These are mainly, depending on the OB 2 CONTRACTOR's assessment:

1. it is assumed that the primary air supply to the windbox will be changed in connection with the change in the bottom bottom ash removal and the replacement of fluidized bottom bed nozzles with a type suitable for burning biomass,

2. replacement of the nozzle fluid bed bottom with the installation of nozzles suitable for a new fuel and composition of the fluid bed bottom,
3. adjustment of the primary air supply to the bottom and the associated change in the discharge of bottom ash from the combustion chamber by direct collection of ash and its cooling in cooling screw conveyors - with cooling to a temperature suitable for further transport of bottom ash,
4. execution of a "kick-out" on the front and back walls of the combustion chamber at the point of transition of the inclined membrane wall to the vertical wall,
5. replacement of the MW evaporator from the irrigation chambers of the bottom to the vertical MW pipes approx. 1.5 m above the break-in the pipes from inclined to vertical ones, restoration of the protective fireproof spray,
6. replacement of the output superheater 3, incl. material changes to a chlorine-resistant material,
7. installation of protection of the 3rd steam superheater against the formation of deposits on the pipes due to an increased formation of deposits on the surface of the pipes. There is also a risk of chlorine corrosion due to its increased content in the phytomass,
8. to elevate the refractories by 1 to 2 m above the "kick-out" level as an increased protection of the MW against abrasion and corrosion,
9. replacement of suspension pipes to the height between the ceiling of the 2nd pass and the 3rd superheater,
10. protection of these suspension pipes in the 2nd pass to the height between the ceiling of the 2nd pass and the 3rd superheater.
11. an assessment of the 1st and 2nd bundles of the air heater is required with the aim of living another 120,000 operating hours, the 3rd and 4th bundles are replaced by new ones and major replacement are not allowed,
12. the Vortex in the cyclone is required to be replaced, incl. suspension anchors with regard to long-term cyclic high-temperature stress and its effect on the strength of the Vortex material and anchors,
13. replacement of existing refractories in those parts that are not resistant to alkaline corrosion until the boiler refurbishment beginning,
14. replacement of a pipe part of the superheater 1.3 is required, incl. material changes to a chlorine-resistant material,
15. the replacement of all ECO parts is requested,
16. replacement of the fabric filter sleeves.

Technical parameters of the existing equipment for which the replacement is proposed and which are important for the assessment and valuation of the replacement are listed in Annex A121.22.

### 6.4.2 Air system

Considering new performance requirements for air fans, the OB 2 CONTRACTOR will check and make any adjustments to the entire air tract and relevant equipment, especially the fresh air fan and the primary air fan, with the provision that both fans will also comply with the new conditions.

Since volatile combustibles are released faster from biomass compared to coal, it is assumed that the ratio of primary and secondary air is preset. Adjustments in the software will be implemented as a part of the boiler test operation.

### 6.4.3 Gas exhaust pipes

The OB 2 CONTRACTOR will also check dimensioning of the existing technical condition, a flue gas fan, air fans including regulations, in connection with possible modifications or replacement of the fabric filter and in connection with the measures applied to achieve emission limits.

The CLIENT will assess the technical parameters (especially velocities, pressure losses, etc.) in the existing gas exhaust pipes and they indicate in their offer whether:

- the existing gas exhaust pipes comply with the new operating conditions,
- on the basis of the technical documents listed in this document, the CLIENT will assess the technical parameters of the existing flue gas fan, incl. its driving by an electric motor and will state in their offer whether:
- the existing flue gas fan complies with the new operating conditions, or whether,
- the existing flue gas fan does not meet the new operating conditions and shall be replaced with a new flue gas fan.

For the possible valuation of a new flue gas fan, the following requirements apply:

- the flue gas fan must ensure safe and reliable exhaust of flue gases. The flue gas fan must withstand working temperatures, abrasion, corrosion, and combustion products of all types of specified fuels,
- the fan will be equipped with a safety device, an oscillation and vibration damper, a noise damper, expansion joints, thermal insulation. The design of the fan must allow for easy inspection and maintenance (cleaning),
- regulation of the speed control of the fan's electric motor will be provided by a frequency converter and will keep them in the area of maximum efficiency.

In the event that it is necessary to provide a new flue gas fan and the fan will be equipped with a frequency converter, the CLIENT requires the operation of the fan even in the event of a frequency converter failure.

### 6.4.4 Refractories

Within the scope of the LOT OB 2, the OB 2 CONTRACTOR will assess and wherever necessary, the K80/90 boiler will be retrofitted with refractories with the necessary properties (temperature resistance, chemical resistance, and a high strength).

They will be carried out on the one hand where the underlying part is changed (the bottom of the combustion chamber, all four walls of the bed up to a height of approx. 6.1m above the bottom axis) and on the other hand because of the replacement with a material resistant to alkaline corrosion in order to achieve the expected life of the refractories.

The boiler refractories will be designed and made to allow for thermal expansion.

Determination of the thickness of the fireclay (refractory) refractories results from the thermal and technical requirements.

To seal any expansion joints, a material with high thermal and chemical resistance, not containing asbestos, will be used.

### 6.4.5 Cleaning of heat exchange surfaces

Due to the low efficiency of the existing surface cleaning system and in connection with the change in the fuel base, higher requirements for cleaning the heating surfaces associated with increased sticking of ash and in other temperature fields on the heating surfaces due to the high content of Na and K elements in the biomass due to ash softening are expected. CONTRACTOR OB 2 will check the current state of the

existing equipment for cleaning heating surfaces on K80/90 boilers, the effectiveness of cleaning incl. evaluation of existing stickers and will design and implement the necessary modifications or additions to the cleaning system or a complete change of cleaning to ensure the required performance and reliability parameters.

The equipment is subject to the same general requirements as those ones listed for K20 boilers in the previous chapter of this document.

### 6.4.6 Reduction of NOx in flue gas

The existing boilers were additionally equipped with the SNCR system for reducing NOx in the flue gas.

In connection with the required reduction of specific NOx and CO emissions and the required operational regulatory range, the OB 2 CONTRACTOR will assess the existing system and propose and implement the modification of the existing equipment system for secondary DeNOx measures.

The possibility of additionally using an aqueous solution of ammonium sulphate or another suitable reagent is required, depending on the overall concept of reducing pollutants in the flue gas and protecting the boiler from corrosion.

No specific solution system is prescribed, or possible combinations of these solutions.

The OB 2 CONTRACTOR is limited by the existing layout of the boiler room and its floor plan.

From the point of view of DeNOx agent handling - the space under the K70 boiler, i.e., storage (incl. sufficient storage stock), discharging, possibly even pumping with booster pumps and a greater part of the pipeline systems (after checking their suitability), it is assumed that the existing solution will be used - in the event that it is not possible to use then the scope of the OB 2 CONTRACTOR is their modification or addition. It is required to use the same reagent for the K20 and other two boilers.

The DeNOx System will:

- work in fully automatic operation without a claim on continuous service,
- automatically controlled, depending on the continuous measurement of the concentration of NOx in the flue gas,
- resist working temperatures, abrasion, corrosion, and NOx reduction technology products,
- ensure safe and reliable discharge of media,
- prevent clogging in pipelines and transport routes,
- allow for easy inspection, maintenance, and cleaning,
- work in the zone of maximum efficiency (rotating machines, use of transport air and others).

### 6.4.7 Removal of bottom ash from the boiler

The OB2 CONTRACTOR will design and ensure a suitable technical solution for ash removal based on the technological properties of the combustion chamber and the grate - the frequency of removal and the amount of a fraction removed and its removal.

n the case of the fine fraction, it is assumed that it will be reused in a fluidized bed, or in case of excess balance with its removal to expeditionary silos.

1. Ash removal is solved in a new way, depending on the newly solved bottom of the combustion chamber, by direct removal from the combustion chamber, i.e., with an ash inlet temperature of approx. 850 °C using the proven technology of cooling screw conveyors.

2. The removal of ash must be carried out with a high reserve depending on the significantly variable content of mineral impurities in the wood chips and different redistribution ratios of solid particles as a combustion product based on the experience of the OB 2 CONTRACTOR.
3. To control the removal of ash according to the pressure of the fluid layer at the bottom, each chute will be equipped with two shut-off plate gate valves with a pneumatic drive, between which an expansion small header, including a expansion joint, will be inserted.
4. Due to the structural changes and changed thermo-technical parameters of the ash, the OB 2 CONTRACTOR will consider replacing the existing screws with cooling screws with new parameters.
5. The screws will be cooled from the existing auxiliary cooling system in the boiler house.
6. The material of the parts in contact with the transported medium will guarantee a high service life. Failure or repair of one extractor and one ash transport line to the intermediate tank will not limit the boiler performance. The extractors will be located, so that they are easily accessible for maintenance and possible repairs (removing the rotor).
7. The system will be sealed, so that the boiler house cannot be smoky.
8. In the case of very different quality parameters of bed and fly ash (especially its composition), the possibility of a separate handling for these sorts of ash should be considered.

The boiler protection against corrosion, Due to the relatively higher content of chlorides in plant pellets, protection against corrosion must be ensured for the K80/90 boiler, this can be solved both in an active form, i.e., by dosing a reagent limiting corrosion attack on heating surfaces, or passively by the materials and protective layers used, or combination of techniques. When using a reagent, this must be in accordance with the overall concept of systems for the reduction of pollutants in flue gas and with the concept of ash waste handling.

The method of corrosion protection is not predetermined.

## 6.5 K80/90 Boiler feed water system

- The existing system of feed water and feed water pumps, including pipe systems up to the connection point, will be used to feed the boiler.
- The feed water system itself will be equipped with electric shut-off and control fittings and valves and it will allow smooth and stable regulation of the pressure/rate of flow of feed water.
- A system with 100percent performance redundancy is required.
- The backup method, or the use of a start-up valve to ensure high reliability and accuracy of regulation and to ensure the overall availability of the UNIT depends on the design solution of the OB 2 CONTRACTOR.
- The regulation of feed water only by control valves on the boiler head is assumed, even for the boiler start-up. As already mentioned in the chapter of the existing description, the feed water pumps are not equipped with speed control and work into one collector.
- The feed water will be used as a cooling medium for steam temperature regulation.

With respect to the layout, the placement is assumed in the same position as the existing system.

## 6.6 Filtration

The OB2 CONTRACTOR will assess the existing filtration system with regard to a new fuel, performance and guaranteed parameters of the boiler and they will make any modifications or replacement of filters.

General requirements for filters:

1. In the case of the filter, it must be ensured that any unburned particles are separated or extinguished in the flue gas stream from the boiler before entering the fabric filter, or such a filter material that will have sufficient resistance to damage and ignition by burning embers.
2. The minimum operational guaranteed temperature of textile materials shall be 200°C.
3. A fully automatic filter operation system, including cleaning the filter elements, is required.
4. The design of the filter and filter elements must respect the type of fuel, granulometry, alternatively electrical conductivity and unevenness of distribution in the gas exhaust pipe and its other variability, as well as the boiler start-up.
5. The design of the filter and ash removal must be suitable for possible use of various reagents for the capture of pollutants being monitored.
6. The service life of the filter cartridges is required for at least 40,000 hours of operation.

## 6.7 Systems for ensuring the limits of other pollutants

As a part of the LOT OB2 it is ensuring the compliance with emissions of other pollutants from the K80/90 boilers - see Annex A6 The Guarantee – the Chapter 4.2.2.

The analysis of fuels used is given in the Annex A6.

The OB 2 CONTRACTOR is not limited in the method of solving the achievement of these limits as far as exhaust fumes exit is considered.

The reagent used, or a combination of reagents, must be in accordance with the overall concept of systems for reducing pollutants in flue gas and with the concept of ash waste handling.

The reagent used, or their combination, must be in accordance with the overall concept of systems for reducing pollutants in flue gas and with the concept of ash waste handling.

The reagent used must be commercially available in the Czech Republic. The reagent must already be characterized in the OB 2 CONTRACTOR's Bid.

## 6.8 The K80/90 Boilers Start-up

The boiler start-up system remains existing, the OB 2 CONTRACTOR will also carry out an inspection in connection with the K20 boiler and will make any adjustments.

## 6.9 Internal (Auxiliary) Cooling Circuit of the E14 Boiler House

Due to changes in the heat removal to the circuit based on boiler modifications, the OB 2 CONTRACTOR will check the existing cooling performance of this circuit. Any changes in the cooling circuit are within the scope of the LOT OB 2.

The system is used to cool auxiliary boiler systems, for example of bottom ash screw conveyors, or also to cool the oil baths of the air fans and the flue gas fan. Filtered water from the cooling circuit will be used as a cooling medium, with the subsequent introduction of warmed water into the sump.

Cooling water with parameters and quality is available for cooling the equipment - see Annex A6, the Chapter 2.2.

## 6.10 Explosion protection equipment

The source of a danger of fire and explosion is the technology of transport, storage and dosing of wood chips, plant pellets or dust from them, incl. natural gas.

The entire production process will be evaluated by the OB 2 CONTRACTOR in accordance with the requirements for ensuring safety and health protection, when working in an environment with a risk of explosion according to NV 406/2004 Coll.

The risk of explosion during transport and storage is particularly high in closed technologies. These are pneumatic transport systems, screw conveyors, closed belt conveyors, elevators, in the area around the conveyor pouring-over and the like.

Based on the analysis, the OB 2 CONTRACTOR will supply and install active and passive explosion protection, both in cooperation with the CONTRACTORS of other OBs, especially the OB 1.

At the same time, it also applies to the choice of equipment and components in accordance with the above-mentioned explosion protection analysis and environmental determination protocols, all newly supplied or modified equipment shall be in accordance.

From this point of view, the entire area of the existing boiler house and the K80/90 bunker building will be evaluated and compliance with the applicable existing legislation.

## 6.11 Storage and transport of pellets to the boiler.

In view of the fact that no change in the increase in the share of pellets in the total boiler output is expected, as well as in view of the existing sufficient reliability of the existing pellet dosing device, no fundamental modification of the system is expected as a part of the transition to 100percent biomass burning in both boilers, unless required by boiler changes within the LOT OB 2.

## 6.12 Others

### 6.12.1 Modifications of distributions for an industrial vacuum cleaner

The suction pipe of the industrial vacuum cleaner will be adjusted to meet the needs of the new fuel handling, including the connection to the distribution of the industrial vacuum cleaner within the fuel bridge between the K20 and the K80.

The concept of using a mobile vacuum cleaner remains observed.

The waste dust from the filter devices will be periodically extracted from the collection containers with an industrial vacuum cleaner, and the OB 2 CONTRACTOR will ensure a possibility of suck-out into the distribution of the industrial vacuum cleaner.

As a part of the LOT OB 2 there is the installation of parts of distributions of the industrial vacuum cleaner which will ensure appropriate cleaning of dust from fuels in the interior spaces affected by the K80/90 boiler retrofit.

The CONTRACTOR is obliged to respect the measures in accordance with the Documentation for explosion protection.

### 6.12.2 Provisional measures

The Work also includes provisional measures necessary for the K90 Boiler temporary operation during rebuilding of the K80 boiler, in cooperation with the CONTRACTORS of the other OBs.

The procedure is similar during the trial or provisional operation of the K80 boiler after reconstruction and rebuilding of the K90 boiler.

# 7 COMMON REQUIREMENTS OF K20 AND K80/90 BOILERS

**Chemical mode**

The existing chemical mode will be maintained with ammonia dosing into the suction of the feed pumps and possible dosing of Na3PO4 in case of boiler water quality deterioration for the K80/90 boilers as well as for the new K20 boiler.

Demiwater from the Z10 Chemical water treatment plant is added as make-up water.

For the description of the chemical mode, see the Annex A112.14 Chemicke Rezimy

**Cleaning operations**

Cleaning operations will be performed on all newly installed piping systems and boiler parts.

The scope of the OB 2 CONTRACTOR includes all necessary preparatory work related to cleaning operations, including waste removal. As a part of cleaning operations, some provisioned constructions will be installed to ensure the execution of cleaning operations.

The completion of cleaning operations for the steam pipeline will be after the results of drafts of a quality that allows steam to enter the turbines.

# 8 LIST OF ABBREVIATIONS

Note: Sorted alphabetically according to the Czech version.

| Abbreviation | Text |
| --- | --- |
| AŘ | Administration procedure code |
| I&C | Automated management of technological process |
| ATEX | ATEX Directions (Atmosphères Explosibles) for equipment and protective systems intended for use in areas with explosion hazards |
| BAT | Best Available Techniques |
| BWTP | Biological wastewater treatment plant |
| BEP | BIM Execution Plan |
| BIM | Building Information Modelling/Management |
| RR | Routine repair |
| OHS | Occupational safety and health |
| BaA | Baltic after the Alignment |
| CE | Conformité européenne |
| CCTV | Closed Circuit Television |
| CEMS | Emission monitoring system |
| CDE | Common data Environment |
| n. | Number |

| Abbreviation | Text |
| --- | --- |
| ČBU | Czech Mining Authority |
| CR | Czech Republic |
| ČSN | Czech Technical Standard |
| ČGS | Czech Geological Survey |
| ČUBP | Czech Occupational Safety Office |
| DOSS | State Administration Bodies Concerned |
| WRW | Waste rainwater |
| DPS | Documentation required for building construction execution |
| DSP | Documents required for building permit |
| DSPS | Documentation of the actual state of construction |
| WCh | Wood chips |
| EIA | Environmental impact assessment |
| EIR | Exchange Information Requirements |
| ECO | Economizer |
| EMC | Electromagnetic compatibility |
| EN | European standards |
| EFAS | Electronic fire alarm system |
| FAC | Final Acceptance Certificate |
| FAT | Factory Acceptance Test |
| FC | Frequency converter |
| FW | Feed water |
| GO | General overhaul |
| GWP | Global warming potential |
| H | Hold point |
| HMG | Time schedule |
| HAZOP | Hazard and Operability Study |
| HW | Hardware |
| MGSV | Main gas shut-off valve |

| Abbreviation | Text |
| --- | --- |
| IAPWS | International Association for the Properties of Water and Steam |
| ID fan | Induced draft fan |
| IEC | International Electrotechnical Commission |
| IFC | Industry Foundation Classes/format |
| IO | Emgineering object |
| I/O | Input/output signals |
| ISO | International organization for Standardization |
| IT | Information Technology |
| ITS | Internal technical standards Škoda |
| IZ | Individual tests |
| k.ú. | Cadastral area |
| CS | Compressor station |
| KV | Comprehensive testing |
| MW | Membrane wall |
| MFB | Material of fluidized bed |
| NDT | Non-destructive Testing |
| LFO | Light fuel oil |
| LV | Low-voltage |
| FWT | Feed water tank |
| NT | Low pressure reducing station |
| NV | Government Regulation |
| SS | Steel structure |
| parc.n. | Parcel number |
| PAC | Preliminary Acceptance Certificate |
| PED | Pressure Equipment Directive |
| P&I | Piping and instrument diagram |
| BC | Belt conveyor |
| PD | Implementation documentation |

| Abbreviation | Text |
| --- | --- |
| SIT | Schedule of inspection and tests |
| POBC | Plan and organization of the building construction |
| PRE-BEP | Design plan of BIM implementation |
| PS | Operational file |
| SCR | Selective catalytic reaction |
| CGM | Combustible gas mixture |
| SEP | Stable extinguishing equipment |
| SIL | Safety Integrity Level |
| CC | Combustion chamber |
| I&C | Instrumentation and Control system |
| SNCR | Selective Non-Catalytic Reduction System |
| SNIM | 3D model non-graphic information standard |
| SO | Building object |
| CfW | Contract for work |
| SP | Building permit |
| QMS | Quality management system |
| SW | Software |
| CS | Control system |
| TG | Turbogenerator |
| TPG | Technical rules |
| PM | Particulate matters |
| HV | High-voltage |
| VOC | Volatile organic compound |
| ACS | Air-conditioning system |
| HP | High-pressure |
| HPH | High-pressure heater |
| W | Witness Point |
| WF | Workflow |
| NG | Natural gas |