Employer
SAKO BRNO A.S.

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

Date
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PART III, APPENDIX 19
DISTRICT HEATING

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ANNEX

1. INTRODUCTION

Two water-based DH networks exists in Brno, where Employer's facility is connected. The Lišeň DH network and the Juliánov DH network. Both DH networks is fed from more district heating production units at different sites. Process and design data for the existing DH networks are further described in Appendix A13 *Process and Design Data.*

The Employer's Existing facility is connected to both the DH networks through an existing DH building. The Existing facility produce DH through two producers:

- Extraction turbine with 11.5 bar steam bleed feeding existing DH station.
- Absorption heat pump (AHP) for component cooling

The new Line shall be connected to both the Lišeň DH network and the Juliánov DH network through a serial connection with the Existing facility DH producers.

A conceptual principle diagram for the DH system for the Complete Line including the new Line is shown in Appendix A15.3 *Concept Diagram, Water/Steam Cycle and DH Connection*.

The district heating system of the Line shall be supplied by the following new DH producers:

- District heating condenser(s) for Line, acting as combined turbine condenser(s) and turbine bypass condenser(s).
- One low temperature flue gas economizer (LT ECO) on Line (Option 1)
- One heat pump for production of DH through flue gas condensation (FGC) on Line (Option 1).

The district heating system shall be able to supply district heating to the DH-networks according to the design data stated in Appendix A13 *Process and Design Data*.

The district heating condenser shall be connected to the turbine exhaust and is further described in Appendix A4 *Technical Specifications for Turbine/Generator and Condensers.*

The Employer's existing DH pumps shall be utilized for the Line.

The district heating system of the Line shall include summer coolers (dry coolers, including DH circulation pumps) to dissipate excess DH production, DH energy meter installations, all necessary piping, valves, heat exchangers and pressure holding equipment for the cooling circuit.

The contractor is informed that the existing DH network includes water conditioning facilities (e.g. NaOH to control pH) to thus keep DH water quality within acceptable limits. Additionally, the DH network already has partial flow chemical and mechanical cleaning (filtration) of the water, as well as DH make-up water facilities to re-fill the DH network, to counter-act loss of water in the system.

In this Appendix the technical specifications of the DH system, the basic principle of the DH system and the basis for the dimensioning of the system are described.

Furthermore, in this Appendix general principles for controlling the DH supply is suggested. However, controlling of the DH supply is the sole responsibility of the Contractor for which reason the Contractor may propose other solutions.

2. TECHNICAL SPECIFICATIONS FOR DISTRICT HEATING SYSTEM

All components including, but not limited to the ones specified below, shall be designed and supplied by the Contractor:

- DH production units
- Reserve pressure maintenance system
- DH control valves
- Circulation pumps
- DH energy meter installations at all heat production units and all heat consumption units
- Summer coolers (dry coolers) including heat exchanger and circulation pumps
- All necessary piping, pipe supports, insulation, valves, instrumentation, venting and drainage equipment

All control of DH pumps, pressure maintenance system, DH producers and DH control valves shall be designed and supplied by the Contractor. Control of the DH system shall be possible from the CMS of the Complete Line.

Production units shall automatically be set in operation as the heat demand increases and taken out of operation when the heat demand decreases. The control shall take into account that the production units may have a minimum production capacity (MJ/s). For instance, it may be necessary to reduce the heat supply from the LT ECO when the heat pump for FGC is set in operation.

The summer-coolers shall operate as a DH consumer for the Line and allow continuous maximum co-production of electricity and DH from the new turbine and DH condenser(s) of the Line.

The above-mentioned overall control system for DH supply shall be designed and supplied by the Contractor.

2.1 District Heating Supply

As the DH consumption of the DH networks increases, the other production units shall be put into operation. Priority of the DH production units shall be as follows:

1. DH condenser(s) for new Line K1
2. Absorption heat pump (AHP) for component cooling (Employer's existing system)
3. Low temperature flue gas economizer on Line K1 (If Option 1 is selected)
4. Heat pump for flue gas condensation on Line K1 (If Option 1 is selected)
5. Existing DH station (Employer's existing system).

The baseload of the DH to both of the DH networks shall be produced in the new DH condenser(s) of the Line and supplemented by the other producers.

The existing AHP for component cooling and the new heat pump for FGC shall preheat part of the DH flow.

The LT ECO shall heat part of the DH water to the required DH flow temperature.

If the required DH flow temperature is not reached the DH flow temperature shall be boosted by the existing DH station.

The relative position of the DH producers of the Complete Line is shown in Appendix A15.3 *Concept Diagram, Water-steam Cycle and DH connection* and Annex A. The Contractor shall use this relative position as basis for his design of the DH system and further optimization of the DH system.

2.2 District Heating piping and network connection.

The DH shall be supplied to the Lišeň DH network and the Juliánov DH network.

The Employer’s existing DH system is connected to the two DH networks through the existing DH building (DH station). Refer to Figure 1.

The networks shall be hydraulic connected to allow for the serial connection between the Employer’s existing DH producers and the new DH producers of the Line. All the flow from the networks shall be led to Line from the existing Lišeň and Juliánov DH pumps and after heating returned to the Employer’s existing DH building. A suggestion for pipe routing is illustrated in Figure 2.

The figure indicates a relative positioning of future pipes including the hot DH pipe, the cold DH pipe and MP steam from Existing facility to a possible absorption heat pump (Option 1) and condensate return (Option 1). However, the relative positioning and pipe routing shall be included in the Contractor’s scope of Contract Object.

Refer to Appendix E1 *External Utilities Specifications* for details on the existing pipes and installations in the ground of the Employer’s site

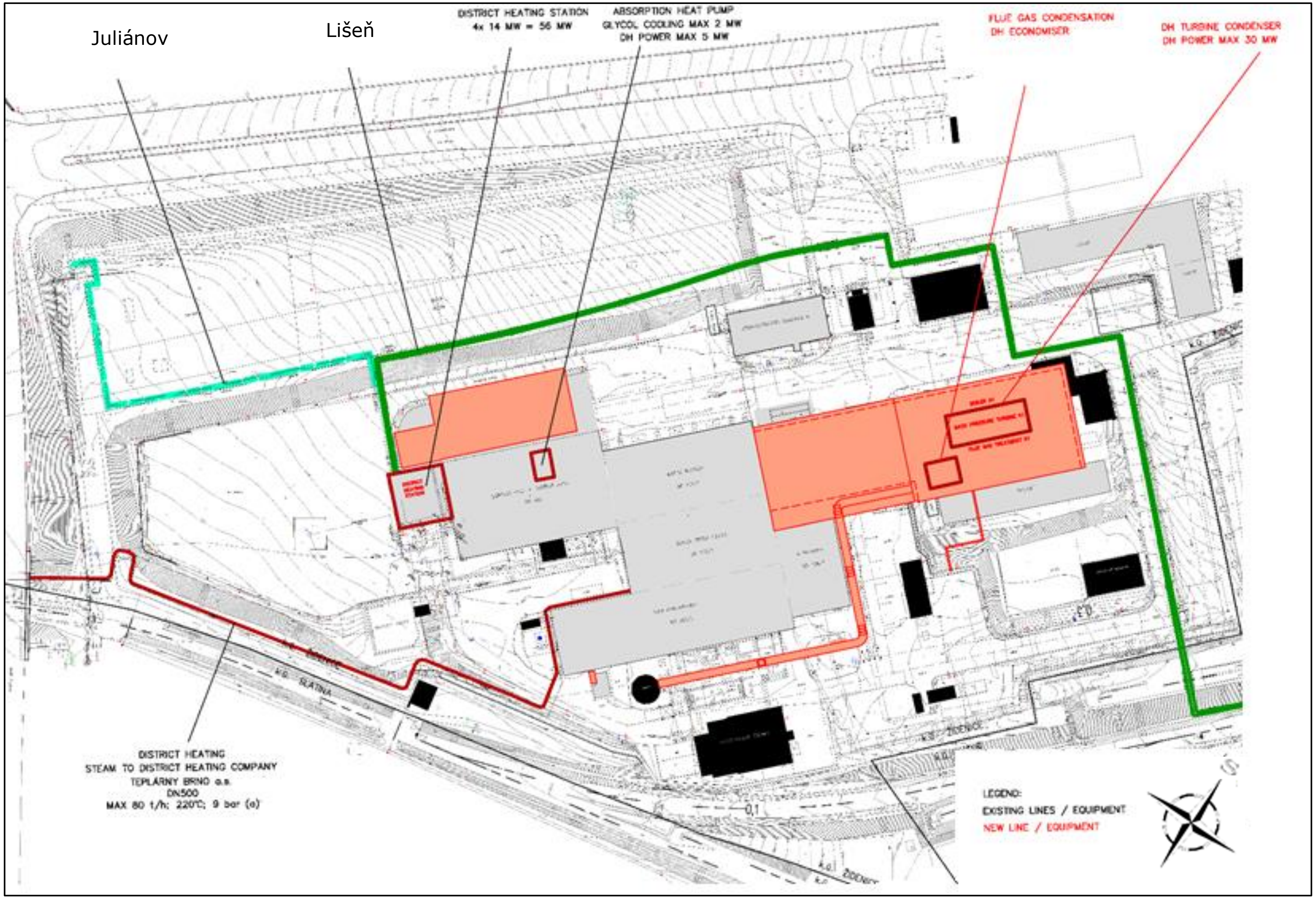


Figure 1, Employer's site including existing and future main DH components. "S" is towards the north.

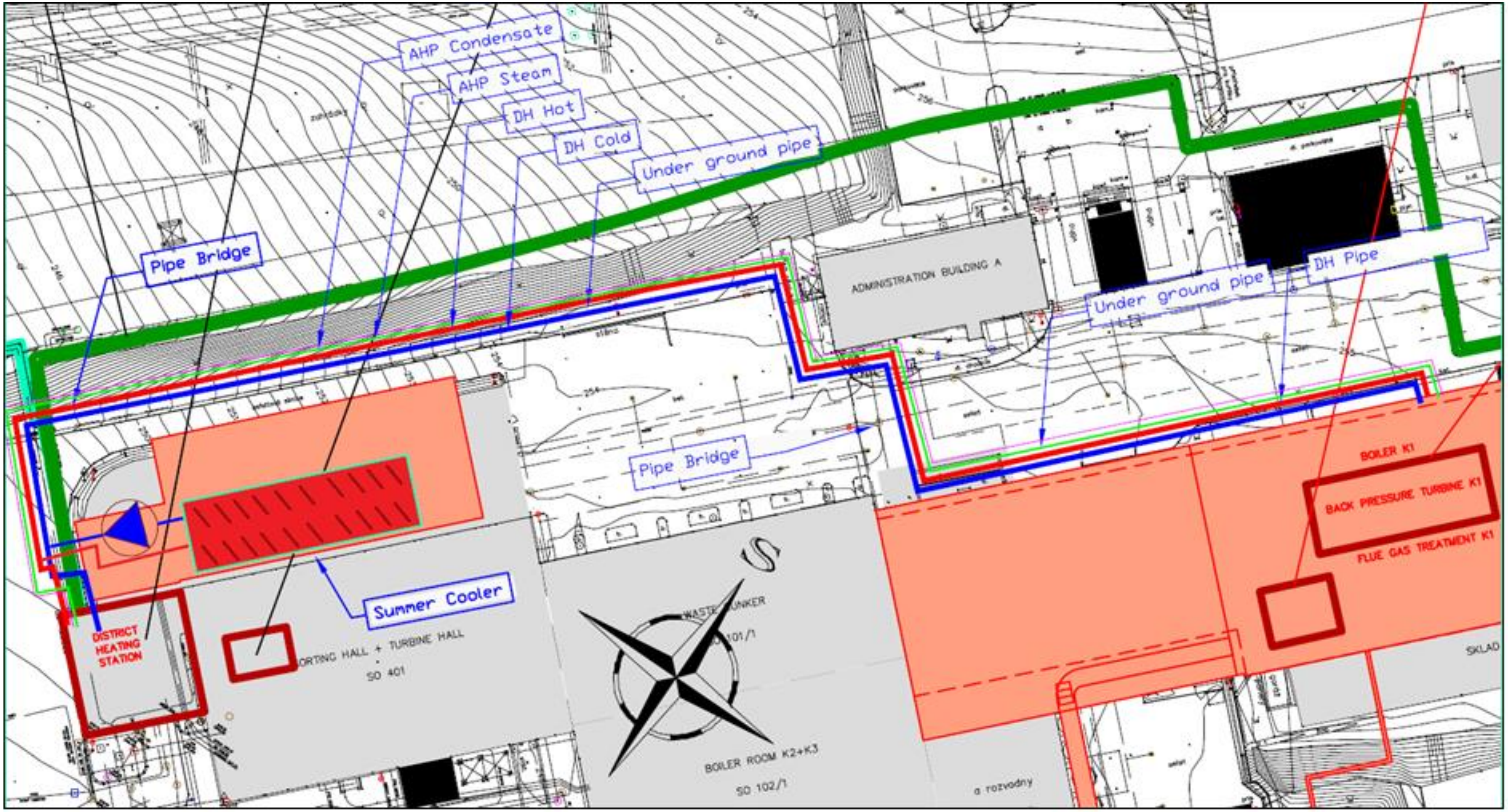


Figure 2, Suggested pipe routing between the Line (Line K1) and existing DH building. "S" is towards the north.

2.3 DH Interconnection

The DH system of the Line shall be connected to the Employer's existing DH installations.

The scope of Contract Object shall include, but not be limited to the following:

- Connection to existing DH station as illustrated in Annex A and described in Appendix A18 *Limits of Supply.*
- Connection to new DH components including
  - New DH condenser(s)
  - Heat pump for FGC (If Option 1 is selected)
  - LT ECO (If option 1 is selected)
  - Flue Gas reheater (If option 1 is selected)
  - Summer cooler(s)
- All necessary piping
- All necessary shut off and control valves
- All necessary pipe bridges, except for pipe bridge integrated into gangway between Employer's administration building and the Existing facility.
- All necessary pipe laying works, including controlled drillings and ground works
- All relocation works of existing pipes and installations in the ground of the Employer's site related to the DH interconnection of the Line.

Refer to Annex A for a principal process flow diagram showing the future DH interconnection of the Complete Line. The relative position of the DH producers shall be as indicated in Annex A.

The DH concept is based on an interconnection of the suction header of the Lišeň pump group and the Juliánov pump group. The Employer shall upgrade the existing DH station to facilitate the future DH concept. This upgrade includes modification of the existing DH pumps, such that the Juliánov pumps will have the same head as the Lišeň pumps.

The summer cooler(s) shall be connected to the DH hot pipe from the Line and the DH cold pipe to the Line. Refer to Annex A.

The DH side of the summer cooler(s) shall have a dedicated pump group. Thereby the pump power consumption for the summer cooler can be optimized.

Refer to Appendix E1 *External Utilities Specifications* for details on the connection point with the Employer's existing DH station and the DH networks and information about existing pipes and installations in the ground at the Employer's site.

Annex B shows two possible routings of the DH connection from the Line to the existing DH station. The Contractor may adopt one of these suggestions as his own or he may work out an alternative DH routing. The Contractor is under all circumstances responsible for the DH routing and interconnection delivered under the scope of Contract Object and all related works.
The Employer prefers to avoid the installation of piping in the underground pipeline (channel) as much as possible due to investment costs. Preference is pre-insulated DH pipes laid in the ground.

The existing gangway connection from the Employer's administration building to the Existing facility will be replaced during construction of the Line (Line K1) as described in Appendix A9 *Technical Specifications for Building* by the Employer. The Contractor is allowed to support the DH piping in a pipe bridge built into the new gangway such that vertical loads are absorbed by the structure of the gangway.

The Contractor is obliged to cooperate with the Employer or his representative regarding the stress calculation of the pipe arrangement on both side of the supply interface at the DH building to get the all in all best static solution for the pipe arrangement in the supply interface.

2.4 DH energy meter installation

Metering equipment for metering of energy, i.e. heat from each heat production unit and heat delivered to the district heating network shall be included in the Contract Object. This shall include relevant temperature measurement installations built into the respective piping. The metering installation shall follow the latest version of EN 1434 and the flow meters shall be delivered with certificate for wet calibration after this standard. Valves shall be installed allowing the flow meters to be dismounted for external calibration.

For DN250 pipes and above temperature shall be measured by four temperature measurement instruments for the hot as well as the cold measurement as indicated in EN 1434-6, paragraph A7.

2.5 Shut Off valves

All DH components (pumps, filters, heat exchangers etc.) shall be installed with shut off valves for repair and maintenance purposes.

All shut off valves shall be ball valves and they shall be equipped with pneumatic actuators if necessary due to the automatic operation of the system. All valves less than DN200 intended for repair work only may be equipped with manually operated gear; all valves equal to or larger than DN200 shall be equipped with actuator.

2.6 DH pump installations

The Employer's existing DH pumps for the Lišeň and the Juliánov DH networks shall be utilized for the Line.

The district heating installation at the Line shall include necessary pumps for the DH installation including circulation pumps for DH producers and summer cooler(s).

The Contractor shall design and deliver all pump configurations except the DH pumps for the Lišeň and the Juliánov DH pumps.

All pumps shall be equipped with an upstream coarse filter (2 mm). The filters shall be supervised by differential pressure transmitters activating an indication if the filter is blocked.

All pumps shall be with speed-controlled motors sized for the pressure loss in the pipeline and the components within the Contract Object and external differential pressure requirements. Individual frequency converters for each motor shall be supplied.

2.7 DH Makeup water

The existing DH networks in Brno includes water conditioning facilities (eg NaOH to control pH) to keep DH water quality within acceptable limits. Additionally, the DH network already has partial flow chemical and mechanical cleaning (filtration) of the water, as well as DH make-up water facilities to re-fill the DH network, to counter-act loss of water in the system.

2.8 DH pressure maintenance

The two DH networks (Líšeň and Juliánov) are pressurized from existing pressurization units outside the SAKO Premises. This pressurization equipment is not a part of the district heating supply.

When the two DH networks (Líšeň and Juliánov) are interconnected the pressure conditions for the total network is controlled by the pressure maintenance system in the Líšeň DH network.

A reserve DH pressure maintenance equipment shall be included in the scope of Contract Object to handle situations where the DH system of the Complete Line is not connected to the DH network.

2.9 Summer cooler(s)

The Contract Object include the design, manufacture, supply, erection, testing and commissioning of a complete summer cooler system including dry coolers, heat exchangers, circuit with a mixture of water/propylene glycol, circulation pumps (on cooler side as well as DH side), pressure holding system (on cooler side), filters, valves, piping, instrumentation and a complete steel structure and its support system including foundations.

The summer cooling system shall supply the necessary amount of cooling water (water/propylene glycol mixture) to a heat exchanger removing heat from the DH network.

2.9.1 GENERAL

The cooling system shall be based on dry air coolers with capacity and ambient air data as stated in Appendix A13 *Process and Design Data.*

The system as an entity is a common system. It shall be designed with sufficient redundancy to ensure that sufficient cooling capacity is always available.

The summer cooler shall be divided into a sufficient number of modules/units including related components (pumps, heat-exchangers etc.), such that full cooling capacity can be delivered even if one module/unit is out of operation.

Spray water system for increasing cooling capacity by evaporation of water will not be accepted.

Vents shall be of the automatic type.

At safety valves and vents spillage shall be collected and diverted to a collection tank for re-injection into the system. Manual contact with glycol must be avoided.

The summer cooling system shall be connected to the DH network as described in section 2.3.

The summer cooler shall be located on top of the existing waste sorting hall in outdoor climate on a civil steel structure support as shown in Appendix D *Drawings.*

The cooler design shall consider the impact on the air intake and heat discharge caused by the permeable civil structures around the dry coolers according to the layout indicated in Appendix D *Drawings*.

It must be possible to operate the summer cooler system at full load within the noise requirements stated in Appendix A14.3 *Acoustic Noise and Vibrations*.

All materials used must be corrosion resistant or corrosion protected to ensure a reasonable lifetime.

2.9.2 COIL SECTIONS

Each coil section of the cooler shall be equipped with separate main shut off valves. It shall be possible to isolate and drain each coil section for maintenance during operation.

Replacement of tube bundles shall be possible.

2.9.3 WATER/GLYCOL CIRCUIT

It shall be possible to entirely drain the water/glycol circuit of the complete summer cooler system as well as from separate coil sections.

The Contract Object shall include a tank for draining of glycol and a pump arrangement for refilling the glycol circuit.

2.9.4 SUPPORT STEEL STRUCTURE

Support steel structure shall be included in the scope of Contract Object, and must be complete with columns, bracings, service platforms, foundations, gangways, access ladders and railings and designed for the purpose with necessary attention on dynamic load and absorption of vibrations etc.

Numbers and position of columns and bracings shall be decided at a later stage together with the Employer, and the steel structure should contain a steel base frame, ensuring a certain flexibility in positioning of columns and bracings.

The design of the steel structure shall comply with Appendix A14.2 *Steel Constructions for Process.* The limit of supply is described in Appendix A18 *Limits of Supply*.

2.9.5 ELECTRICAL MOTORS

The design of electrical motors shall comply with Appendix A6 *Technical Specifications for Electrical Equipment.*

The fan motors shall be located in order to resist climate conditions and shall be protected from heat from coils and other parts of the dry coolers. The fan motors shall be designed for speed control through frequency converter control.

3. CONTROL OF DH SYSTEM

The control of the components in the DH system of the Line shall be designed, supplied and put in operation by the Contractor.

The Contractor shall supply all measurement instruments and component data exchange (for instance from pump frequency converters and valve actuators) to operate the DH system in a safe, reliable and economical way. The control system for the DH network (outside the Line) itself is outside the scope of Contract Object.

Pressure measurement transmitter instruments with local display shall be installed at all places where a change of pressure may take place. Pressure measurement transmitter instruments shall be installed at the interfaces of the DH system.

Temperature measurement transmitter instruments with local display shall be installed at all places where change of temperature may take place. Temperature measurement transmitter instruments shall be installed at the interfaces of the DH system.

Production units shall automatically be set in operation as the heat demand increases and taken out of operation when the heat demand decreases. The control shall take into account that the production units may have a minimum production capacity (MJ/s).

This section, including subsections provides a suggested control concept for the DH system of the Complete Line based on the new Line installations and the Existing facility installations.

The Contractor may adopt this suggestion as his own or he may work out an alternative high-level control concept for the DH installations of the Complete Line. The Contractor is under all circumstances responsible for the proper operation of the Line.

In general, the control concept shall be supplemented with sequences for starting and stopping pumps according to the required flow capacity developed by the Contractor.

Annex C illustrates the main components in the DH installations and the main controllers for handling the DH supply. The new DH installations for the Line is indicated to the right in the figure in Annex C.

To the left in Annex B is indicated the DH pumps and the related controllers. The DH pumps and the controllers is not a part of the scope. Further is indicated controllers for the existing condensers to the left in the Annex. These controllers are not a part of the Contract Object.

Annex C does not show:

- other components such as check valves, filters etc.
- measurement transmitters not used for control purpose.
- control loops for security purposes, as for instance turbine trip.

3.1 Control of boiler pressure

The boiler is indicated in the upper, right corner of Annex C.

The boiler pressure is normally controlled by the steam supply to the turbine. The boiler pressure (P) is compared to the required setpoint (to the right of the "P") and a control deviation is calculated based on the "+" and "-" in the drawing. The control deviation is sent to a PID controller, which create an increasing output if the control deviation is positive and a decreasing output if the control deviation is negative.

If the boiler pressure is higher than the setpoint a positive control deviation will be calculated, and the output of the controller will increase and thereby increase the opening of the steam valve to the turbine.

Normally the pressure in the DH condenser is controlled by the cooler, but if the condenser pressure for some reason gets too high a condenser max pressure controller takes over the control of the turbine steam valve. The condenser pressure controller will act as a limiter for the boiler pressure control of the turbine valve. This may be done by multiplying the output from the boiler pressure controller with the output from the condenser pressure controller (indicated with a circle with an "x" inside).

If the condenser pressure is lower than the maximum pressure set point (P_max_set) the output of the condenser max pressure controller will increase until it reaches the value 1. In that case the turbine steam valve will be controlled by the boiler pressure regulator. If the condenser pressure becomes too high the output of the condenser max pressure controller will decrease and thereby take over the control of the turbine steam valve.

If the condenser pressure has taken over the turbine steam valve control the boiler pressure will have to be controlled by the start-up valve as indicated in the drawings to the left of the boiler. If the start-up valve for some reason do not have sufficient capacity or it will not open, a safety valve will protect the boiler.

If the turbine for some reason is not in operation a turbine by-pass steam valve will take over as indicated in the drawings to the right of the turbine steam valve. The turbine by-pass steam valve is controlled the same way as the turbine steam valve although it may be controlled with a positive (high – H) offset added to the boiler pressure setpoint.

If the turbine trips a fast opening of the turbine by-pass steam valve may be desired – this is not indicated in the drawing.

3.2 Control of Summer Cooler(s)

The heat production in the turbine condenser is always determined by the turbine load. When the summer cooler is in operation, its aim is to have the supply DH temperature match a setpoint. In order for this control to be fast, the summer cooler should be based on the pressure measurement in the turbine condenser to forecast the forward temperature. Thus, the condenser steam pressure shall correspond to the required DH flow temperature including heat exchanger temperature difference. Therefore, the condenser pressure setpoint is generated by a temperature controller shown to the left of the condenser. If the DH flow temperature is too low the output (condenser pressure setpoint) will increase. The increasing condenser pressure setpoint will decrease the output of the condenser pressure controller, which will reduce the rotational speed of the summer cooler DH pump.

The cooler fan will be controlled by the DH return temperature from the cooler. If the temperature is too high the speed of the fans will be increased.

The glycol cooler circuit is not shown in the drawing.

3.3 Control of Low Temperature Economizer

The LT ECO consists of two circuits separated by a heat exchanger, the economizer circuit and the DH circuit.

The DH circuit is controlled to obtain the required flow (t/h) as indicated in the drawing. Alternatively, the DH circuit shall also be controlled to obtain the required heat power (MJ/s) based on the Flow, the DH return temperature and the setpoint for the required DH supply temperature.

The economizer circuit is controlled to obtain the required DH flow temperature. If the temperature is too low the rotational speed of the pump in the circuit is increased.

A limiter for the DH flow controller based on the DH flow temperature shall be added (not shown in Annex B). The limiter may restrict the DH flow if the DH flow temperature is lower than T_set minus T_set_offset. Such limiter may be used for maximizing the economizer heat production by inserting a high set point for the DH flow.

Further it shall be possible to control the low temperature economizer DH flow to maintain the required DH supply temperature (minus an offset). This control mode can be used when the DH consumption has reached the level where the summer cooler no longer can control the condenser DH supply temperature. This control mode is not indicated in Annex B.

3.4 Control of Heat Pump for Flue Gas Condensation

The heat pump extracts heat from the flue gas by a chilled water circuit. The total heat supply (heat from flue gas and energy from the heat pump driving force) is supplied to the DH system.

The driving force of the heat pump is controlled to maintain a required DH supply temperature. If the DH supply temperature is too low the energy from the driving force shall increase.

The heat pump DH circuit is controlled to obtain the required flow (t/h) as indicated in the drawing. Alternatively, the DH circuit shall also be controlled to obtain the required heat power (MJ/s) based on the flow, the DH return temperature and the setpoint for the required DH supply temperature.

A limiter for the DH flow controller based on the DH flow temperature may be added (not shown in Annex C). The limiter may restrict the DH flow if the DH flow temperature is lower than T_set minus T_set_offset. Such limiter may be used for maximizing the heat pump heat production by inserting a high set point for the DH flow.

Further it shall be possible to control the heat pump DH flow to maintain the required DH supply temperature (minus an offset). This control mode can be used when the DH consumption has reached the level where the summer cooler no longer can control the condenser DH supply temperature. This control mode is not indicated in Annex B.

3.5 Control of Flue Gas Reheater

With the heat pump in operation the flue gas temperature might become too low. Therefore, the flue gas can be reheated by a flue gas reheat circuit as indicated in Annex C. If the flue gas is too low the rotational speed of the pump in the reheat circuit is increased.

3.6 Control of DH Supply

As mentioned, the control of the DH pumps and the existing K2/K3 condensers are not a part of the Contract Object. Nevertheless, the function of these controllers is described here as an information to the Contractor.

During higher DH load supplying of a fixed flow (t/h) or heat capacity (MJ/s) to the DH networks will be the general form of supply from lines K1, K2 and K3. In this operational mode (fixed supply) one or more other production plants located elsewhere in the DH networks will have to supply heat to the DH networks and one or more of these production plants will have to have a varying production (modulating supply) to match the DH demand.

In the summertime the Complete Line may be the only supplier to the DH networks. In this situation a modulation operational mode based on differential pressure (dp) measurements in the DH networks will be required.

In general, the pumps are controlled according to the required flow. The setpoint (t/h) may be set directly by the operator (fixed supply mode) or it may be generated by a dp controller.

Annex C shows the future situation with a common suction interconnection of the two pump groups (lower left corner, the interconnection between the two pump groups on the suction side is open).

Annex C shows a controller for each pump. This controller controls the electrical power consumption for the pump as generated by the frequency converter. The interconnected pump group may be controlled by the common flow to the two DH networks measured as the sum of the flows to the two networks. The flow setpoint may be specified by the operator or the operator may by a switch decide that the flow setpoint shall be based on a dp measurement from the common DH network.

The flow deviation is led to an electrical pump power controller where the output is the required electrical power for each pump. For the Juliánov pumps the required electrical power is multiplied by a factor. If for instance the max power consumption of each Juliánov pump is 140 kW and the max power consumption of each Lišeň pump is 332 kW the factor could be 140/332 = 0.42.

In general, when the DH flow is increasing, the summer cooler will decrease the DH cooler flow to maintain the Line K1 DH condenser pressure. When the DH flow goes beyond a certain limit the summer cooler DH flow will be stopped and the DH flow temperature will be less than the required value.

The flow from Line is normally led through the line K2/K3 DH condensers. If the flow temperature from a K2/K3 DH condenser is lower than required, the condensate drain valve for that condenser is opened and controlled to maintain the required DH flow temperature. In this situation the Line heat supply is at its maximum and additional heat supply is added from line K2 and K3.

3.7 Trip of DH flow

If the DH water flow by accident is stopped the DH water temperature in the condenser may get higher than the design temperature for the DH networks. It is the Contractors responsibility to secure that the supply temperature from his production units do not exceeds the DH networks design temperature. The Contractor shall consider how the DH supply immediately can be re-establish with a DH flow temperature lower than the DH design temperature.

This could for instance be done by designing the piping to the summer cooler and the summer cooler itself to a higher temperature (corresponding to the maximum condenser pressure) and thereby using the summer cooler for removing of the hot water pocket in the condenser. Or a by-pass could be established parallel to the condenser for cooling down the high temperature condenser water by mixing during reestablishment of the DH supply.

3.8 Low DH-pressure

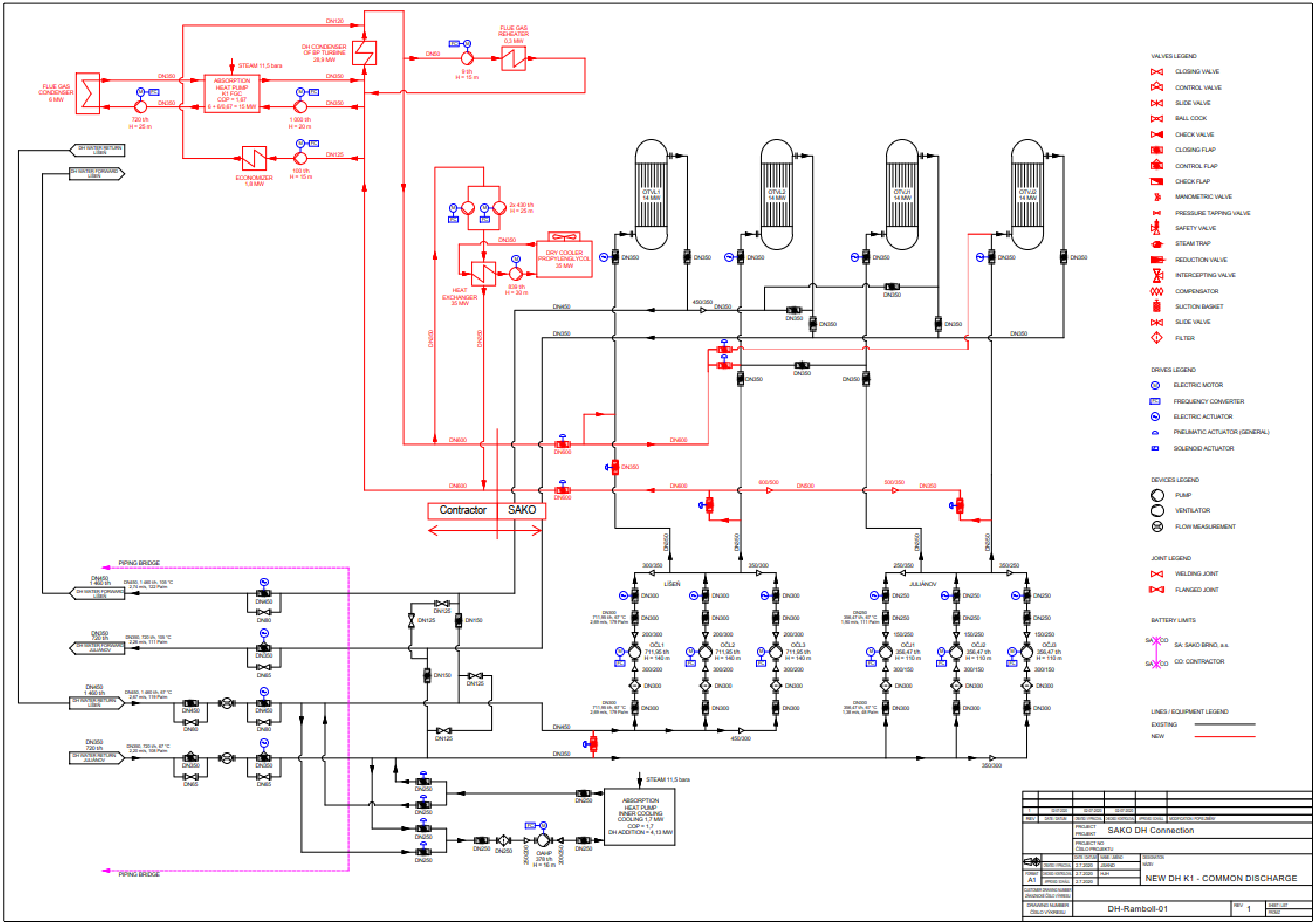
If the DH pressure by accident gets too low the water in the condenser may boil which should be avoided. Therefor the steam supply to the condenser shall be shut off if the DH water pressure in the condenser gets too low.

ANNEX A
PFD OF FUTURE INTERCONNECTION OF DH SYSTEM FOR COMPLETE LINE

The process flow diagram shows the Employer's vision and suggested interconnection of the existing DH system including upgrades and the new DH system of the Line.

The PFD is solely indicative, and all design of the system including piping, valves, sizing and connection points shall be supplied by the Contractor.

The relative position of the DH producers shall be as indicated in the PFD.


VALVES LEGEND
CLOSING VALVE
CONTROL VALVE
SLIDE VALVE
BALL COCK
CHECK VALVE
CLOSING FLAP
CONTROL FLAP
CHECK FLAP
MANOMETRIC VALVE
PRESSURE TAPPING VALVE
SAFETY VALVE
STEAM TRAP
REDUCTION VALVE
INTERCEPTING VALVE
COMPENSATOR
SUCTION BASKET
SLIDE VALVE
FILTER
DRIVES LEGEND
ELECTRIC MOTOR
FREQUENCY CONVERTER
ELECTRIC ACTUATOR
PNEUMATIC ACTUATOR (GENERAL)
SOLENOID ACTUATOR
DEVICES LEGEND
PUMP
VENTILATOR
FLOW MEASUREMENT
JOINT LEGEND
WELDING JOINT
FLANGED JOINT
BATTERY LIMITS
SA: SAKO BRNO, a.s.
CO: CONTRACTOR
LINES / EQUIPMENT LEGEND
EXISTING
NEW
FLUE GAS CONDENSER 6 MW
ABSORPTION HEAT PUMP K1 FGC
DH CONDENSER OF BP TURBINE 28,9 MW
FLUE GAS REHEATER 0,3 MW
STEAM 11,5 bara
ECONOMIZER 1,8 MW
DH WATER RETURN LÍŠEŇ
DH WATER FORWARD LÍŠEŇ
DH WATER FORWARD JULIÁNOV
DH WATER RETURN JULIÁNOV
DRY COOLER PROPYLENGLYCOL 35 MW
HEAT EXCHANGER 35 MW
Contractor
SAKO
PIPING BRIDGE
LÍŠEŇ
JULIÁNOV
ABSORPTION HEAT PUMP INNER COOLING COOLING 1,7 MW COP = 1,7 DH ADDITION = 4,13 MW
PROJECT
SAKO DH Connection
NEW DH K1 - COMMON DISCHARGE
A1
DRAWING NUMBER
DH-Ramboll-01
REV
1

ANNEX B
POSSIBLE DH ROUTINGS

This Annex shows two possible routings of the DH connection from the Line to the existing DH station.

The Contractor may adopt one of these suggestions as his own or he may work out an alternative DH routing. The Contractor is under all circumstances responsible for the DH routing and interconnection delivered under the scope of Contract Object and all related works.

Alternative A

In Figure 3 a possible routing of the DH connection from the Line to the DH building is shown. The compass direction “S” in the drawing is towards north.

The figure indicates a relative positioning of the hot DH pipe and the cold DH pipe. In addition, the relative position of a potential condensate pipe and the steam pipe is indicated. This is relevant if Option 1 is chosen, and an absorption heat pump is delivered.

The pipe routing starts on the north-west side of the K1 turbine building.

From the turbine building of K1 the routing is underground along the building preferably without utility channel, there are no other major installations in the ground in this area.

At the west corner of the new K1 waste bunker there are some sewer pipes for rainwater. These pipes will likely have to be rearranged in connection with the erection of the K1 waste bunker.

The DH pipe routing runs to the west corner of the K1 waste bunker. From there it goes above ground on a pipe bridge to the other side of the traffic road in front of the existing administration building. A pipe bridge could be integrated into the support structure of the new gangway, with the aim to obtain both the overall lowest cost for gangway and pipe crossing and providing a design integrated in the overall building design. The use of such pipe bridge will furthermore avoid conflicts with the very large sewer pipes and water supply pipes in the ground beneath the gangway.

From the administration building the DH pipes will again go down in the ground and directed along the north-west perimeter of SAKO Premises side and parallel to the existing waste sorting hall. There are no other major underground installations in this area.

The DH pipes will go above ground before crossing the existing Lišeň and Juliánov DH connection. From here the DH connection will go on a pipe bridge across the underground Lišeň DH connection to the south-west of the existing DH-pipe bridge. From there the new pipe bridge will go along the existing pipe bridge, or – if possible – the DH pipes will be attached to the existing pipe bridge.

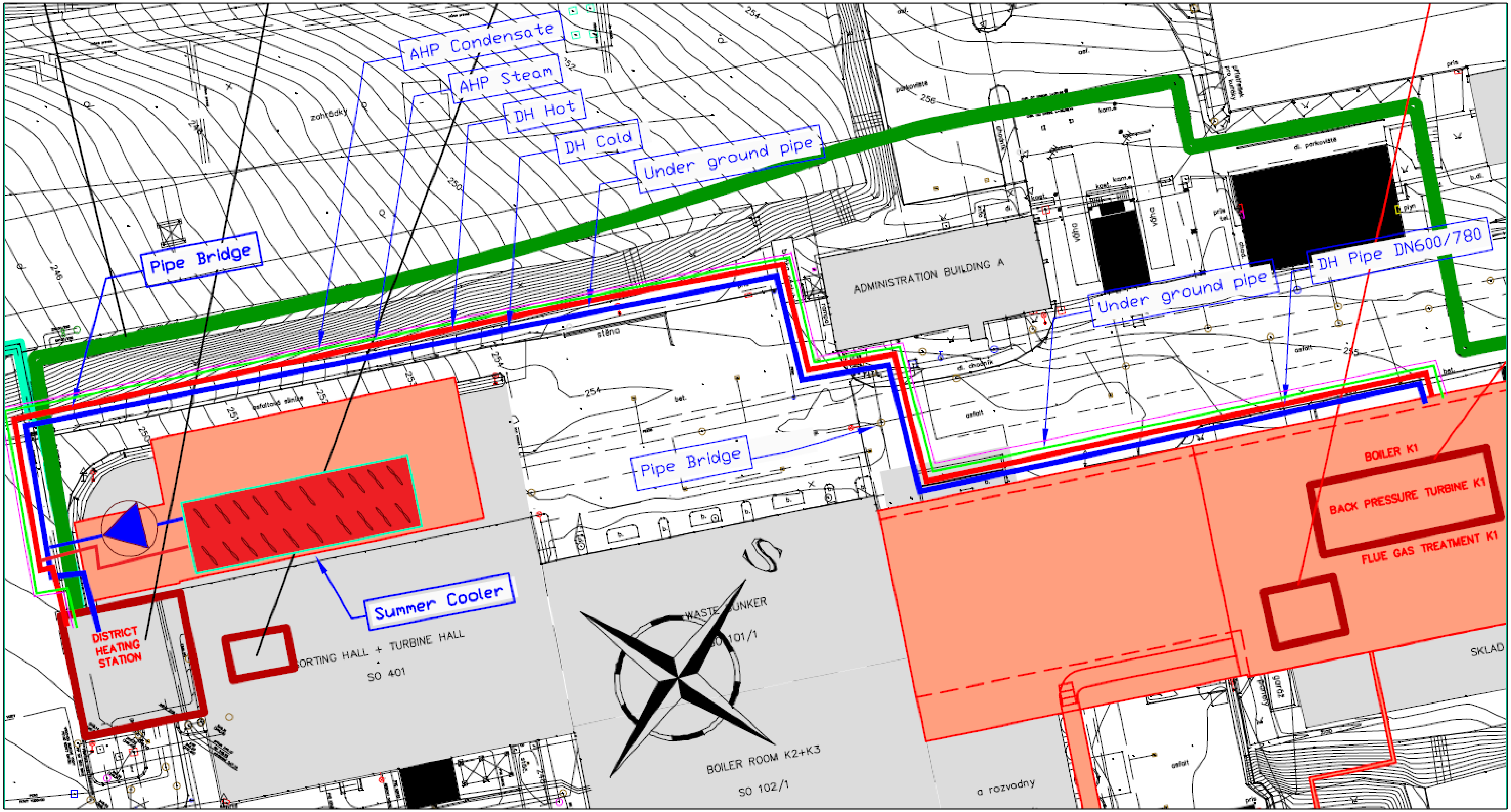


Figure 3, Alternative A - Pipe routing between line K1 and existing DH building. "S" is towards the north

Alternative B

As an alternative to the pipe bridge from the K1 waste bunker to the administration building the DH pipe may go in a controlled drilling beneath the above-mentioned sewer and water pipes. This is illustrated in Figure 4. It is assumed that the DH pipes will be installed in duct pipes which makes it possible to perform repair work on the DH pipes.

Figure 4 indicates that some space for drilling from the K1 waste bunker side is required. This drilling may be done in connection with the excavation for the K1 waste bunker.

The figure also indicates a chamber next to the K1 waste bunker. The purpose of the chamber is to provide access to the pipe installations going down to the deep drilling.

Next to the administration building is shown another chamber which shall provide space for the duct pipes to be hauled from this space towards the K1 waste bunker. Also, the chamber can serve as space for dismantling the DH pipes in case of repair work.

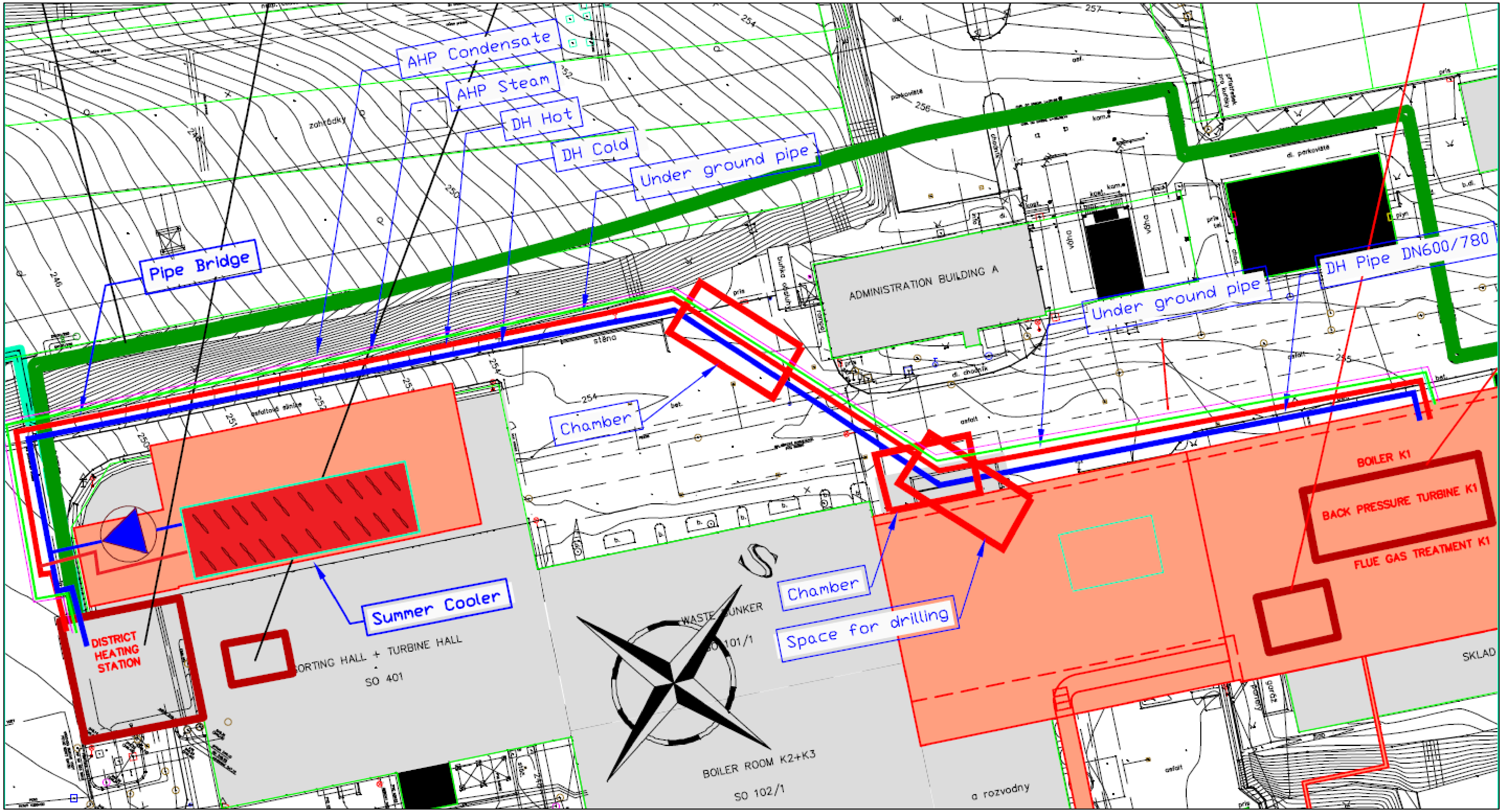
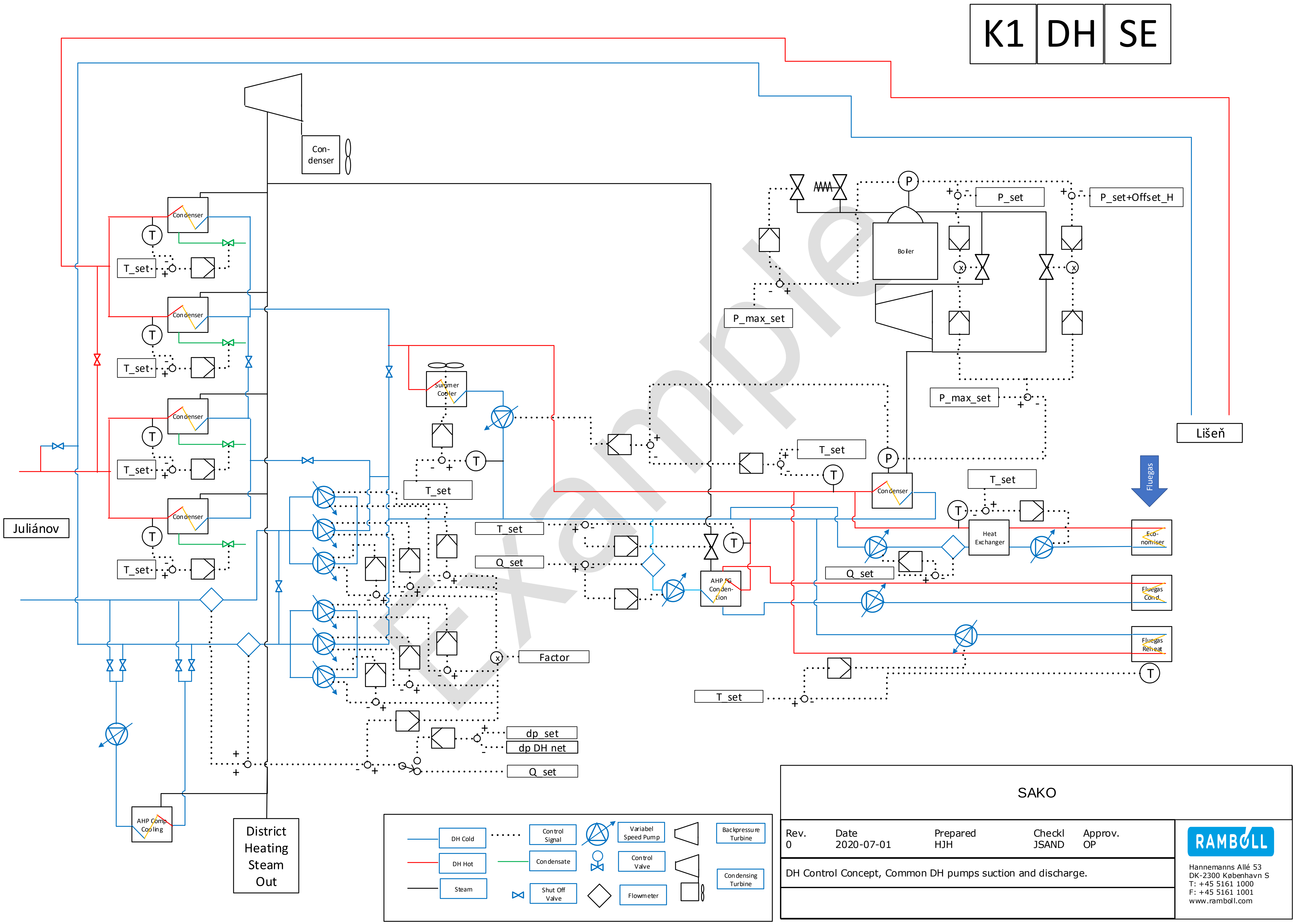


Figure 4, Alternative B - Pipe routing between K1 and existing DH building. "S" is towards the north.

ANNEX C
OVERALL DH CONTROL CONCEPT



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