

Employer
SAKO BRNO A.S.

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

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PART III, APPENDIX A5

TECHNICAL SPECIFICATIONS

FOR AUXILIARY EQUIPMENT



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TECHNICAL SPECIFICATIONS FOR AUXILIARY
EQUIPMENT**

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1. GENERAL

This Appendix A5 describes the main auxiliary equipment which is not covered in other appendices describing scope of work for main components.

2. WASTE RECEPTION AND HANDLING

2.1 General

The new waste bunker will be established as shown in the layout drawings in Appendix D *Drawings*. In the following the term "waste bunker" describes the entire waste bunker area covering both the existing waste bunker and the new waste bunker.

The existing waste reception area (outdoor) and existing unloading bays shall be used for all future waste unloading. No new unloading bays are foreseen for the new waste bunker.

The Employer receives primarily municipal solid waste (MSW). The waste composition is indicated in Appendix A13 *Process and Design Data*.

The existing waste cranes including all related equipment such as crane operator station, electrical cabinets, festoon cables etc. shall be removed as part of the Contract Object.

2.2 Waste Reception Area

The equipment in the waste reception area (described in sections 2.2.1-2.2.5) shall be delivered for all eight (8) existing unloading bays and shall be controlled and interlocked by the crane CMS as part of the Contractors overall waste reception and waste bunker area management system. Signals from existing equipment (such as bay load gates) shall be sent to the overall CMS. The Contractor shall implement all necessary signal exchange with the new crane CMS.

It shall be possible to manually set the traffic lights from the crane CMS.

The crane control system shall ensure that the crane keeps a safe distance to any open gates in the waste reception area.

2.2.1 TRAFFIC LIGHTS

New traffic lights for all 8 existing gates shall be installed replacing the existing lights. The traffic lights are for regulation of waste unloading vehicles.

Traffic lights shall be placed at each unloading bay in the waste reception area. The traffic lights shall inform if the bay is open for unloading (green) or closed (red) - meaning the crane is allowed to work in the waste bunker area behind the bay.

2.2.2 BAY LOAD GUARDS

Bay load guards for personnel safety during unloading of waste shall be established. There shall be one guard for each bay. The bay load guard system shall be equipped with detection sensors so that the guards only can open when the vehicles position is correct. Bay load guards may never close during unloading of a vehicle.

Bay load guards may not open if the traffic light signal is red.

2.2.3 BAY LOAD GATES

All unloading bays in the waste reception area are equipped with gates.

The gates shall have an interlock with the bay load guards which makes the bay load guards unable to open if the gates are closed.

The gates shall be operated from the control room and manually (button push) from the waste reception area when released by the Crane CMS.

2.2.4 WASTE TRUCK DETECTION

The Contractor shall include any additional detection of waste trucks if he deems it necessary.

2.2.5 EMERGENCY STOPS

Emergency crane stop buttons shall be placed on each side of each load bay in the waste reception area. If the emergency stop is triggered the cranes shall stop all movement, an acoustic alarm and flashing lights in the waste reception area and in the control room shall be activated.

2.3 Waste Bunker

The waste bunker stores all the waste and allows for mixing before feeding to the Line and Existing facility (K1, K2 and K3).

The Contractor shall during design and engineering pay special attention to the waste crane parking position near the Line and the ability to feed the Line waste hopper with both cranes. It may be necessary to extend the crane rails more than usual in order to safely reach and feed the Line waste hopper with both cranes.

The Contractor shall during design and engineering demonstrate that the existing waste bunker structure (columns, consoles etc) is sufficient for the new faster cranes. If the existing structure is inadequate, the Contractor may issue a Variation Order, which includes any necessary changes to the existing structure.

As part of the Contract Object the existing hopper deck shall be equipped with sufficient railings to prevent people from falling into the waste bunker.

2.3.1 FIRE DETECTION SYSTEM AND FIREFIGHTING EQUIPMENT IN WASTE BUNKER

A fire detection system and fire-fighting equipment covering the entire waste bunker is included in the Contract Object. Reference is made to appendix A9, *Technical Specification for Building*.

If a fire occurs in the waste bunker, a signal shall be given to the waste cranes, so they automatically can move away from the fire to the maintenance areas in case of fire.

2.3.2 DUST SUPPRESSION

Effective dust suppression is included in the Contract Object.

A series of water nozzles above the hoppers and unloading bays shall spray water mist in the air above these areas to minimize dust when unloading waste into the waste bunker or the hoppers.

The nozzles shall be self-cleaning and protected from the grab. Nozzles and pipework shall be heat traced.

3. WASTE SHREDDER

The Employer's existing shredder shall be used for future operation of the Complete plant.

The shredder is fed manually by a dedicated front loader from outside the waste bunker. The shredded waste goes directly into the waste bunker.

Dust suppression is installed on the outlet of the existing shredder. The dust suppression starts automatically when the shredder is started.

The shredder is operated manually and does not have connection to the existing CMS.

4. WASTE CRANES

Removal of the existing waste cranes, runways and rails is included in the scope of Contract Object

Two (2) fully automatic waste cranes, each with 100% capacity (full redundancy), shall be installed for waste reception, waste feeding and mixing of waste in the waste bunker. The waste cranes shall be able to reach all areas of the waste bunker as well as all hoppers as well as all service and hopper decks. Both cranes shall be able to feed all waste hoppers K1, K2 and K3 in the Complete plant.

The replacement of existing waste cranes shall be coordinated with the Employers planned summer revision outage of K2 and K3 and executed with the smallest possible number of outage days for the Existing facility. The Contractors planning shall be presented and approved by the Employer latest 9 months before planned implementation.

The Contractor shall produce a drawing of the operating area of the cranes showing access ways, working and restricted areas for maintenance of the cranes together with his Tender to be elaborated further in the design phase.

The layout of the crane system and access ways shall be agreed with the Employer.

The Contractor shall in his Tender comment on the suggested crane capacity and grab size (ref. Appendix A13 *Process and Design Data*), and the Contractor shall in his Tender state travelling and lifting speeds for obtaining adequate feeding, moving and mixing capacities as specified in Appendix A13 *Process and Design Data*. All shredded waste shall be mixed with household waste before feeding into the hopper. Calculations of feeding, recasting and mixing capacities including cycle time calculations for manual and full automatic modes shall be documented by the Contractor.

The Contractor shall provide valid references for the 24 hours fully automatic (unmanned) crane system in his Tender.

When the waste cranes are occasionally operated in manual or semi-automatic operation mode, the cranes shall be operated from the crane operating chair located in the crane control room, as indicated in Appendix D *Drawings*. It shall also be possible to operate and program the waste cranes in automatic or semi-automatic mode from the control room using a dedicated crane operator station.

Mixing of the shredded waste shall be possible in automatic mode.

4.1 General Requirements

All parts of the crane shall be designed for continuous efficient and heavy-duty operation with minimal outages and maintenance, even under the inherent dusty and humid conditions in the waste bunker.

Both cranes shall be able to work simultaneously in the waste bunker and carry out different tasks. It shall be possible with one crane to receive all incoming waste, mix (also shredded waste) and feed all incinerators. The feeding, moving (redistribution) and mixing capacities shall be as specified in Appendix A13 *Process and Design Data*. In fully automatic mode the crane shall operate continuously.

The waste cranes shall be tested at 1.25 x nominal load. All additional expenses occurring as a result of the load tests not being passed, including necessary modifications to the crane are to be paid by the Contractor. The Contractor shall deliver the test loads as part of the Scope of Contract Object.

Galleries, platforms, railing, kick-plates etc. shall be provided according to EN 14122 and ISO 11660-5 and the regulations of the Local Authorities.

Galleries and platforms required for appropriate operation and maintenance of the crane and its components shall be included in the Contract Object. Galleries and platforms shall be constructed so that daily and weekly maintenance of the crane can be made without use of safety lines. At all places where repair and dismantling of components and railings is to take place, a connection for a safety line shall be provided.

The relevant Authorities shall approve the waste cranes before commissioning.

4.2 Runways and rails

Included in the Contract Object are all runways and rails mounted in place.

Crane runways and rails shall be mounted on consoles on the structure of the building.

Runways shall be designed in accordance with international (EN, ISO, DIN or FEM) and national Czech standards.

The crane rails shall be mounted on a sound absorbing, flexible base material fixed with clamps. The rails, clamps and flexible base material shall comply with the requirements stated in VDI 3576.

Crane rails shall be according to DIN 536 Teil 1 or equivalent and tolerances conform to VDI 3576 Tolerance Class 1.

4.3 Crane Bridge

The Crane Bridge shall be of a rigid construction and covered with chequered plates as far as possible.

There shall be minimum one gallery running along the side in full length of the bridge. From the gallery there shall be safe access to the trolley. If needed for the removal of components the galleries shall be provided with dismantable railings.

It shall be possible to access all crane wheels for service and maintenance. The width of the gangways/galleries along the crane shall however be minimum 700 mm free space.

The design of galleries and platforms shall be endorsed by the Employer.

4.4 Trolley

The trolley shall be of rigid construction and shall be covered with steel chequered plates as far as possible. The trolley shall be furnished with galleries and platforms for safe access to all components on the trolley. If needed for the removal of components the galleries shall be provided with dismantable railings. Special attention shall be taken when going down from the trolley to the crane gallery.

4.5 Grab

The grab shall be a motor-powered polygrab (multi-jaw grab) specially designed for waste handling with hydraulic valve system for opening/closing of the grab. Each spade shall have a separate hydraulic cylinder. The grab shall be supplied with open close contacts, tipping contacts and oil temperature reading.

There shall be an extra spare (third) grab included in the Contract Object.

The size of the grab shall be tailored to suit both the new Line but also Existing facility (lines K2 and K3) with a minimum risk of blockages. Refer to Appendix E7 *Waste hopper drawings for Existing Plant* for size of existing hoppers of Existing facility.

4.6 Picking Crane

Each crane shall be equipped with a picking crane for picking large items from the waste hoppers.

The picking crane shall be permanently mounted on each trolley. The picking crane shall be designed such that when it is retracted, it shall not be able to disturb the workings of the waste crane. The picking cranes shall be fixed in position when not in use, so that swinging of the picking cranes during operation of the waste cranes is avoided. It shall be possible to unfix the picking crane automatically for using it immediately when required.

The picking crane shall be controllable from the crane chair as well as from the crane operator station and remote controls.

4.7 Personnel Basket

Included with the Contract Object is a personnel basket for inspection and for rescue of man in bunker. The personnel basket shall conform to the requirements stated in the latest version of EN 14502-1: Cranes – Equipment for lifting persons as well as national legislation.

4.8 Motors, Drives and Frequency Converters, Brake resistor for hoist

Hoisting, travelling and cross travelling motors for the crane shall be frequency controlled.

Serial communication to frequency converters, for example profibus, shall be employed.

Drives shall be supplied in a steel enclosed or welded design and where gearing is required the gear shall be equipped with a sharpened, cylindrical bevel-cut gear working in a closed-circuit oil bath.

Drives shall be designed in accordance with international standards (DIN or FEM) (ref. Appendix A13 *Process and Design Data*) and dimensioned for 100% duty cycle.

The energy from braking shall be reused with energy recuperation.

4.9 Bearings

All lubricated bearings shall be dustproof and shall allow for re-greasing.

4.10 Brakes

Brake discs and lining shall be dimensioned according to the operating conditions described in the Contract.

It shall be possible to release the brakes on the cranes so that it is possible to push a stranded crane away with the other crane.

4.11 Lubrication

For the crane equipment lubrication shall be grouped together i.e. lubrication nipples and lubrication reservoir filling for lubrication points shall be placed together and be easily accessible.

For the grabs a central automatic lubrication system shall be included in the Contract Object.

4.12 Weighing System

Each crane shall be equipped with a weighing system consisting of weighing cells on a separate frame and with a precision within +/- 2% of full scale.

The weighing cells shall be of a robust make and be able to withstand the shocks from lifting of the grab without loss of precision. Periodic automatic calibration of the weights shall be included.

The Contractor shall ensure signal exchange between the overall CMS, the crane system and the crane weighing system.

Certified test weights for calibration and all other necessary equipment shall be included in the Contract Object.

A display at the crane operating chair shall show the current load of the crane.

4.13 Positioning System

A complete positioning system with absolute encoders or equivalent for long-travel, cross-travel and hoisting shall be supplied for the crane. The positioning shall not be dependent on the revolutions of powered running wheels on trolley or girder.

The positioning system shall be precise and reliable and be designed for the dusty conditions in the waste bunker (laser-based systems will not be accepted).

Based on signals for the positioning system the crane CMS shall calculate the position of the crane, and all control operations shall be affected accordingly.

Automatic re-calibration features shall be included to ensure the accurate positioning, when deviations caused by mechanical slip occurs.

Position reference points/hopper positioning points shall be included in the scope of Contract Object.

The position system must be backed with a safety positioning system for the operation in the safety areas. The redundant positioning system may be mechanical based and hard-wired.

The Contractor must ensure that the positioning system has adequate precision for the crane control system. The positioning system shall be subject to approval by the Employer.

4.14 Collision Protection System

A crane collision protection system shall be supplied for the crane system. The anti-collision protection system shall be supplied in accordance with the Contractor's experience with this type of system.

The total anti-collision system shall comprise the following parts:

Software protection system

Software protection shall be based on a positioning system with encoders or equivalent.

Mechanical switches/contacts

Necessary mechanical contacts or other redundant safety positioning system shall be supplied as an extra cut-off protection around the crane cabin, bunker walls and in connection with securing the hopper deck and other working and maintenance areas.

Radar anti-collision sensor system

A radar sensor for each crane shall be supplied

Mechanical buffers

Mechanical buffers shall be mounted each crane, counterpart stops shall also be mounted on both ends of the crane rail system. Necessary removable or hinged mechanical physical stops shall be placed easily accessible to secure the maintenance areas when working on the cranes.

4.15 Pendulum Damping System

In order to optimize grab movements in the waste bunker, the crane control system shall include a pendulum damping system.

During manual operation, it shall be possible for the operator to turn off the pendulum damping control.

Instrumentation for registration of grab movements shall be part of the Contract Object.

4.16 Waste Heights and Volumes in the Waste Bunker

The Contract Object shall for each of the cranes include a scanner for measurement and registration of waste height in the waste bunker. The cranes shall also be equipped with a slack-wire system to verify the waste heights when grabbing. Registration of waste heights in the unloading bays shall be secured regularly in order to avoid overfilling of unloading bays

Based on the crane system's registration of the height of the waste in the waste bunker, the crane CMS shall continuously calculate and map the amount (m³ and tonnes) of waste in the waste bunker and it shall also be possible to be viewed in the overall CMS.

The measuring equipment (laser or similar) shall be supplied in accordance with the Contractor's experience from similar projects.

4.17 Hopper Levels

All hoppers and chutes shall be equipped with measuring equipment for registration of the waste in the hopper and in the chute. The Existing facility had sensors that are to be reused for the chute only. Hopper level sensors are to be included as part of Contract Object. Reference is made to Appendix A2 *Technical Specifications for Incinerator/Boiler*, Section 1.2.3 for more information.

4.18 Access Zones

There shall be a number of safety (restricted) zones in the waste bunker and hopper deck to which the waste cranes will have restricted access when in normal operating mode. Access to the restricted areas shall only be possible in manual mode with override or with the remote-control panel. Both electrical and mechanical safety mechanisms shall be applied.

- Access to the area around the waste hoppers shall be restricted.
- Access to the grab change area shall be restricted.
- Access to the crane parking and maintenance sections on each end of the waste bunker shall be restricted.
- Access close to the crane control room shall be restricted.

4.19 Crane access ways and crane galleries

Access ways in the form of galleries, platforms and stairs on the crane required for appropriate operation and maintenance of the crane and its components shall be included in the Contract Object. Access ways shall be constructed so that all maintenance to the crane including inspection and maintenance of crane rails can be made without use of safety lines or scaffolding.

At all places where repair and dismantling of components is to take place, a connection for a safety line shall however be provided.

The access ways on the crane shall be coordinated with the buildings access ways. The Contractor shall establish a gallery above the hopper deck in the full length of the waste bunker wall from where the waste cranes galleries can be accessed. If needed for the removal of components the galleries shall be provided with dismantlable railings.

Exchange of the crane cable must be possible in an easy and safe way. The method shall be described by the Contractor and agreed by the Employer.

There shall be a possibility of access to the crane wheels.

Access ways to the crane shall comply with EN and ISO standards including ISO 11660-5, and any regulations of the Authorities.

The design of galleries and stairs shall generally be agreed with the Employer and in accordance to Appendix A13.10 *Standard for Staircases and Galleries*.

A working platform for the waste crane – to be used for exchange of lighting in the waste bunker etc. - shall be included in the Contract Object. The platform shall be installable by the monorail crane. Refer to section 5.3 for details on the monorail crane.

4.20 Safety Matters - Restricted Areas & Boundaries

Risk analysis

As a part of the Contract Object the Contractor shall carry out a risk analysis of the fully automated crane system.

The risk analysis shall include a structured review of the functions of the crane system with a view to identifying the possible occurrence of any unwanted event as well as causes and consequences. It shall be possible to service one crane with the other crane in automatic mode.

The purpose of the risk analysis is to identify necessary measures reducing the risk of accidents that may harm people, the plant or the environment.

The conclusions from the risk analysis shall form basis for establishment of the restricted areas and boundaries as well as guards in connection with access ways.

The risk analysis shall be issued for review to the Employer and tested during the Trial operation period.

Restricted Areas & Boundaries

Restricted areas and boundaries include working areas subject to both safety concerns and functional demands.

Furthermore, mechanical physical stops shall be placed to secure maintenance/service areas.

Restricted areas and boundaries include among others:

- Service and maintenance areas for cranes in waste bunker

In order to ensure safety under maintenance/service of the cranes in the waste bunker, two 'repair zones' shall be established. During maintenance/service the crane in question will be positioned in its own 'repair zones', and the safety system is activated manually (by key). To prevent the crane on duty from colliding with the parked crane, the 'repair zone' shall be equipped with mechanical/electrical switches which are activated if the active cranes comes too close to the parked crane. Activation of the mechanical/electrical switches shall cause a complete halt of the crane system. Service and parking zones for crane 1 and 2 shall be in each side of the waste bunker. An area on the hopper deck shall serve as a grab parking area.

The extent of the safety zones shall be agreed in detail with the Employer.

Operation of cranes to/from and within areas shall be affected by manual override or locally by the application of remote-control units for manual operation. The cranes shall move at reduced speed with acoustic alarm and flashing lights.

- Areas in front of unloading bays

The CMS shall include interlocks, which in semi-automatic and fully automatic modes prevent crane movements in front of bays where waste is being unloaded.

- Areas around hoppers when maintenance staff is there

The CMS shall include interlocks, which in semi-automatic or fully automatic mode prevent the cranes from moving to a hopper deck when maintenance staff is present. It shall be

possible for the maintenance staff to work on the hopper deck, outside of the restricted area around the hopper.

Conditions pertaining to fencing of the area around the waste hoppers, including registration of staff working inside the area shall be discussed and agreed with the Employer.

- Area around crane cabin

The area around the crane cabin shall be provided with mechanical switches and interlocks, which in manual, semi-automatic and fully automatic modes prevent crane movements within the safety area around the crane cabin.

Emergency Stop

A number of emergency stops on the hopper deck shall be included in the Contract Object.

Emergency cut-off switches shall be installed in appropriate places in the hopper deck area. Emergency switch signals from the waste reception area shall be incorporated in the safety system.

Activation of one switch shall cut-out all motions on all cranes.

Reset functions for the emergency stops from the crane cabin and control room shall be included in the Contract Object.

Access control

The operational and safety related precautions to be taken when operating staff is working in the waste bunker area shall be investigated as part of the risk analysis to be carried out by the Contractor.

Access doors leading to the waste bunker area shall be monitored through door contacts connected to the crane CMS.

Access ways to the cranes from the walkway along the waste bunker in level with the cranes shall be monitored through gate contacts connected to the crane CMS.

Layout of access ways to the waste bunker area and to the crane from the walkway along the waste bunker shall be approved by the Employer.

4.21 Cabling

The waste crane shall be equipped with two independent power and control cable systems. These systems shall be in the form of travelling cables (festoon-type) with cable carriers running on I-beam runways. The cable runways shall be of rigid and twist-resistant design and shall be fixed in such a manner that no deflections and/or lateral movements will occur.

Cable carriers shall be connected with rope or wire to avoid stress on the power and control cables.

Cable carriers shall be easily replaceable.

The cable system shall be protected against fire where possible.

4.22 Overload Protection

The crane shall be equipped with overload protection.

4.23 Crane Lighting and Service Power Sockets

Lights for operation and maintenance shall be mounted on the crane bridge. Lights shall be placed or screened so that they do not give the fire detection system false readings.

Each crane shall be equipped with 2 sockets for 230 V and 1 socket for 400 V (16 A) for electrical tools.

4.24 Crane operating chair and control panel

There shall be one (1) crane chair included in the Contract Object. The crane operating chair shall be ergonomically designed, suitable for heavy duty operation and equipped with versatile adjustment facilities and damping devices. All grips shall be of rugged design and shall be placed according to ergonomic practices.

The left-hand grip shall have the following functions:

- Cross travel
- Long travel

The right-hand grip shall have the following functions:

- Lift/lower grab
- Open/close grab

It shall be possible to operate the feeding chute cut-off gates from the chair.

From the control panel on each chair it shall be possible to select and control any one of the waste 2 cranes. The panels shall show crane status (position, failures etc.).

It shall be possible to operate one crane in manual mode while the other crane is automatic/semi-automatic mode.

From the crane chair it shall be possible to change pictures from the camera monitoring equipment.

The control panel on the chair shall be prepared for a number of buttons specified by the Employer for control and monitoring of miscellaneous external equipment, i.e. shredder, picking crane, etc.

There shall be up to 20 control buttons on the control panel of the crane operating chair.

The crane operating chair shall be subject to approval by the Employer.

The control panel shall be ergonomically designed and shall at all times show the status of the cranes (crane in operation, position, weight, faults, waste heights in waste bunker, traffic lights etc.)

The control panel shall communicate with the crane system through the PLC's of the CMS.

The Employer shall approve the final layout of the control panel.

4.25 Remote Control Units

Two portable wireless remote-control units for manual crane operation (e.g. during maintenance) shall be included. Each control unit shall be able to shift control between both cranes. Extra rechargeable batteries for the remote are included in the Contract Object.

4.26 The Operation Mode/Function of Waste Cranes

The crane automation system shall allow the plant operator to choose between the following modes of operation:

- Manual operation
It shall be possible to perform the following main functions in manual mode:
 - Opening and closing of grab
 - Hoisting and grab movements, including lifting/lowering with closed grab and lifting/lowering with open grab.
 - Trolley cross travel.
 - Bridge long travel.
- Semi-automatic operation with the following main functions (program):
 - Manual filling of the grab.
 - Manual choice of furnace as well as hopper position, (2-3 positions pr. hopper)
 - Start of lifting movement.
 - Start of bridge travelling movement.
 - Start of trolley movement.
 - Stop above the selected furnace hopper.
 - Manual emptying of the grab.
 - Automatic return and lifting to 40 - 50 (minimum) predefined positions in the waste bunker.
- Fully automated, unmanned operation mode (24 h / day)

When in fully automated, unmanned operation mode, the crane system is only supervised by the Employer's standard operating personnel. The personnel are assigned to other main duties and manual operation of the cranes shall only take place in case of deviations from the normal operation situation such as deviations in the waste quality or deviations from the normal operation (plant outages, overhaul etc.).

Special personnel will not be assigned for crane operation.

In the fully automated, unmanned operation mode, the crane control system shall perform the following tasks:

- Feeding of waste to the waste hopper
- Removing waste in-front of the waste tipping bays
- Redistributing waste in the waste bunker, including distribution between the existing and new bunker
- Mixing of waste (homogenisation).

The crane automation system shall co-ordinate the operation of the two cranes and prioritize among the tasks in order to achieve good bunker management. In addition, the crane control system shall be capable of controlling a number of external facilities such as gates and traffic lights in the waste reception area etc.

It shall be possible to assign each crane with different tasks irrespective of mode (manual, semi-automatic and fully automatic), i.e. one crane feeding and moving waste from the bays and the other crane redistributing and mixing shredder and household waste.

There shall be a possibility of predefining a number of standard task groups (minimum 20). Each task group shall have a number of tasks that are given priority. Upon completion of a task, the crane shall automatically change to the next prioritized task in the task group.

When feeding waste to the hopper the waste shall be spread evenly across the width of the hopper. During mixing the grab shall slowly release the waste by means of a series of opening and closing motions while the crane is in motion, so that waste shall be spread over a wide area.

There shall be the following possibilities for feeding in semi-automatic and automatic mode:

- The waste shall be spread evenly across the width of the hopper.
- The waste shall be released at 2-3 pre-destined places over the hopper.

The Contractor shall include waste bunker management instruction describing optimal bunker logistics and management in the overall operation manual of the plant.

4.27 Electrical Installations and Equipment

The electrical installations and equipment shall fulfil the requirements specified in the Contract (see also Appendix A6 *Technical Specifications for Electrical Equipment*). The Contract Object include, but is not limited to, all LV switchboards, cabling, motors, frequency converters, emergency pushbuttons, service switches, all necessary cable ways and installation of the above at site, including all FAT/SAT testing and commissioning.

The cranes shall be powered by two independent 0.4 kV power supplies – one for each crane.

The power consumption of the waste cranes shall be monitored by a meter (kWh counter). The measured consumption shall be transferred to the CMS system.

4.28 Control and Monitoring System (CMS)

The CMS for the waste crane system shall fulfil the requirements specified in the Contract (see also Appendix A7 *Technical Specifications for Control and Monitoring System*). The Contract Object include, but is not limited to:

- Waste crane instruments, component and intelligent equipment
- All cabling, mounting of above equipment including emergency stops and doors contacts.
- Any needed cable routing for the waste crane system
- PLC cabinets including all hardware in the cabinets
- Bus communication cables for all waste cranes instruments, component and intelligent equipment Mounting/installation of all instruments, component and intelligent equipment

- Bus communication from waste crane to the CMS (serial interface) incl. mounting/- installation in both ends. This includes the connection from PLC to the configuration PC as well.
- Mounting of CCTV camera(s), crane specific monitors and cabling to the nearest switch.
- Waste cranes associated bus- and signal-cable pulling, termination and all adaptation work
- Design basis for programming the overall control and monitoring system (CMS) for waste cranes and all connected auxiliary equipment
- Programming of crane control system for the waste cranes including all auxiliary equipment
- Programming of process functions and associated HMI in the CMS for all waste crane system and all connected auxiliary equipment
- One configuration PC including system software and all needed licenses for configuration

General:

The cranes should be controlled by local PLC and communicate with the overall CMS via serial communication. The program in the PLC shall be configured by a standard PC placed in the control room and connected via serial interface.

All configuration of the waste crane operation shall be done from the operator stations in the control room.

Operator stations:

In the control room the configuration and supervision of the crane system functions shall be implemented.

All configurations for semi-automatic and unmanned full automatic mode shall be configured from the operator stations.

A number of overall graphics give the operator an overview and the possibility of accompanying the performance of the automatic functions. This includes graphics showing the crane movements in a 3-dimensional view (re Section 4.16).

The complete implementation in the CMS including test and documentation are included in the Contract Object.

The graphics shall be approved by the Employer before implementation.

PLC panel:

The PLC shall, based on signal collection from the instrumentation of the crane installation, control the cranes in accordance with the functions selected by the crane operator through the operator station. The PLC shall communicate with the crane chair and the overall CMS via serial communication.

Each crane should be controlled by its own PLC. The program must be designed so every crane can run individually in case of break down, repair or other problems with the "other" crane. Issues like master/slave and redundancy should thus be taken in consideration when designing the program and network. Normal operation is that both cranes are active.

The program shall be documented by means of functional description and flowchart/sequence so it is easily understandable for operators and maintenance.

Interfaces to other systems:

The following interfaces to other systems applies

a) Fire detection system.

The local PLC must interface with the fire detection system. The signal must put the crane into safe neutral position when fire is detected.

The signal will be made available through the serial interface to the CMS.

b) Fire fighting system.

From the crane position it shall be possible to control the fire fighting sprinklers. The communication will pass through the serial interface to the CMS.

c) Traffic light and gates.

When the grab is near an unloading bay the gate must stay down. When the gate is up for unloading of a lorry, the grab must stay clear of unloading bay.

Signals for gates up/down will be made available through the serial interface to the CMS.

d) Door contacts.

Door contacts shall be hardwired by the Contractor to the crane control system and incorporated in the safety system for the cranes.

e) Emergency stops

Emergency stops for "Man in Bunker" shall be placed on central places around the waste bunker.

The emergency stops must be hardwired to the PLC panel and implemented in the crane control system. The same applies for all emergency stops described in Section 4.27 *Electrical Installations and Equipment*.

5. SERVICE CRANES

Service cranes for service of the Line shall be of same make.

5.1 General Design of Service Cranes

Crane consoles, runways and rails

Included in the Contract Object are all runways and rails mounted in place.

Crane runways and rails shall be mounted on consoles on the structure of the building. Steel consoles shall be included in the Contract Object. If these consoles are to be made in concrete the Contractor shall deliver steel cast-in parts to be casted into the concrete.

Wires and Cables

Drives, cable drums, brakes and dimensions of hoisting wire shall be designed by the Contractor. All the above-mentioned equipment shall be easily serviced and maintained. Secure access conditions and maintenance platform for the equipment is included in the Contract Object.

Access, Platforms

Included in the scope of Contract Object are all necessary galleries, stairs, and platforms for safe and convenient access for inspection, service and maintenance of the service cranes.

Overload Protection, End Stops and other Safety Equipment

The service cranes shall be equipped with overload protection. The Contractor shall decide the type of overload protection. The protection system shall stop the cranes at overload.

For all crane movements, mechanical end stops shall be installed.

Emergency Stops

The service cranes shall be equipped with the necessary emergency stops, working on the main power of the cranes.

Power Socket

One 230 V AC socket shall be installed on the service cranes for tools.

Power and Control System

The complete electrical installation is included in the Contract Object. The equipment and installations shall be compliant with the requirements of Appendix A6 *Technical Specifications for Electrical Equipment*. All relevant alarms shall be transferred to the overall CMS system.

Test Load

All necessary test loads are included in the Contract Object.

The service cranes shall be tested at 1.25 x nominal load. All expenses occurring as a result of the load tests, including necessary modifications of the crane are to be paid by the Contractor.

The Contractor is responsible for the approval of the Authorities of the cranes before commissioning.

Hooks

The load hooks of the service cranes shall be equipped with ball-thrust bearings, so they can rotate. The hooks shall be equipped with a safety lock.

Control

All service cranes shall be operated by remote controls, included in the Contract Object. Each crane shall be supplied with an extra remote control and extra batteries. All batteries are to be rechargeable.

The following functions shall be possible to perform from the control unit:

- Lifting and lowering hook, 2 speeds
- Long travel with bridge, 2 speeds
- Cross travel with trolley, 2 speeds

5.2 Turbine Hall Crane

A turbine hall crane for servicing both the steam turbine and the generator shall be supplied.

The operation area of the crane shall be the entire turbine hall.

The turbine hall crane shall be designed according to DIN 15020 or FEM 1.001. Crane classes are given in Appendix A13 *Process and Design Data*.

Travelling and hoisting speeds shall be in accordance with the service work that may occur on the turbine and/or the generator.

The turbine hall crane shall be equipped with a main hoist and smaller auxiliary hoist for smaller operations. Additional lights shall be added to the crane.

The load capacity of the turbine hall crane shall be designed by the Contractor and shall be in accordance with the supplied turbine and generator, but with a minimum capacity as stated in Appendix A13 *Process and Design Data*.

A portable wireless remote-control panel with 1 reserve battery shall be included in the Contract Object. All batteries are to be rechargeable.

5.3 Waste Bunker area

One overhead remote-controlled monorail service tackle. The tackle shall run on a monorail above the hopper deck and service the waste cranes and the grab service openings. The monorail shall be able to lift the largest and heaviest component on the waste cranes through the service shaft.

5.4 Service Cranes in Boiler/Flue Gas Treatment Hall

Any required service cranes in the boiler hall and flue gas treatment hall are to be included in the Contract Object. The crane(s) shall service the furnace/boilers and the flue gas treatment area. Service cranes shall be installed in any place in the Line where components are to be replaced during the Line's lifetime and are not acceptably accessible on regular access ways.

The service cranes shall be designed according to DIN 15020 or FEM 1.001 (1987).

6. GRAB SERVICE EQUIPMENT

There shall in the Contract Object be included the following equipment for servicing the waste grabs:

- Two (2) grab carriages for transport/moving of the grabs
- Hydraulic pump station with hoses and connections for testing the grab hydraulics

7. COMPRESSED AIR DISTRIBUTION SYSTEM

The Employers existing compressed air system from Existing facility shall be utilized for the Line.

The Contract Object shall include a complete distribution system for service air and instrument air for line K1 including necessary filters, buffer tanks, piping and connection points to serve the Line.

7.1 Air Quality and Quantity

Process air shall e.g. be used for pneumatic transport, machines, tools, pressure cleaning.

Instrument air shall e.g. be used for control and regulation purposes.

The air quality available from the existing compressed air system is stated in Appendix A13 *Process and Design Data*.

7.2 Buffer tank

The Contract Object includes buffer tanks large enough to absorb all variations in the demand for compressed air for Line.

7.3 Distribution System

The Contract Object shall include distribution systems for process and instrument air with pipes and connections overall in the new Line. The compressed air distribution systems for process and instrument air shall be ring systems.

For service air the connections points shall in general be close to the points where the air is required, so that air hoses lying on gangways etc. is avoided.

The needed connection parts of the Line shall be included in the Contract Object. In addition, the Contractor shall include 50 additional connection points for both working and instrument air to be placed in other parts of the Line. The additional connections shall be placed in agreement with the Employer.

8. CENTRAL VACUUM CLEANING DISTRIBUTION SYSTEM

A complete central vacuum cleaning distribution system including all pipes, connections and hoses shall be installed. The distribution system shall be connected to the Employers existing vacuum cleaning system. The distribution system shall cover all areas of the Line, hoppers area (all hoppers) and crane service areas, but excluding office and administrative areas. There shall be a sufficient number of connections so that it shall be possible to effectively clean all surfaces within the Line with a maximum vacuum hose length of 15 meters.

A minimum of 5 sets of vacuum hoses, each with a length of 15 meters shall be provided.

Pipes shall be suitable for the application and it shall be possible easily to clean the pipes in case of clogging.

The Contractor shall prepare a proposal as to the placing of connections, length of hoses, as well as other relevant data. The final number and location of connection points for the central vacuum cleaning system shall be agreed upon with the Employer.