Project:

Østfold Avfallssortering IKS - MRF

Title:

APPENDIX A8

CONTROL AND MONITORING SYSTEM (CMS)

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1 GENERAL

This document describes the Control & Monitoring System (CMS) delivery of the project.

It describes the scope of work and technical requirements for the whole CMS, consisting of:

- SCADA server for visualisation and operation of the plant
- Central operator stations
- Server Management Workstation
- Local operator panels
- Mobile remote operator panels (WLAN)
- Automation system (PLC)
- Local and distributed I/O modules
- Industrial Ethernet network
- Fieldbus network (Profinet / Profibus)
- CCTV camera system

This is not a stand-alone document. The content shall be seen in context of the remaining part of the contract documents. In particular, this chapter has to be considered in context with Appendix A7 “Electrical Equipment”.

Contractor has to prepare a detailed listing of the provided equipment with the designation of manufacturer, type and the main technical data for each component or component group.

Contractor shall define the responsibility roles in a RACI Matrix (#RACI = Responsibility, Accountability, Consulting, Informed) for the offered OT/IT Infrastructure. This to define the responsibility of monitoring, updating and maintaining the infrastructure after the plant is in operation.

The RACI matrix shall, as a minimum, cover the following tasks:

- Updates and maintenance of Firewall
- Logging and response of security events - Firewall
- Monitoring and response on system health - Firewall and Router
- Security updates of switch
- Logging of events and response - Switches
- Monitoring of system health – Switches

1.1 General Requirements

The control and instrumentation equipment and systems shall meet the quality, safety rules and practice according to the commonly accepted rules of technology. All materials, devices and systems in the scope of work shall be proven technology and correctly dimensioned to its operation.

Contractor shall guarantee that all equipment and devices are suitable and reliable for the intended function and ambient conditions they will be used in.

Contractor has to regard in his detailed design of the CMS the same sophisticated level as described in here.

Contractor has to deliver a complete CMS including all needed equipment and services to fulfil the requirements of a fully automated operation of the sorting plant, even if they are not specifically mentioned.

Network communications flows for all units and systems shall be documented. This includes Protocol, Source IP/Unit, Destination IP/Unit and Destination port.

1.2 Standards and official Regulations

Any relevant standards, directives and regulations, which are listed in Appendix A7, have to be applied and regarded by Contractor.

2 TOPOLOGY OF THE CONTROL AND MONITORING SYSTEM

2.1 General Information

The plant shall be equipped with a control system, consisting of a redundant server PC system in ruggedized industrial design, hosting a SCADA system and client devices like operator stations and local operator panels for main operation and a main PLC.
A superior data network system, following the Industrial Ethernet standards, connects all of the control devices.

In addition, there are some machines, which come as a so-called Package Unit (PU) with their own PLC or microcontroller system. This PUs must be fully integrated into the superior control and data acquisition system (SCADA).

The plant shall be monitored and operated from a control room. The server PCs with the SCADA system for main operation will be placed inside the MCC room.

All units with Human interaction, and interfaces accessible to operators, should be secured. This to prevent unauthorized operations and unauthorized units to communicate with the plant systems.

The superior data network system must be built in such way that the connection between future additional control systems can be realised with a data backbone in fail-safe ring structure made of fibre optic cable.

To allow an optional application of a maintenance software provided by Client, the operating hour counter of each drive from the SCADA system must be made available via an appropriate software interface.

Client will optionally establish an KPI system, so-called Data Warehouse, for evaluation and analyses of process- and production data of the plant. Contractor has to provide an OPC interface with the SCADA system as an option to transfer all relevant data to the Client's system. See also description in chapter 6.6.7.

For an optimal surveillance of the sorting plant, a CCTV camera system has to be installed. Monitoring screens and camera control facilities will be installed in the control room. A detailed description of the CCTV camera system is written down in chapter 7.

Contractor shall define the remote access requirements of the equipment and the recommended communication interface for service access to the plant.

Contractor shall define backup requirements, recommended backup- and restore routines. Define the RACI Roles (*Responsibility, Accountability, Consulting, Informed*) of all aspects of the Backup/Restore process.

2.2 Control System of the Sorting Plant

The sorting plant shall be provided with a high level of automation. The topology of the whole automation, control and monitoring system is shown in the drawing “Network Topology Control and Monitoring System”, refer attachment 1 to this document.

All process information and actions to the process must be supervised and controlled from the control room over the CMS with the SCADA servers and the operator stations. For local operation in the field, local operation panels, centrally placed among the machinery inside the plant groups have to be foreseen by Contractor.

A main PLC contains the control program of the whole plant and is responsible for the data exchange between the SCADA software, running on the SCADA server and operator stations, and the process. Redundancy of the superior main PLC has to be provided as an option.

All of the Package Units, like shredder, baler, etc. and sub-systems like the dedusting plant and the compressor unit, which comes usually with a separate controller or control system, must be linked to the main PLC as subordinated systems. The data exchange between the Package Units and the SCADA server has also to be done by the main PLC. If there is no direct interface to main PLC possible, an OPC interface directly to the SCADA server shall be chosen for a comprehensive data exchange and a maximum of control capabilities.

Contractor is responsible for the coordination of the whole data exchange with the subordinated sub-systems of the Package Units. For a maximum range of information, all internal signals like status messages, alarms, etc. have to be transmitted.

To ensure a high automation level of the plant, the Package Units have to be fully integrated into the automation process. The functionality and operability of the machine including the change of operation modes by the operator stations must be guaranteed.

Independently of a local process visualisation, which comes with a Package Unit, the machine must be integrated into the process visualisation of the whole process which runs on the SCADA server, so that status of the Package Unit will be displayed in the control room.

The PLC system has to be built up as a distributed I/O system. Remote I/O modules have to be placed in the MCC switchboard cabinets in the MCC room and in the casings of the local arranged operation panels in the process halls. Additional remote I/O modules shall be placed in local terminal boxes where needed.

For the communication between the main PLC and the remote I/O modules, Contractor has to install a fieldbus system which includes all the necessary equipment like data switches, repeater, cabling and plugs. The preferred fieldbus system will be Profinet.

All frequency converters must be equipped with a fieldbus interface and integrated into the automation system by Contractor. The full operability of the devices must be ensured. If there is a special adjustment and surveillance software available for these devices which may be useful for the common operator, this software shall be installed and run in the background of the visualisation software.

Evaluation devices of belt weighers, bunker weighing units and load cells may be equipped with a fieldbus interface. A direct connection to binary and analogue inputs of remote I/O modules of the PLC is also possible.

Local operation in case of maintenance or disturbances must be made possible by local operation panels with touchscreen display.

They must be centrally placed among the machinery in a plant group and linked to the Industrial Ethernet network. From these local operation panels, it must be possible to change the operating mode of any drive inside the group from AUTO to MANUAL and to start and stop the device.

It must also be easy to restart the whole plant or solely run capable plant groups after a shutdown (planned or caused by disturbance).

For the operator convenience mobile operation panels for industrial use are required. These mobile panels have to be provided with a touchscreen display and shall fulfil the same functionality as the local operation panels mentioned above.

For integration into the fieldbus system, all the necessary equipment to build up a WIFI communication for industrial environment shall be provided by Contractor.
To ensure a high grade of availability, mobile panels shall be delivered.

Ipads, Android or Windows tablets with protective casings, suitable for rough industrial environment, may be possible as mobile panels. All additionally needed hard- and software for integration of tablet PCs shall be part of Contractors delivery.

The superior communication network between the main PLC, the SCADA servers, the operator stations and the local operation panels has to be Industrial Ethernet / Profinet. The control system of the Package Units shall be linked to the automation system via Profinet. In single cases, other interfaces like Profibus or OPC may additionally be allowed after Client approval.

The SCADA system shall be built up as a server/client system with redundant servers as a ruggedized server PC, which has to be adapted for continuous 24/7 use in an industrial environment. A WINDOWS based server software package has to be installed and configured for the visualisation tasks (HMI) and the supervisory control and data acquisition (SCADA).

The operator stations inside the control room and also the local operation panels inside the plant are connected as clients to the server via the Industrial Ethernet automation network.

Server and the clients (as long as they are full clients and not thin clients) shall be built up as virtualized systems. The management of these virtualized machines will be done on a Server Management Workstation with an appropriate management software.

For remote maintenance via the Internet the automation network is connected to a High-Speed DSL router with an integrated firewall, which will be the only connection between the internal automation network and external networks (also the Internet). Direct connection of the SCADA server to external networks is not allowed.

An additional management software for proper management of the virtualized server and client installations of the SCADA system and backup management has to be installed.

3 REQUIREMENTS FOR PACKAGE UNITS AND WEIGHING SYSTEMS

All Package Units and weighing systems for conveyors and bunkers have to fulfil the requirements as described for proper integration to the automation system of the plant.

For data exchange with the superior PLC and SCADA system, the recommended PLC of package units has to be equipped with a fieldbus interface like Profinet or Profibus. Profinet will be preferred.

In the following are listed individual requirements for each package unit and subsystem, which have to be followed by Contractor.

Shredder

- For data exchange with the superior PLC and SCADA system, the recommended PLCs have to be equipped with a Profinet fieldbus interface like a PN/PN coupler.
- It must be possible to make pre-selection of operating modes and perform operation of the machine in automatic mode via the superior control system.
- All status signals and alarms from the machine shall be transferred to superior PLC and displayed on the visualisation.
- The shredder shall be equipped with frequency converters for regulation of the throughput capacity which has to be regulated via a control element. The throughput of the devices must be adjustable from the superior control system via fieldbus.
- Remote maintenance must be made possible via the automation network

Baler

- For data exchange with the superior PLC and SCADA system, the recommended PLCs have to be equipped with a Profinet fieldbus interface like a PN/PN coupler.
- It must be possible to make pre-selection of operating and pressing modes and perform operation of the machine in automatic mode via the superior control system.
- All status signals and alarms from the machine shall be transferred to superior PLC and displayed on the visualisation.
- Remote maintenance must be made possible via the automation network

NIR Machines

The control system of the NIR machines must be designed in such a way, that when handling different materials, the program shall automatically be changed from the superior control system. Therefor the following requirements must be fulfilled:

- Software interface like Profinet, Profibus or OPC must be provided for data exchange between the NIR machines and the superior PLC and SCADA system.
- It must be possible to show all status signals and alarms of each NIR machine in clear text on the visualisation.
- It must be possible to choose a predefined sorting mode for each NIR machine from the superior SCADA system and getting back a response signal in clear text, which sorting mode is active.
- Equipment for remote maintenance via internet has to be designated, delivered and installed.

De-dusting Plant

The de-dusting plant may be integrated in the superior PLC or equipped with an own controller. In each case the following requirements have to be fulfilled:

- It must be possible to make pre-selection of operating modes and perform operation of the plant in automatic mode via the superior control system.
- All measured values, status signals and alarms from the plant shall be transferred to superior PLC and displayed on the visualisation.
- Remote maintenance must be made possible via the automation network.

Compressor Plant

The compressor plant may be equipped with individual controllers for interaction of the compressors and the ventilation system. In any case, both controllers have to be connected to the superior PLC and SCADA system for comprehensive data exchange. The following requirements have to be fulfilled:

- It must be possible to make pre-selection of operating modes and perform operation of the plant in automatic mode via the superior control system.
- All status signals and alarms from the plant shall be transferred to superior PLC and displayed on the visualisation.
- Equipment for remote maintenance via internet has to be designated, delivered and installed.

Container Compacting Station

The container compacting station may be integrated in the superior PLC or equipped with an own controller. In each case the following requirements have to be fulfilled:

- It must be possible to make pre-selection of operating modes and perform operation of the container compacting station in automatic mode via the superior control system.

- All measured values, status signals and alarms from the s container compacting station shall be transferred to superior PLC and displayed on the visualisation.
- Remote maintenance must be made possible via the automation network.

Belt weigher and bunker management system.
See Appendix A6, for detailed information.

4 OPERATION OF THE SORTING PLANT

Where the possibilities are given, the sorting plant will be operated in different modes, where the operator has to do preselection and adjustment for operation before starting the plant. Further details will be fixed during the detail design process.

Some changes and adjustments must be made possible also during the operation of the plant. This is important for doing cleaning and maintenance (e.g., for the drum screens) during operation of the plant. This requirement has to be approved in the risk analysis of Contractor.

In all cases, it must be taken care that all of the plant equipment which are needed for proper operation will be considered for the startup, even if they are not part of the chosen plant group.

The startup has to begin always against the conveying direction. The shutdown has to follow the conveying direction, whereas the time the conveyors and machines needed to get empty must be regarded.

The time delay during the startup has to be as short as possible. The delay time between the feedback of one machine and the starting command for the next one must be adjustable in the CMS at the operator station or in the PLC by the system administrator only.
The delay times for the devices to run empty must be adjustable separately for each component and will be optimised during commissioning of the waste sorting plant.

In case of a disturbance in the plant, the conveying line will be stopped up to the point where the fault occurred. Behind this point the conveying line shall run furthermore in automatic mode. After correction of the fault, it must be possible to restart the plant or the plant group without a complete shutdown.

Each component of the sorting plant must be switchable from automatic mode to manual mode at the operator station in the control room or locally at the operation panels. In manual mode it shall be possible to start and stop a single drive. If the switchover takes place while the plant is running in automatic mode, the conveying line will be stopped up to the correlating device. Behind this point the conveying line shall run furthermore in automatic mode. After the device is switched back to automatic mode, it must be possible to restart the plant or the plant group without a complete shut-down.

In the reception hall, process hall and storage hall, an optical and acoustic start up warning for the start of automatic operation of the entire plant or the remote start of a single unit in manual mode has to be provided.

The optical and acoustic alarm devices shall be placed in the halls, so that a comprehensive audibility and visibility is achieved. The frequency of the audible alarm has to be set or selected so that a clear distinction is given, considering the normal noise of the running plant. A sound pressure of at least 115 dB / A at 1 m distance from the acoustic source is required. The alarm lights must be visible from everywhere inside the halls.

A risk analysis is mandatory and has to be made by Contractor to ensure that all operation modes and plant operation possibilities fulfil the valid safety regulations.

5 MAIN PLC

5.1 Design of the PLC System

The main PLC for the entire plant includes all programs and switching procedures to control and regulate the operating modes described. The data exchange with the individual controls of the Package Units is realized via Profinet.

Any part of the machinery and equipment have to be connected to the PLC, so that at least the current status (in use, on / off / standby / manual mode / automatic mode / malfunction, etc.) including all measured values can be displayed and recorded on the process control system.
In addition, the rotational direction of reversing drives, the conveying direction of reversible conveyors and the speed in percent in case of adjustable drives have to be displayed.

Further signals, like position of moveable devices, preselected operation modes, status signals and measurements from subsystems of Package Units, etc. have to be made available, displayed and recorded.

Actual values, limits and set points that are derived from continuous (analog) measurements are always monitored in the PLC and forwarded to the SCADA system for visualisation and archiving.
Desired values and limits shall be adjustable in the process control system by the operator in accordance to access a password level hierarchy. Changes shall be transmitted to the PLC and stored in RAM.

Adjustable speed drives in manual mode only run at preset speed which has to be entered at the central operator station.
Process-related adjustments of the conveying speed of the system are only effective in automatic mode. The ability to enter separate speed values for automatic operation and manual operation has to be provided by Contractor.

The PLC shall be placed into a separate cabinet inside the MCC room. Grounding and ground treatment shall be provided according to the specification of the PLC's manufacturer.
Approximately 25% reserve area for additional PLC equipment has to be provided inside the cabinet.

A reserve of 25% shall be considered also for the scope of I/O modules, with reserve units to be retrofitted if required. For the case of extension of the PLC, the power supply for the binary I/O modules has to be dimensioned with a reserve of approximately 25%.

The fusing of the supply voltage has to be made separately for input, output, and analog signals with miniature circuit breakers (MCB). The same applies to external measurements and analysis equipment. The specification of the PLC's manufacturer has to be noted. Tripped fuse must be indicated with LED.

Maximum rated current of the MCB's shall not be more than 6 A.

For 24 V DC control voltage circuits also electronic power surveillance devices with individually adjustable tripping current and manual or automatic reset function are possible.
Additionally, the following requirements concerning signal handling must be fulfilled:

- Analog signals are transmitted as 4-20 mA current loops.
- Coupling relays in connection with all PLC outputs shall be installed. Relays must withstand continuous charging voltage of 27,2 VDC.
- Signals to / from the PLC to the switchboards shall be terminated on separate terminal strips.
- Internal wiring between I/O modules has to be connected directly to the module terminals. For that, cables with a cross-section of 0,5 mm² shall be used.
- If the analog input modules are not internally protected against short circuit or overcurrent, all analog loops shall be connected to a terminal block with integrated 5 mm fuse clip and glass tube fuse.

5.2 Programming of the PLC System

Before the programming of the PLC, a document shall be created by Contractor, in which the overall program structure, the start-up and shut-down procedures and the control of the individual drives must be described. This document shall be approved by Client.

The software has to be built structured according to IEC standard EN 61131-3:2003, as a worldwide valid standard for PLC programming. Fail safe systems shall be programmed according to EN 61508-3 instead.

Regardless of the technological use, similar functional processes can be realized with the same part of the program structures. If some parts of the program structures used regularly (more than two times, e.g., for the evaluation of speed sensing switches, etc.) function blocks have to be used. These FB's must be programmed by the use of Instruction Language (IL).
Basically, the function block diagram representation (FBD) has to be applied. The dual use of flags is not allowed.
Technical data tasks, communication tasks, etc., are also allowed to be solved by means of function blocks. However, Contractor has to ensure a proper documentation of the function blocks, which has to include:

- parameter descriptions
- function descriptions
- revision status
- explanatory comments for each command line written in IL

6 CENTRAL OPERATOR STATION

6.1 Design of the Central SCADA Server

The redundant SCADA servers for the operator stations shall be delivered in a 19" housing for rack assembly and will be placed in a data rack in a server room or, if Client decides not to build a server room, in the MCC room adjacent to the control room of the sorting plant.

For server management a client workstation with monitor, keyboard and mouse has to be delivered. This workstation may be placed inside the control room, the server room or the MCC room. See chapter 6.3.

The servers have to be equipped with hard- and software capabilities for full redundant 24/7 operation. For the communication with the client PCs and the thin clients (local operation panels) an applicable number of terminal servers have to be installed.

The size of the main memory has to be suitable for the upcoming tasks concerning HMI, SCADA and communication to the clients. A reserve of approximately 25% has to be regarded for system performance and further tasks.

The hard disk drives shall be executed as a RAID 1 system for secure data storage (Mirroring) at least.

The following requirements have to be regarded as minimum:

- Withdrawable mounting rails
- Redundant power adaptor, Hot-Swap
- RAID 1 system with 1 TB usable memory
- Internal front mounted alternate SDD frame; Hot-Swap
- 2 x GBit-Ethernet network adapter with RJ45 ports
- 2 x front mounted USB ports, 4 x back mounted USB ports, a minimum of 4 USB 3.0 ports is required.

Software requirements of server:

- Operating system Windows Server in the latest tested and approved edition, multilanguage edition including all required client licences
- Virtualizing software for installation of the virtual server

Software requirements of virtual server:

- Operating system Windows Server in the latest tested and approved edition, multilanguage edition including all required client licences
- Additional server licenses for OPC interfaces
- OPC UA interface incl. server license for data transmission to KPI system of the Client
- HMI and SCADA software package incl. all licences for the required Power Tags
- Additional software packages for the HMI and SCADA software to build up the required client/server network (terminal server, web access software, etc.)

- Archiving software package for recording and evaluation of process data as described in the following
- Software package for remote maintenance via High-Speed DSL and Internet with a query function for authorisation categories. It must be guaranteed, that a supplier only gets access to the control systems of his own machines

Each software has to be offered including installation and set-up.

Additional equipment:

- 1 pc. Managed Industrial Ethernet / Profinet switch with connection ports for fibre optic cable in fail-safe ring structure and an amount of RJ45 ports, suitable for the automation network layout of the plant
- several. Industrial Ethernet / Profinet switches with 24 RJ45 ports as a package offer. Quantity depends on network architecture and is in the responsibility of Contractor
- 1 pc. Complete Industrial Ethernet / Profinet network incl. fibre optic cable and network cable Cat 7 for all network stations in the automation network, FO plugs and RJ45 plugs designed for industrial use, connection cables, patch cables, etc.
- 1 pc. Network colour laser printer A4 for printouts of trend graphs, process pictures, protocols and system settings.
  The printouts must be made available as paper prints and as PDF file!
- 1 pc. Central UPS device for buffering of the supply voltage during data backup and shut down of the control system and for the control voltage supply 24 VDC for PLCs. The UPS shall be installed in a suitable switchboard cabinet and placed inside the MCC room of the sorting plant.
- 1 pc. Network closet for the installation of Server PCs and PC system for CCTV, equipped with a frontside glass door, power outlet strip with overvoltage protection, ventilation and castors. The network closet will be placed inside a server room or the MCC room nearby the control room of the sorting plant.

Network Switches in the plant must have the ability to mirror traffic of one or more ports, to a local or central monitoring port. This is used in implementation of Intrusion Detection Systems that analyses the dataflow/data-traffic for anomalies and threats.

Firewall must have the ability to send system and security logs to a third part log source (syslog). Firewall rules are to be established on a zero-trust policy base, with login enabled.

The firewall, routers and switches shall be redundant.

6.2 Design of the Central Operator Stations

For surveillance and operation of the sorting plant, Contractor has to deliver a minimum of two central operator stations.

The client PCs for the operator station have to be delivered as a Small-Form-Factor Windows-PC in a housing for VESA assembly at the backside of a flatscreen monitor

and will be placed in the control room of the sorting plant. Each has to be equipped with two minimum 32-inch flatscreen monitors for multi-monitor operation.

Additional hardware requirements (minimum):

- Standard keyboard with USB connection and Scandinavian keyboard layout
- Optical USB mouse, two mouse buttons, scroll wheel
- Adapter Display Port to HDMI, where needed

Software requirements:

- Operating system Windows in the latest tested and approved edition, multilanguage edition including all required client licences
- HMI and SCADA client software package incl. all licences for the required Power Tags

Each software has to be delivered including installation and set-up.

6.3 Design of the Server Management Workstation

The server management workstation is a client PC, which serves as an operating interface for the redundant SCADA server system, as these do not have their own operating and display options.

The client PC for the server management workstation have to be delivered as a Small-Form-Factor Windows-PC in a housing for VESA assembly at the backside of a flatscreen monitor and will be placed in the control room or in the MCC room of the sorting plant. It has to be equipped with one 32-inch flatscreen monitor.

Additional hardware requirements (minimum):

- Standard keyboard with USB connection and Scandinavian keyboard layout
- Optical USB mouse, two mouse buttons, scroll wheel
- Adapter Display Port to HDMI, where needed

Software requirements:

- Operating system Windows in the latest tested and approved edition, multilanguage edition including all required client licenses
- Management software for virtualized server environment

The server management workstation has to be offered including delivery, installation and set-up.

6.4 Design of the Local Operation Panels

The local operation panels with touchscreen display shall allow local operation in the case of maintenance or disturbances. They shall be installed in a wall-mounted cubicle or switchboard cabinet with base at central places inside different plant groups, from where the operator has a good overview of the plant group. The places

have to be selected in such way, that mechanical damages can be avoided as good as possible. An openable protective window has to be installed in front of each panel.

Together with the operation panels, a remote I/O module shall be provided inside the cubicle for connecting local signals to the PLC.
Every cubicle has to be equipped with a mushroom-shaped emergency stop switch and terminal strips for power supply and external cables.
The operation panels shall be designed as HMI clients to the SCADA server in the control room. The data exchange in this case will be performed via the Industrial Ethernet / Profinet network, so that the same functionality concerning operation and visualisation is possible.

Contractor has to offer:

- 3 pcs. Industrial PC as HMI client with embedded technology; communication with the central operator station via Industrial Ethernet; with the following features in minimum:

  - 22-inch TFT widescreen display, resolution 1920 x 1080 pixel
  - Touch screen operation
  - Protection Class: Front IP 65, Back IP 20
  - Main and HD Memory suitable for proper operation

Each local operation panel has to be offered including wall-mounted cubicle or switchboard cabinet, remote I/O module, terminal strips, power supply, installation and set-up.

The positioning of the local operator panels is not fixed until now and will be decided later during detail engineering.

6.5 Design of the Mobile Operation Panels

For mobile wireless operation of the sorting plant**,** mobile operation panels have to be delivered. For communication between the mobile Panel and Profinet a WIFI network with wireless industrial LAN access points has to be erected. The access points shall be installed in the plant at suitable places. The functionality of the WIFI network must be guaranteed everywhere in the entire plant. The shielding effect of machines, steel construction and concrete walls has to be minded.
The access point devices must support the possibility to hand over the connection of a mobile device from one WIFI device to the next when the operator is walking through the plant.

The mobile panels may be Ipads, Android or Windows tablets with protective casings for the use in rough industrial environment and 10” touch screen.

All needed hard- and software for integration of tablet PCs must be part of Contractors delivery. The internet connectivity of the tablet PCs has to be switched off. The connection to the automation network of the sorting plant shall be the only network connection allowed.

The mobile panels shall show all process pictures, alarm lists, etc. like the other operator stations and shall allow individual login.

The mobile panels and the Wi-Fi network have to be offered including programming, installation and set-up.

Contractor shall deliver:

- 4 pcs. 10” tablet PCs with:
  - Protective casings for industrial environment
  - Wall plug loading device

6.6 Programming of HMI and SCADA

The following list shows the process images, which have to be created for the visualisation of the sorting plant at least. For the illustration of trend graphs and archival representation the graphical function blocks of the HMI and SCADA software have to be used.

1 Image for pre-selection, start up and shut down and pop-up window for parameter changes of the sorting plant
1 Schematic overview of the sorting plant
20 Detailed group images with pop up control panels for each drive
1 Detailed image Compressors
1 Detailed image Shredder
1 Detailed image for Baler
3 Status images for the NIR Machines
1 Overview bunkers with illustration of filling quantity
1 Overview container compacting station
ca. 10 Images for additional representations
1 Information pop-up image with the used colour key
3 Status images for all drives (spreadsheet-style)
2 Images with engine-hours indicator for all drives (spreadsheet)
1 Overview of energy consumption of the process equipment
1 Overview of all emergency stop switches (graphic)
2 Overview of automation network components with status displayed for each device like

- CPU status (RUN / STOP / FAULT)
- I/O node status (RUN / STOP / FAULT)
- Failsafe system status (RUN / STOP / TRIPPED / FAULT)

ca. 50 Trend graphics,
1 Data archive for min. 6 months with process relevant data (masses, quantities, power consumption, etc.).
1 Message archive with alarms and warnings (last 1000 actual messages)
1 Message archive with alarms and warnings (archived messages for min. 6 months)
1 Login / Logout archive
1 System archive CMS (system and network messages)

The process images shall show basically:

- Rotation direction / conveying direction / operation message
- Values of temperature, pressure and level measurements, if they are recorded continuously
- Weighing data of the belt weigher (actual weight and throughput rate in t/h)

- Position of movable or adjustable devices (graphic)
- End position for movable or adjustable devices (as colour change or icon)
- Tripping of the emergency stop circuit with indication of the activated switch
- Actual running operating program

The design of the process images has to be made in consultation with Client as a kind of process flow chart representation.
As a template for the overview screen and the group pictures, the process flow chart of the sorting plant shall be used. For the overview image of the bunkers with the representation of filling quantity a top view has to be chosen.

It must be possible to choose different process pictures at any time on each operator station connected to the visualisation network. Parallel switching of process pictures and interlocking of displays are not accepted.

6.6.1 Password Level

The start of the control system and all functions with respect to operating, monitoring, configuration parameter changes have to be implemented via a password prompt. Only when the user has been identified by a valid access code, the system will accept user inputs. The access code has to distinguish the approval for operating / viewing and programming / parameter change.

Passwords shall be personal, i.e., each employee gets his own personal password with the assignment to his level of authorization.
At least 5 levels of password protection have to be provided. After the take-over of the plant by Client, the password management (change and reallocation) through high-level employees (e.g., plant manager) has to be made possible without using the administrator level to prevent unintentionally changes in the plant control system.

An automatic logout after an adjustable time of inactivity shall be available. All operators have to log out from the system after their shift.

Allocation of administrative privileges to the levels of password protection has to be developed in a later conversation with Client.

6.6.2 Engine-Hours Indication

For each drive in the plant, which runs in the operating mode S1 (continuous operation), a continuous and a resettable engine-hours counter have to be provided on the image mentioned above. The value has to be archived in the SCADA software.

For each drive, an absolute time counter, a maintenance interval time counter (with reset function) and a maintenance interval input field have to be provided. The maintenance intervals have to be entered according to the specifications of the manufacturer of the machine. After input of the maintenance interval, the service interval time counter has to be reset.

With an adjustable time hysteresis, a warning message has to be created, to call attention to the operator that a maintenance for this machine is still to be done.

The input of maintenance intervals and reset of the maintenance interval time counter has to be protected by a password with high priority (e.g. plant manager level).

All engine hours must be additionally made available for a possible maintenance software.

6.6.3 Archives

6.6.3.1 General Message Treatment

All messages shall be stored chronologically in message archives and have to be distinguished by colour, according to the categories of operating message, warning and alarm. Each alarm and warning message has to be categorized as follows:

- must be acknowledged
- must not acknowledged, self-acknowledging

The state of a message has to be displayed with a letter symbol or icon:

C	incoming message
E	exiting message
A	acknowledged message
AS	acknowledged by the system (automatically)

These letter symbols have to be seen as suggestions. The symbols choose has to be matched with Client.

All messages have to be displayed with a local reference (tag code, machine number, measuring point number), date and time. Additionally, a descriptive clear text has to be provided for each message.

The alarm, warning and event logging systems shall be separated and ordered in accordance with user types and password levels.

6.6.3.2 Status Bar

A status bar at the top of the screens has to ensure, that the operator is informed in any operating situation at any time about new process events.
This status bar has to be placed and fixed at the top of every process image, to show the last three messages with local reference, date and time similar to the representation in the actual message archive.

This user information will be displayed immediately on the occurrence of an event. If the information is acknowledged, it disappears from the status bar. If there are several unacknowledged events, the last three messages will be displayed. If they will be acknowledged, the next oldest information will be displayed

In addition to date and time the name of the logged in user and the actually chosen operation mode shall be displayed in the status bar.

6.6.4 Graphs and Trend Displays

The course of continually measured values must be represented in a diagram in the form of curves (trends) with an arbitrary number of values by the use of different colors.

In addition to the 0-100% scale, at least one additional scale must be possible to be activated, in which the scaling is done with physical units. The activation of the additional scale has to be done online for each of the displayed values.
A so called 'reading ruler', which is moveable over the time axis, and a zoom function must be provided. The marked values must be represented in digital form with the physical units and a descriptive text below the diagram.

Daily, monthly and yearly graphs have to be made available. Additionally, the user must be given the possibility for a free choice of the displayed time interval.

The trend displays have to offer the ability to call up outsourced data from the measured value archive and to represent them as 'historical trends'.

6.6.5 Process Data Backup and Backup Management

A data management module has to support the management of information on a file organised level. The archive module of the SCADA software must be able to store all messages and data archives automatically in regular intervals to long-time archives and to write back outsourced data files to the system. This shall be made possible from the standard visualisation screen. For outsourced data in long-time archives, the operator must not have any access to the file level or operating system level of the visualisation server. All intervals must be adjustable by an operator with high password level. In case of a long-time storage facility, provided by the Client (“Data Warehouse”), the storage intervals and storage procedure have to be coordinated together with the Client.

Data, which have to be outsourced shall be written to a defined hard disk area of the SCADA servers, so that the operator has the possibility to back up archived data at regular intervals or on another server of a connected network. The hard disk area of the servers must be able to store archived data for a min. of six months.

The free disk space for the outsourcing of archived data has to be monitored automatically by the system. The percentage of used disk space has to be displayed digital (in percent) and as a coloured bar. If the percentage of used disc space exceeds over 80% the operator has to be made aware of the necessity of a data backup and outsourcing by a colour change (e.g. from green to red).

6.6.6 Process and Production Data

Process and production data like masses, quantities, power consumption, etc. must be archived in regular intervals with an archiving software tool. All intervals must be adjustable by an operator with high password level.

Daily, weekly, monthly and yearly evaluations from the data archives have to be made available with the archiving software tool. A simple function to export these data archives via network to standard office software (e.g. EXCEL, ACCESS) for further evaluation is additionally required.

For all archives a short time archive with fast access and a long-time archive for historical data have to be provided. Long-time archives may be outsourced on the hard disk of the server as described, or as a cloud-based solution. Cloud based storage and access, must be accompanied by local, physical storage.

6.6.7 Interface to Client systems

Process and production data from the plant shall be made available to Client systems such as data warehouse, resource planning etc. for the Client to perform his own evaluation and analyses independent from the SCADA system of the plant. All data available to the SCADA system, should be possible to export to Client systems.

The details of the interface will be determined at a later stage in cooperation between Client and Contractor, including which data to export, sampling intervals etc. The interface should preferably be REST API with JSON.

6.6.8 Hardcopy

In addition to the print function for system native reports of the HMI and SCADA system, any screen and process image must be printable via a hardcopy function on the designated printer.
For that, a hardcopy button must be available in the lower menu bar at the bottom of each process picture.
The printouts must be made available as paper prints and as PDF file. The user must have the possibility to choose the printing option after pressing the hardcopy button.

7 CCTV CAMERA SYSTEM

For the video surveillance of the sorting plant a closed-circuit television (CCTV) system must be delivered and erected by Contractor.

The cameras shall be IP cameras, which are connected to a PC system via an Ethernet network. The power supply for the cameras shall be via the Ethernet network (Power over Ethernet, PoE). Since the cameras will be placed in the process hall, installed nearby or inside moving/ rotating machinery, the casings have to fulfil the requirements for an industrial environment. The protection class must be IP 55 or better.

Some of the cameras shall have a motor-driven swivel base and engine zoom function, so-called PTZ cameras (pan-tilt-zoom). Moving and zooming must be controllable with a mouse or operation panel, which will be connected to the video PC system. The power supply for swivel base and motor zoom shall also be made via PoE. An external power supply for heating, etc. will be not accepted.

The cameras must fulfil the HD requirements and should be suitable for filming moving parts in environments with limited lighting.

The camera network must be built separate from the automation network and shall be used only for the CCTV system. Additional switches with PoE functionality shall be placed in local cabinets to reduce the installation of network cables. The camera system should be linearly scalable and expandable without limitation on the number of future cameras. The system should not be proprietary, and it shall give a flexibility to use different camera suppliers in future extensions of the system.

For surveillance a PC based monitoring system incl. PC and two 65-inch flat screen monitors is required and has to be placed in the control room of the sorting plant. The system shall give the possibility to connect up to four monitors via HDMI interface to the PC without the use of a splitter. The capacity of storage media (SSD or HDD) shall ensure a complete recording of the last 24 hours in minimum.

If one PC system cannot handle the amount of connected IP cameras in HD quality, a second system for parallel operating must be calculated and delivered.

The software must fulfil the following requirements:

- Easy installation and setting of the cameras
- Full screen and split screen display of each camera
- Digital zoom without the use of a zoom lens for fixed-type cameras
- Remote-controlled moving and zooming for cameras with swivel base and motor zoom lens.
- Free assignment of a describing text (e.g. TAG number) to each camera, which will be shown together with date and time on each camera picture
- Management of up to four monitors, e.g. full screen on one monitor and split screen for 2 to n cameras in HD quality on the other. It shall be possible to operate each connected flat screen monitor independently for setup of displayed camera pictures, zooming, etc. at the same time.
- Programming of camera pre-sets and slide show functionality
- Easy recording abilities

Contractor shall deliver:

- 60 pcs. fixed CCTV IP camera in HD quality with ruggedized casing, incl. lens, suitable for the use in industrial environments
- 8 pcs. Moveable PTZ CCTV IP camera in HD quality with ruggedized casing, incl. motor zoom lens and motor driven swivel base, suitable for the use in industrial environments (inside/ outside)
- Complete Ethernet network installation for the CCTV system, incl. the equipment for the power supply via Ethernet cable
- Monitoring software packages incl. PC
- 2 pcs. 65-inch flat screen monitors with wall mount brackets

The CCTV camera system has to be offered including installation, programming and set-up.

8 ATTACHMENTS

Attachment 1 - “Network Topology Control and Monitoring System”
Attachment 2 - “ØAS – Network Security Model”