A 3.8 Control & Instrumentation Systems

A 3.8.1 General

The control and monitoring equipment to be provided shall be suitable for faultless and safe control and supervision of the entire plant during all phases of operation and shall be suitable for the location in which they will be mounted.

The Contractor shall adhere to VGB standards and to the functional requirements, design criteria and system configuration contained in this document.

The process control and safeguarding system shall be highly automated regarding normal operation as well as for starting and stopping of the plant. Fully remote operation, including cold, warm and hot start-up and normal/emergency shut down from the central control room shall be possible. The operation of the GT and ST shall be fully automated. Automatic starting, synchronising, loading and shutting down of the GT and ST shall be provided by one push button concept. The only operator intervention required shall be to set the load.

The main control and automation components of the control, monitoring and operation system (DCS) will be based on contemporary technology and mainly one central system type from one system manufacturer.
As a consequence the DCS operator stations in the control room shall be part of one integrated platform and from each of them the whole plant has to be operated.

The control room design shall, at least be based on the following considerations:
- Provisions for easy and direct visual and oral communications
- Application of ergonomic principles
- Provision of sufficient areas for operations during plant start-up and testing.
- Provision of sufficient areas for lay-down and consultation of documents.
- Division of the control room into different function areas.

The DCS and all related control equipment, including possible PLC's for subsidiary installations, shall incorporate 5% installed spare I/O capacity as a minimum.

Loading of communication highways shall not exceed 60 % of total time under all conditions, including upset, and with "spares" installed.

The final configuration loadings of RAM's, etc. shall not exceed 75%.
CPU execution of the configured software application shall not exceed 50% CPU time during the course of normal process and control.

All text, abbreviations in tag descriptions and displays shall be in the local language. All process value units shall be configured and presented to the operator according to the International System of Units (SI) Standard.

For all safety loops, a safety assessment and SIL classification according to IEC61508/61511 has to be made by supplier. The classification shall fulfil European and National directives/standards. These assessments and calculations will be subjected to Employer’s approval. For the critical signals there shall be a software/hardware validation check. For GT, ST and HSRG protection at least SIL level 3 shall be a delivered.

Tag coding will be based on KKS power plant identification system (minimum 17 characters)

For power frequency control and voltage control by the real time dispatch system signals are connected to the DCS. Via the DCS operation station power and voltage

control set points can be set local for operation by operators or remote for operation by the real time dispatch system. When controlled by the dispatch system, control over the whole power range, without plant limits being exceeded and without interference of operators, shall be possible.

All information and control facilities, necessary to operate the plant shall be present in the control room. It shall not be necessary for the operator to leave the control room in order to obtain additional or more detailed information for operation.

A complete control strategy shall be presented by the vendor.

A 3.8.2 Distributed Control System (DCS)

- This Subsection covers the minimum requirements for the design and fabrication of the DCS. The Contractor shall be responsible for all hardware, software, interfaces to other systems, system testing, documentation, delivery, installation, supervision and field support and any other services as required for the procurement of the system as defined within this specification.
- The design of the DCS shall already have been proven in at least three other similar plants for more then two years. No SCADA/PLC like system is allowed.
- Only high quality systems from reputable suppliers preferably with established local back-up for maintenance and after-sales technical and spares supports shall be offered. For technical after sales support the supplier must have a service centre within a 4 hour travelling time with people who speak Dutch, English or German language.
- The system shall be capable for remote service without disturbing operation or affect safety.
- For the system offered, a guarantee shall be given that spare parts will still be available at least 15 years after commissioning of the plant.

Availability and redundancy
The plant control system shall be based on a very highly reliable and maintenance poor Distributed Control System (DCS).
Total system requirements are:
Availability: > 99.99%
Reliability: MTBF> 80,000 hours

Redundancy shall be provided to support on-line maintenance and minimize nuisance trips. The processes shall be controlled and hardware arranged in such a way that the control system continues to operate upon single component failures and does not require a complete system outage for repair or for minor upgrade activities.

The control system network has to be redundant to guarantee network availability, so operators can always observe the process. The supplier shall indicate how this can be achieved.

Process stations and controllers for the Gas turbine and Steam turbine have to be redundant and critical loops have to be equipped with redundant I/O-modules.

The control system shall be connected to a company wide existing Process Information Management system (PIM) for which every data point to/from the DCS has to be provided with status information on the reliability of the data point or process value.

For important automatic trips, a two out of three approach with self check (up to SIL 3) shall be provided, designed to permit independent maintenance on each channel.

It shall be possible to replace individual modules during plant operation.

All plant controls general shall be distributed in different control stations, so that failure of one control station shall not lead to total plant loss.

The assignment of the various displays on the VDUs shall be flexible, so that in case of failure of a VDU or operator workstation the adjacent VDU(s) can take over its function.

In case of control system power interruption the DCS shall:
- set all outputs (analogue or digital) to a, per channel individually configurable ,fail safe position, (in principal with shutdown a safe state shall be reached)
- retain the system (control) configuration or execute an automatic restart (reload) without operator's intervention while maintaining the fail safe status on all outputs. Control shall be initiated by the operator (all controllers shall be manual and all sequences, motors etc. stopped unless otherwise specified).

The system shall have all necessary fault diagnostics. Errors shall be alarmed and recorded.

Process station
The process stations shall consist of a redundant microprocessor based system.

Signal input and output processing
The process I/O shall be able to accept signals from commercially available signal sources such 4...20 mA, any kind of thermocouples, RTD and digital signals.

The system I/O shall be designed to meet the following general requirements:
- Any input shall withstand a steady signal of 10 times normal input. Overload of any channel shall not affect any other.
- The process I/O operation shall not be affected or damaged by ground faults of field equipment.
- The process I/O operation shall not be damaged by a short circuit in the field wiring.
- I/Os from redundant process equipment shall be accommodated in different modules

To compensate for possible hardware failure on testing, an 'override function' shall be available to allow 'forcing' of the measurement or outputs.

Analogue I/O
The following minimum requirements shall be considered for the analogue I/O modules:
- For the analogue inputs the system software shall check for signal integrity and if the input signal exceeds ±5% of the specified range the measurement shall be declared invalid. Analogue input modules shall also provide the power supply for the field transmitters. Live Zero shall be monitored.
- The analogue output modules shall provide 4 - 20 mA DC, capable of driving up to 600 ohms total loop resistance. DC loop power to be provided by the DCS.
- Normal thermocouple linearizations shall be accurate to 0.25 °C of the measured temperature. All type of thermocouples linearization shall be available. For thermocouple signals automatic compensation of cold junction temperature shall be provided.
- Linearity shall be within 0.2% of all inputs.
- For analogue 4-20 mA inputs, the inputs resistance shall not exceed 250 ohm.
- Analogue inputs shall contain over range protection circuits.
- 4-20 mA signals shall support the HART protocol to read instrument data and

status
- RTD/PT100 inputs shall be supported

Binary I/O
The following minimum requirements shall be considered for the binary I/O modules:
- The binary input modules shall be provided for 24 V DC. Sense voltage to field contacts and input for proximity switches shall be provided by the DCS.
- Wire break shall be detected and not cause unintended control action
- Inputs shall be individually isolated.
- The binary input modules shall be able to supervise the circuit integrity and they shall ensure that the current through the closed contacts of binary transmitters shall be at least 3 mA.
- Input modules for pulse inputs shall be available.
- Input modules for proximity switches shall be available.
- The digital output modules shall provide dry contacts rated at 2 amperes, 24 V DC.
- The system shall have the capability to provide faster scan rates for some selected digital points (Sequence of Event Recording), for these signals a scan rate of 1 milli second is required.

Communication cards and interfaces
The following minimum requirements shall be considered for communication/interface modules:
- Watchdog functions shall be available for detection of communication/interface failures.
- Capacity of interfaces must be sufficient to exchange necessary signals from all process parts to DCS and PIM.
- After interface recovery, the database must be first updated with actual values.
- Support of profibus DP, Profibus PA, Modbus and IEC61850.
- Application of a field bus system for field equipment, such as measurements, drives etcetera, redundancy aspects shall be considered and need Employers approval.

Hardware
The interposing relays shall be housed in the motor control centres of the switchgear (if no modern bus technology is applied).

Application software
The PID controllers shall contain facilities for bumples transfer, anti-reset windup, auto/manual switching, cascading, feed forward control, signal exchange with open loop controls, etc.

Sequential Group controls are to be provided for start-up, operation and shut-down of associated functional units and drive groups, i.e. it shall be possible to start or stop main aggregates (e.g. feed water pumps, cooling water pumps, etc.) with all associated equipment by issuing two commands (command and acknowledge).

To indicate the sequence progress special sequence displays shall be provided. Via these displays the sequential steps within the individual sequential programs and 'missing criteria' (error condition) shall be displayed on the VDU. Sequences including time related events shall include a time-out alarm indication.

Group controls must be capable of being switched 'on' and 'off' and must have defined commands for 'automatic' and 'manual'.

Every remote operated drive or circuit breaker shall be controlled via MCC (Motor Control Centre), by means of a software drive control module as the standard interface between the DCS and the switchgear. The control module shall issue the

order to the switchgear via coupling relays or profibus. It will be preferred if the logic required for the functions of the drive control will be integrated in a dedicated single or multi-channel hardware module.

Operation of aggregates shall aside automatically via function group level (according to VGB) also be possible remotely by hand at drive level. Alarms, locks and protections shall warn the operator and prevent the process from danger and damage.

The Contractor shall describe in his offer the hardware and software modules he intends to use for the drive control.

Some alarm annunciation are of interest to the operating personnel only if the corresponding part of the assembly or units are in the start-up, operating or shut-down condition. The alarms shall be inactive when the relevant unit or equipment is supposed to be out of operation.

The automation shall be hierarchically structured into automation levels according to VGB. By means of this hierarchical structure of the automation, the tasks of each level shall be clearly assigned. Three automation levels are foreseen:

- Blockautomation
- Functiongroups consisting of:
    - Sequences
    - Aggregates
    - Uppercontrol and controlloops
- Operating level consisting of:
    - Processcontrollers
    - Drives, motors, etc.

All automation and control software will be based on graphic configuration via the DCS-system and must be presented in graphic function plans. In these plans the actual dynamic state of signals must be presented. Via simulation it must be possible to test the configured automation and control.

The control execution rates for analogue and discrete functions shall be individually configurable. The minimum scan rate shall be 10 msec as far as this does not conflict with power plant control and protection functions.

Data highway communication

- The data highway shall be dual redundant fibre optic cable.
- UTP twisted pair cables shall be used for short distances.
- Different routing for the cable trays shall be foreseen. Failure of one of the data highways shall not reduce the availability of any of the system components or degrade system performance. Connection of additional equipment shall be possible on line without disrupting operation.
- The bus shall be capable of running 100 Mbps data rate.
- In case of loss of both data highways, the individual controllers must remain in operation.

Operator station

To reduce the noise level in the central control room, no computers with fans or hard disks shall be installed in this room. Computers are to be installed in the instrument room and should be connected to the VDU's (19") and keyboards with KVM-extenders. Thin client computers without hard disk and fan which do not produce much noise, can be installed in the central control room.

The display units or VDU's shall be of LCD type (A class). The intensity of the display shall be adjustable by the operator so that characters and symbols shall be clearly legible from a distance of 1.5 meters under high ambient lighting conditions. Viewing

angle shall be better then 175 degrees. The screen shall be of anti reflection type.

The operation via the MMI shall be mouse orientated in combination with a qwerty keyboard, by which the mouse pointer can move from one to an other screen.
The MMI shall be window based and pull down menu's shall be as much as possible avoided.

All data entry and operator commands shall be subject to two steps of operating action so as not to cause any inadvertent actions. In critical situations the switch from a general display to a display suitable for direct control must be possible directly without the need to select additional intermediate displays.

New graphic including dynamic points shall be presented on the screen within 2 seconds. The system shall be capable of processing all inputs in such a manner that all displayed data shall be updated within maximum 2 sec. for analogue inputs and within maximum 1 sec. for digital inputs. Presentation of trends from historical databases shall be within 2 till 4 seconds.

An overview display shall enable the operator to determine the overall operation of a large segment of the plant. It shall indicate the alarm status of all loops. The operator shall be able to call up directly any overview display.

The Contractor shall provide an extensive MMI concept during the detail design phase. This concept must be discussed and agreed upon with Employer.
Process displays have to be designed according to Employers standards and will be subjected to Employer's approval. All text will be presented in the local language.

The Contractor shall consider a sufficient number of graphic displays in his offer to allow a complete control of the plant. The considered number of graphic displays shall be submitted with the offer.

All activated alarms/events shall be listed in chronological order and presented in miliseconds. Alarms not yet acknowledged shall be distinguishable by flashing annunciation and depended of the priority give an acoustic alarm. The VDU shall display the message of occurrence and of disappearance. The choice of colors have to be free configurable. Employers standard is red = alarm, orange = pre alarm, yellow = disturbance, green = normal, white = general.

Every new alarm shall activate a separate acoustic alarm for 2 seconds to call the attention of the operator.

The alarm condition of each point shall be displayed on the group display by colour change and blinking.

The system shall be capable of displaying both real time and historical trends as follows:

- Real time trend. The real time trend shall be for a minimum of 8 hours at a sampling rate of 10 seconds.
- Historical trend. The historical trend shall be for a minimum period of 96 hours. Historical data shall be stored on a non-volatile memory device such as hard disk. It shall be able to be archived for recall.

The available storage shall be sufficient for all analogue and binary points for a period of one year. Varying the sampling rate or producing averages such as one minute, two minute etc. shall make it possible to store more points or for longer periods.

Sequence of events recording functions (SER)
Alarms and events from other systems like the gas turbine controller or PLC's have to

be included with the correct timestamp in the SER. For optimum identification of the cause of faults the individual alarms shall be displayed in their true sequence of appearance.

It shall be possible to activate filters for the displays, so that only selected classes of alarms/events will be presented, for example only alarms, only certain KKS range, certain time limits etc. and combinations of them.

Naming and formal conventions shall be proposed by the Contractor and agreed with the Employer during detail design phase.

Regardless of its source, configurable priority shall be able to be allocated to an alarm.

DCS shall provide a first out alarm capability.

The time resolution of the SER function shall be 1 millisecond or better, i.e. if the second event occurs 1 millisecond after the first event, then the equipment shall be capable of resolving the two events.
The offered SER shall cover all alarms and events from the complete plant including subsystems.

Aside process alarms, process events and operator commands, the system shall consist of an alarm registration and diagnostic function for disturbances in the automation and control system itself.

An effective fault analysis tool has to be provided.

System diagnostics and configuration
For system engineering, diagnosis and system maintenance two double head engineering stations shall be supplied. These engineering stations shall be accommodated in the CCR and in a separate engineering room/area adjacent to the CCR. The engineering consoles shall be equipped with two LCD VDU's (19").

The engineering consoles shall allow system configuration, graphics development, logging specification, system self documentation functions, system monitoring functions, system database load/save etc. In addition it shall be possible to tune controllers, change limit set-points, view all loop variables including measurement ranges, graphic based configuration of control systems, add and delete alarms.
It shall be possible via the engineering station aside engineering on the control level also do engineering on the operator HMI level.

It shall be possible to implement changes on-line without the necessity to initialize the system after downloading or otherwise implemented changes.

All I/O-loop diagram drawings with marshalling point numbers and KKS codes of sensors and actuators shall be made via the DCS-system and stored in the system and shall be supported by a searching system to find loop diagrams in case of disturbances. Also all measurements ranges shall be registered in the DCS-system.

One colour printer and one black/white printer shall be provided allowing for VDU hard copies, configuration and parameter printout etc.

Operation of the engineering consoles by unauthorized personnel shall be prevented by the use of key lock or code words.

OPC Servers
The Contractor shall deliver OPC server functionality for an OPC connection with data

history recovery functionality to exchange data from the local DCS to the Nuon Process Historian Data (PHD) systems. PHD systems will be delivered by Nuon.

External interface to substation
The electrical information of the substation (current, voltage and status of equipment) shall be interfaced with the DCS via a redundant fiber optic link using the IEC61850 protocol.

Clock System
A central clock system shall be provided with necessary interface for synchronizing form standard time signals e.g. DCF, GPS. The master clock in turn shall provide necessary safe synchronizing signals to the following:
- DCS
- HRSG Protection System
- GTG control and safeguarding system
- STG control and safeguarding system
- Generator/transformer/HV switchyard control systems
- Maintenance/ data management system
- Building management system
- All supplied PLC's
- Specified CCTV surveillance system
- Fire detection system
- Gas detection system
- Flue gas emission measurements system

Time indication on DCS-operator station will be automatic switched-over from summer to wintertime and visa versa. Time label of stored data will be based on wintertime.

Firewall and virus detection
The system has to be provided with proper protection from virus and illegal login. Therefore a firewall and a virus detection system are part of the delivery. These systems will not influence the performance of the DCS and operator stations.

Instrumentation Asset management system
Instrumentation and drives information via HART or profibus is to be stored in this instrumentation asset management system. The system should support FDT/DTM or EDDL.

A 3.8.3 PLC based control systems

Programmable logic control (PLC) devices may possible only be deployed in subsidiary installations, which do not affect the availability of the main process in case of malfunction, and can be offered according to the Contractor's standard. The applications of PLC's and interfaces have to be approved by the Employer. The aim is to standarize and minimize the number of PLC's and PLC-types. Maximum 3 types are allowed.

PLC's shall be configured according to IEC61131 Function block programming language.

For each type of supplied PLC controller a programming device has to be provided and must have a life cycle of minimal 15 years.

Depending on the amount of information to be exchanged with the DCS, parallel (via I/O) or serial interfacing shall be considered. Correct time stamps for the alarms and events in the DCS have to be considered.

A 3.8.4 Gas turbine control and protection systems

The gas turbine control system shall be integrated in the DCS system of the power plant and suitable for fully automatic remote start/stop/operation from the central control room with DCS-operator stations of the power plant. For detailed information and for trouble shooting of the gas turbine, an operation station and programming device of the GT control system shall be provided in the instrument or service room. The control system shall be redundant with redundant I/O.
Signal exchange with DCS should be via conventional I/O and/or via redundant serial link in such a way that also all necessary information for PIM can be exchanged.

Speed/load control system
The speed set point adjuster must be capable of adjusting the no-load speed over the minimum range of 95% - 107% of rated speed.

Start-up and shut-down control system
After the start procedure has been initiated, start-up of the gas turbine including auxiliaries is to proceed automatically (i.e. running up to full speed in readiness to be synchronized), till the pre-set electrical load, completely automatically and initiate the shaft turning device during the cooling down period period all supervised from the central control room.

Performance monitoring
Monitoring the performance parameters of gas turbine depending on the degree of soiling shall be part of the gas turbine control system. The calculations shall be performed continuously during operation by measuring and evaluating the fuel flow and the operating parameters of the engines and by comparing them with the expected, determined values of an unsoiled gas turbine which can be calculated.

Control of auxiliary systems
The control of auxiliary systems must basically be of such a nature that a fully automatic operation is guaranteed. It shall be noted, that in the event of unavailability of individual devices or equipment, the appropriate auxiliary devices or stand-by equipment, if available, must start automatically.

Overspeed protection system
The overspeed protection system must at least possess a three channel electronic system which is arranged to shut-down the gas turbine unit at overspeeds of 10%. The channels shall be automatically checked continuously to ensure they are working properly. Aside the speed measurements for the three channel electronic system one reserve speed measurement shall be installed.

Vibration detection system
The gas turbine has to be equipped with vibration detection and monitoring system. All vibration measurements shall also be connected to the DCS for trending.

Emergency stop
Local emergency stop for the gas turbine sets must be provided at the GT control panels and outside of the enclosure and shall be protected against accidental operation.

The emergency stop button must be lockable and tamper-proof to ensure that when it is operated the gas turbine set and associated equipment cannot be re-started until unlocked again and reset.

Alarm and event recording
The GT control system shall advise the operator in the CCR of any problem which may occur within the various systems. The GT alarm and event system shall provide

readout of the alarm on the local monitor with a „first-out“feature. The time of occurrence of the alarm annunciation shall be displayed.

A sequence of events recorder function shall be provided for detailed alarm recording. The alarms shall be recorded with clear text in the technological correct sequence with a resolving time of 1 millisecond.

The above alarm and trip signals shall be made available at the DCS operator station in the CCR.

A 3.8.5 Steam turbine control and protection systems

The steam turbine control system shall be integrated in the DCS system of the power plant suitable for fully automatic remote start/stop/operation from the central control room with DCS-operator stations of the power plant.

To maintain a high efficiency at part load the turbine is operated with sliding pressures. The regulation equipment supplied must successfully control rapid changes in load. Operation in the speed control mode shall also be possible for start-up of the steam-turbine until the SSS-coupling is engaged (if applicable). If so, speed control is taken over by the gas-turbine, the steam-turbine controller only controls the steam-parameters.

A turbine governor system is to be employed, providing safe operation of the turbine.

It shall fulfil at least the requirements described below:

- The turbine shall be capable of being run up from stationary to rated speed under speed control with a governing accuracy of 1% or better. The system must also be capable for switching over from speed control (start-up until engagement of the SSS-clutch) to pressure-regulation after the SSS-clutch is engaged. The reverse principle shall be applied, if the speed of the steam-turbine goes down and the SSS-clutch disengages.
- The speed overshoot caused by a full load shedding has to be less or equal to 8% referring to nominal speed.
- A facility for limiting the rate of speed variation shall be provided.
- Speed set point adjustment facility with pre-settable slope, and with limiting action on the step and rate limiter corresponding to the allowances, shall be provided.

All governor system status and fault conditions are to be signalled individually.

Step and rate limiter system
As a supplementary, feature for the turbine governing system, a step and rate limiter system shall be supplied. This shall permit rapid load following by the turbine and fast load-changing consistent with permitted levels of material stressing and taking into account the thermodynamic response of cylinder and shaft. This involves monitoring and evaluation of temperature differences at representative critical points. The critical points are to be selected by the supplier in the light on the machine design (e.g. monitoring of emergency stop valve, high-pressure cylinder and high-pressure shaft). At least two measuring points are to be monitored accordingly.

The computed allowances are to be made available to the turbine governor for limiting purposes, and fed to information displays at the DCS operator station in the central control room. In the event of a temperature or stress limit appropriate alarm signals are to be initiated.

Equipment faults must not lead to unacceptable limitations on operation.

The "Turbine protection" shall be implemented in safe and high quality technology in

such a way that the turbine is protected from overload and damage throughout the complete operating range.

The steam turbine has to be equipped with vibration detection and monitoring system.

It is also necessary to guarantee that the operating personnel will be made aware of danger by alarms before the operation of the protective mechanisms.

The protective circuits for the turbine must for high availability as much as possible be designed with fault tolerant principles using 2 from 3 selection, and self check without blocking rapid shut down in actual cases of danger.

The protective circuits must be supervised by checking the equipment initiated from the central control room and it must be possible at any time to inspect the functional correctness of the protection without causing a trip of the turbine. The protection signals must operate on all turbine emergency stop valves and, where applicable, on the bleed emergency shut-off valves.

A 3.8.6 Electrical control systems

The electrical system within the power plant shall be operated and monitored through the DCS operator station from the central control room (CCR). Operation by not-authorised personnel shall be protected by a key switch.

Start-up, shutdown and synchronizing of the emergency AC power supply system (redundant diesel) shall be possible from the central control room through the DCS. A group alarm of the unit is send to the DCS to alarm the operator in the central control room. The emergency power restoration program shall be switched in automatically by the DCS and power feed to all other essential loads will be restored.

Main transformer condition and monitoring data shall be provided via the individual sensors. Status and alarm signals shall be available at the DCS

The necessary control and monitoring signals of all transformers are to be wired to terminal strips for remote control and monitoring through the DCS.

The automatic voltage regulator (incidental switched to hand operation) is remotely controlled from the DCS; all required interface facilities shall be provided. Remote automatic control shall be included in the plant automatic start up sequence control.

The circuit breakers, contactors and load break switches of the switchgear installations shall also be remotely controlled from the central control room through the DCS. Communication can take place via conventional I/O or via bus coupling.

The Contractor shall provide for the Motor Plug-in Units the remote measurements and signals to the CCR trough DCS. Communication can take place via conventional I/O or via bus coupling. Contractor should make clear what has been offered. The kind of bus has to be approved by employer.

A 3.8.7 HRSG protection system

The following requirements are applicable:

- Complete boiler protection for the heat recovery boiler including a programming device for the system has to be provided.
- The design of the equipment shall be fully fail-safe and fault tolerant.
- The boiler protection system shall be incorporated in the DCS process station.
- All necessary signal exchange with other protection equipment shall be hardwired.

- Control and monitoring shall be realized via the operator stations of the DCS in the CCR.
- The boiler protection system shall be SIL 3 classified and so arranged that the application program of the protection system is not accessible for change.
- 2 out of 3 intrument selection with self checks has to be provided for the safetyloops.
- The safety equipment shall be certified by notified bodies for this kind of application. There shall be numerous systems of this kind in use for industrial control.
- Safety requirements will be incorporated in a logic diagram. The logic diagrams will be displayed dynamically at the operator stations in the CCR.
- A programming device shall be included in the scope of supply. The software shall provide off-line and on-line self diagnostic facility for fault detection and identification.
- In case of a major failure of the DCS a safe shut-down of the plant must be guaranteed. The fail safe control system must bring the plant into a safe operational status in this case.

A 3.8.8 Vibration monitoring system

- At large rotating or reciprocating machinery pedestal bearing and /or shaft vibrations shall be measured and monitored for protection and predictive maintenance purposes.
- Suitable indications via the DCS shall be provided in the central control room for each measurement point. Exceeding threshold values shall be suitably alarmed or the machine shall be tripped.
- Equipment foreseen for measuring and monitoring of the specified machinery parameters at steam-generators or gas turbine-generators as part of a comprehensive machinery condition monitoring system shall be of the Contractor's standard and subject to Employer's approval.
- The condition monitoring system is connected via the office LAN/WAN network to the central data recorder of the Employer.
- The amplitude of vibration of rotating plant when measured on the bearing housings under steady state conditions at the designed operating speed shall not exceed the values given in the Guarantee Schedules of the Data Sheets
- Any lateral or torsion critical speed of the total combined shaft system (including generator, steam turbine and couplings) should be at least 15% above and 10% below the normal range of operating speeds.

A 3.8.9 Fire detection system

General

The fire detection system and the DCS are separate systems. The fire detection system has to contain the correct certifications. The fire alarm system shall be designed in accordance with the relevant regulations and guidelines and has to be certified by local authorities.

Fire detectors shall be suitable for the protection to be provided and shall be reviewed and approved by the authority having jurisdiction.

- A complete, integrated fire protection system including active and passive protection shall be provided by Contractor.
- The major philosophy of protection on this complex is the early detection of hazardous conditions and immediate remedial action by shutdown, depressurizing and activation of fire-fighting measures.
- The fire detection system has to guarantee a highly reliable early-warning system in the event of fire by means of automatically activated detectors, so that orders for extinguishing the fire can be issued.
- Where required and applicable, depending on systems and the area to be

protected, spray system, sprinkler system as well as clean agent total flooding system should be provided in transformer, process control and safeguarding rooms, gas turbine enclosures etc

- The whole of the plant area to be monitored shall be divided into individual alarm sections, the latter being arranged as to enable rapid and positive identification of fires.
- All automatic fire/smoke detectors shall be of an addressable type and temperature range shall be adapted to the local situation (e.g. GT-casing).
- Push-button actuation must be provided for manually operated fire alarms in staircases, next by exits and on all escape routes and by hose reels..
- All rooms shall be equipped with the necessary fire/smoke detection (automatic and manual) in order to detect a possible fire in an early stage.
- Fire detection and alarms shall be installed in all rooms where switchgear and control equipment are installed.
- In the central control room and other rooms with suspended ceiling the necessary automatic fire detectors shall be incorporated in the luminous ceiling.
- In general each separate unit enclosure of the gas turbine or steam turbine shall be provided with an automatic fire detection
- Sirens for indoor and outdoor installation must be provided for warning the operating personnel.

Fire alarm station

The fire alarm station shall be accommodated in metal enclosed panels with type IP 31 enclosure free standing installation.

The arrangement and functioning of the fire alarm central station shall be such as to permit as a minimum the following:

- The fire alarm and fault annunciation system shall be designed with optical and audible alarms.
- An automatic fire alarm signal shall be transmitted externally to the central control room and with a direct line (DM1) to the local fire brigade via a main alarm unit.
- The individual fire alarm lines of the fire-detection equipment and facilities, as well as of the fire alarm central station shall be continuously monitored for faults and breakdowns.
- For checking out the functioning of the complete fire alarm system including the fire alarm lines and fire alarm devices, testing facilities shall be provided. When testing a circuit, initiation of fire alarm warnings in external facilities shall be prevented. After testing, the tested circuit shall automatically reset to normal operation.
- Simulation (e.g. test pins) of all relevant fault signals as listed above as well as of all fire alarms shall be possible in order to check-out the externally connected fire fighting facilities.
- The fire alarm central station shall be provided with potential-free change-over contacts wired to a central terminal board.
- Area group alarm signals for fire and gas alarm and system troubles shall be monitored and logged in the system. Signal(s) for alarm, quick unload or trip are connected to the DCS system.

Power supply for the fire alarm system shall be taken from the safe AC busbar, emergency supply shall be maintained by a rectifier/battery set (1 (one) x 100%), designed for 24 hours discharge time.

One fire alarm operator station and management system shall be provided in the CCR for the overall monitoring status and alarm display and the fire fighting system equipment of the whole Plant.

Local annunciate panels

Local annunciate mimic panels shall be installed at the main entrance of each major

building, complex or area (including gate building) providing detailed LED-annunciation of each detection, alarm and release function for all relevant floor levels of this building, complex or area.

The local annunciate mimic panels shall be made of engraved stainless steel or aluminium and be housed in a wall-mounted, red painted steel cabinet with glass front. A visible alarm device outside the entrance shall be activated if an alarm occurs.

Detectors
The fire detector system elements and the associated mountings shall be provided with sturdy, corrosion-proof plastic housings.

The fire detectors shall be provided with optical means for signalling their activation (e.g. light-emitting diode), and shall be suitable for the connection of an additional optical external alarm indication.

The fire detectors can be reset following each alarm, without outside intervention, and shall be provided with suitable means to prevent unauthorized removal or disconnection of the fire alarm central station.

Each detector shall be addressable. Activation of any detector shall be displayed individually on the fire alarm central station and on the management system.

The following detector types as a minimum shall be used for fulfilling the requirements for the power plant as a whole:
- Optical smoke detector for early identification of visible smoke generation, consisting of photoelectric unit, alarm electronics, optical alarm indication, detector socket.
- Flame detector for early identification of fire outbreaks and open flames, consisting of optical unit, alarm electronics, optical alarm indication, detector socket, variable response sensitivity.
- Thermo-differential and thermo-maximum detector for early identification of fires as they break out with rapid temperature rise and little smoke generation, consisting of temperature sensor, alarm electronics, detector socket.
- Manually operated push buttons consisting of push-button, only operable after smashing the replaceable glass window fitted in the housing, painted red, interlocking mechanism, to be reset by key.

Air sampling system
At locations which are not accessible for regular testing of the detectors (e.g. transformer rooms or cable channels) an approved air sampling system shall be installed for fire detection.

Sirens
The protection degree of the sirens for indoor and outdoor installation must be at least IP 54. The outdoor sirens are to be arranged on the boiler house, turbine house, transformer area etc. The arrangement of the indoor sirens must meet the requirements at site for satisfactory warning of the operating personnel, e.g. mounting in the turbine hall, pipe ducts etc. The control of the sirens shall be performed automatically by the fire alarm system, but manual operation from the central control room must also be possible.

Alarm signal lamps
In areas with high background noise, the sirens shall be complemented by alarm signal lamps.

System isolation
It shall be possible to lock off the fire protection system to allow safe access to any of

the compartments for maintenance or other purposes.

A 3.8.10 Gas detection system

The gas detection system and the DCS are separate systems. Signals for alarm, quick unload and trip are connected to the DCS system. The gas detection system has to contain the correct certifications.

Gas detectors shall be suitable for the protection to be provided and shall be reviewed and approved by the authority having jurisdiction.

Gas detection system shall be designed to detect measure and monitor concentrations of combustible gases as follows: Concentrate of combustible gas, measured and displayed in the range of 0 to 100% Lower Explosive Limit (LEL). The sensor system shall provide for 4 - 20 mA output.

For GT as well as for all other areas in the plant where flammable gases could emerge a gas detection system shall be provided.

The operation of a combustible gas detector shall initiate local audible and visual warnings and similar warnings at the central control room.

A 3.8.11 Training Simulator

To train the operator a full training simulator has to be offered as an option. The training system runs on standard Personal Computers (PC), it simulates the process values and emulates the user interface to the operator. The same user interface as in the real life DCS is obtained. The trainer should be able to simulate a specific process situation for the trainee and is able to introduce specific errors, process upset, etc. It shall be possible to import and replay actual disturbances.

A 3.8.12 Central control room

The control room shall mainly contain the following components:

- two DCS operator stations*) for two operators, each equipped with three VDUs, workstation, function keyboard and mouse
- one DCS operator station equipped with two VDUs, workstation, keyboard and mouse for service and engineering on operator or service desk
- PC for Data Management (including office software, linked to the office network) with VDU, Keyboard and mouse
- Two large Displays
- one laser colour and one black/white laser network printer A4 format
- panels for gas and fire detection and alarm, for CCTV, for communication systems, etc.
- Side boards with sliding doors
- Chart drawer for storing forms and drawings
- Work permit desk.
- white boards 2000 L x 1200 H
- One multi-layers sliding board for P&I diagrams, drawings.
- Filing cabinets for documentation
- writing desk with drawers
- chairs

*) The indicated operator stations are triple heads but also 3 single heads in master/slave configuration can be applied.

The following requirements are applicable:

- The DCS operator station platform with clients, switches and servers shall be connected to a redundant safe power supply or UPS.
- A minimum number of emergency stop push buttons for GT, ST, etc. shall be provided on the control desk to allow the unit to be shut-down safely in the event of major failure.
- Adjacent to the CCR, in a separate Engineering Room, an engineering station for program generation and modification, system diagnosis and documentation shall be installed.
- For the plant overview display and normal operating displays modular large screen rear projection systems shall be provided, in front of the Control Desk.
- The projection system for the large screen shall preferably based on DLP (Digital Light Processing), TFT LCD (Thin Film Transistor-Liquid Crystal Display) or similar technology. The minimum size of each display shall be 67” diagonal approximately. They shall be placed seamless to each other to display one overall process display over both screens without gap.
- For the arrangement of VDU’s and control equipment in the control desk, the Contractor shall provide an ergonomic design of modern furniture matching the control room design.
- The control room and furniture design must be discussed and agreed upon with the Employer.
- The large screens shall be aesthetically integrated in a panel and into the CCR environment in a manner that maximizes operator ergonomics. The system shall be capable of displaying any graphic screen available in the DCS and special graphic displays created for the large screen projection system, especially designed for optimum plant overview. And coupled to DCS operator stations with same functionality as the other DCS operator stations.
- No deformation of symbols and processdisplays is allowed.
- It shall be possible to use the system as one screen or as multi-screen system. Colour adjustment to minimize the colour difference between the modules shall be automatic.

A 3.8.13 Field instrumentation

General

- A consistent instrumentation philosophy shall apply throughout the plant and shall be implemented in terms of a range of equipment exhibiting a minimum diversity of make and type. The objective shall be to standardize all instrumentation equipment throughout the plant for easier operation, maintenance and reduction of spares inventory.
- Any equipment to be installed within potentially explosives atmospheres shall comply with the EU-Directive 94/9/EC (ATEX 100a).). Note: In principle the installation shall be provable designed and realized zone free (e.g. gas control valve is gastight casing)
- The instrumentation equipment shall have a high grade of immunity with regard to electro-magnetic and radio frequency interference and shall not be affected by portable radiotelephonic transmitters, cellular phones, radio devices etc. operated in the vicinity of the equipment.
- Generally, transmitters in 2-wire technology of the "SMART"-type with an output current of 4 - 20 mA shall be provided.
- The accuracy considering also other effects such as linearity, hysteresis and repeatability shall be ± 0.5 % of span or better.
- All transmitters shall be fitted with a LCD-indicator displaying user defined pressure, flow, level or volume units.
- Three portable programmers for programming and calibration of SMART transmitters have to be provided.
- Position sensors at valves, dampers etc. shall be of the proximity type.
- Direct mounting of the any kind of instrumentation on the process equipment is not allowed. All these equipment has to be grouped on local instrument racks or

control boards, protected from vibration, jarring and sprayed water.
- Each measurement of 2oo3 measurements for (differential) pressure has its own primary isolating valve arranged directly at the tapping point. When used for boiler protection a mechanical interlock between the isolating valves shall be installed.
- Instruments and block valves on process and instrument-air pipes shall be provided with nameplates according to KKS.
- The design of the name plates is subject of approval by the Employer.
- All instruments shall be accessible from platforms or floors without the need to use ladders or similar temporary provisions.
- Measuring devices shall be in accordance with the latest developments in technology corresponding with low maintenance costs and efforts.
- Due to calibration of the instruments, the transmitter plug has to be of robust design with a metal lock mechanism.
- Cables connected to control valves and actuators shall be of flexible type and connected via electrical plugs (to simplify maintenance and qualification involved people).
- Control valves and actuators shall be supported with appropriate construction materials to relieve the pipe from additional strain.
- Signals used for the safe-guarding system will have separate measuring points and transmitters.

Local instrumentation shall be provided including at least the following:
- Pumps:
  - Suction and discharge pressure gauges
  - Gland sealing pressure gauge (if applicable)
- Strainers and Filters:
  - Differential pressure gauges
- Heat exchangers
  - Temperature upstream and downstream.
- Lubrication and Cooling systems
  - Pressure gauges indicating pressure at appropriate locations
- Tanks and Vessels
  - Level indicators

Local instruments have to be positioned in such a way it is easily readable and maintained.

Temperature measurements
The following requirements are applicable:
- Local temperature gauges shall confirm to protection class IP 65.
- Local temperature gauges if necessary the measuring probe shall be provided with capillary tube of sufficient length, to enable reading the indication from a normal working position.
- For remote measurements and if not specified otherwise, type K thermocouples in accordance with IEC 584, class 1. Application range shall be employed from 300°C up to maximum temperature of 1200°C. For higher temperatures thermocouples type R may be used.
- Resistance thermometers (RTDs), type Pt 100 according IEC 751 class A shall be employed. All RTDs shall be shock proof type and wired according to the three-conductor principle. Accuracy of RTD's for measuring cooling water inlet and outlet temperature shall be +/- 0,1 degrees Celcius according to regulations of local authorities. A calibration certificate shall be part of the delivery.
- Radiation pyrometers may be considered for use on applications where:
  - Temperatures are above the practical operating range of thermocouples.
  - The environment will contaminate or seriously limit the life time of thermocouples.
  - An average temperature of a large area is required.
- Radiation pyrometers shall respond to 98% of target temperature change within

two seconds.

Pressure measurements

- Local pressure gauges shall be of class 1.0, shall be shock resistant and have a diameter of 100mm.
- Local pressure gauges in steam shall be provided with siphon.
- Tapping points shall be equipped with one primary isolating valve arranged directly at the tapping point.
- When steam pressure measurements are involved, the impulse line between tapping point and transmitter shall be arranged in such a way as to form a siphon loop.
- Each transmitter shall be mounted on a stop valve. Test connections with separate isolating valve are required for all vital process measurements.
- It shall be possible to shut off the test connection without isolating the service pressure gauge at the same time.

Flow measurements

The following requirements are applicable for remote measurements:

- Primary elements such as orifice plates or flow nozzles located in steam or high pressure feed water pipes shall be of the weld-in type.
- Tapping points shall be equipped with one primary isolating valve. For high pressure installations two isolating valves with bleed shall be installed. In the case of steam measurements condensation pots (steam traps) shall be provided between the tapping point and the isolating valve.
- Tagging on primary elements shall contain the basic design information (i.e. flow rate, pressure and temperature of the passing fluid, the orifice diameter and the pressure differential generated). The flow direction shall be consistently marked on the orifice or nozzle by means of an arrow.
- In case orifices are used, they shall be in accordance with DIN 1952, latest edition.
- Inductive flow measurements shall only be used for fluids with conductivity of more than 20 uS/cm.
- Turbine measurements shall be used only in clear media in applications without risk of unacceptable pressure fluctuations during operation and maintenance periods.
- Natural gas flow measurement shall be by means of orifice for control puposes. For gas consumption measurement a turbine measurement shall be installed with pressure and temperature measurement for volume correction connected to an electronic device for volume conversion to standard conditions (normal m2/h). The accuracy shall be 0,5% of total scale. A calibration certificate shall be part of the delivery.
- Rota meter flow measurements shall only be used for local indication purposes.

Level measurements

Local gauge glasses of mica type or flat glass reflex type shall be provided. They shall be designed so that the level column will be indicated over the entire level range. Vents and drains as well as integral illumination facilities shall be foreseen.

The following requirements are applicable for remote measurements:

- In atmospheric and high pressure tanks the level measurements shall be based on dP for liquids with constant specific gravity. For measurements where a reference leg of process fluid is used, the design of the system shall ensure that the reference leg is fully maintained at its prescribed height during all conditions of process level change and changes in process conditions and the density of the reference leg does not vary from that of the process fluid due to temperature changes or other reasons.
- The measuring error shall be < 1% of full scale.
- For all measurement with differential pressure transmitters isolating valves at the

tapping point, 3-valve manifolds and separate blow-off valves at the transmitter side shall be provided and if necessary a condensate pots shall be installed.
- Measuring stand pipes (DN80) shall be provided on all open or pressurized vessels and tanks. The stand pipes shall be fitted with isolation valves according to the pressure requirements.
- 2 out of 3 measurements shall have separate stop valves.

Control valves
- Control valve spindles and internals shall be made of chromium steel with high resistance to wear and corrosion. Cones and seats shall be hard faced with materials with a high resistance to wear and corrosion. Housings shall be made of forged or cast steel. A hand wheel, with provision for switching to manual operation and a local position indicator shall also be provided.
- Valves shall not generate noise in excess of 80 dBA, measured at a point 1 meter downstream of the valve outlet and 1 meter from the edge of the valve. Where this requirement must be exceeded because of physical limitation, suitable sound attenuators shall be provided in terms of special valve trim, in-line attenuators, isolators and enclosures to satisfy the noise requirement.
- Valves shall have trim designed to avoid cavitation damage. If an application cannot avoid cavitation entirely, material selection shall be such as to withstand the effects without damage.
- Line strainers shall be provided upstream of control valves where required.
- Leakage through a closed control valve shall not exceed 1%.
- The installation shall include upstream and downstream isolating valves and, for critical control valves, a bypass valve for each control valve on all services.
- The control valves must be provided with all data important for their identification, such as TAG no., type, nominal diameter, nominal pressure, seating, CV value. Flow direction to be indicated ad the valve body.

Actuators
- Unless otherwise specified actuators for open/close or modulating services shall either be electrically or pneumatic operated. Self contained sealed hydraulic units may be considered where high thrusts or high speeds of operation are required but each application shall be approved by the Employer.
- The various types and sizes of actuators shall be rationalized and as far as possible each type shall be from a common manufacturer to facilitate interchange ability and spares.
- For all electric driven actuators of valves and dampers 4 freely adjustable position limit switches and 2 torque switches shall be provided. If the valve or damper needs to operate in intermediate positions, a position transmitter with 4-20 mA (including HART) output shall also be foreseen. Actuators with integrated control devices will be preferred. A field bus (e.g. profibus) connection can also be applied.
- All actuators except pneumatically operated ones shall be provided with a local indicating pointer and with a hand wheel for direct manual operation.
- Pneumatically operated actuators shall - depending on the process needs - be designed in such a way that in the event of air failure the actuator will remain in the position immediately prior to loss of power (FB), or shall assume a position which is safe for the process (FO or FC).
- An air set with pressure regulator, filter, gauge and auto drainage shall be provided with the actuator.

Electrical measurements
For the processing of electrical values such as voltage, current, power, frequency etc. transmitters shall be provided. The transmitters shall be housed in the switchgear.

A 3.8.14 Exhaust gas Monitoring Stations

- The continuous, quantitative analysis of flue gas for the purpose of emission

monitoring shall be performed by appropriate analyzers of proven type, acknowledged by the local authorities.
- Exhaust gas emission monitoring stations shall be installed at the HRSG stack and the auxiliary boiler stack (if required).
- Measuring modules for NO_X, CO, dust, O_2, as well as sample temperature and pressure shall be provided for each monitoring station, capable of future system extension (addition of sensor modules).
- Oxygen-analyzers required for combustion control shall be of the in-situ type with zirconia-probe. The response time shall suit the requirement for closed-loop controls. The accuracy of the device shall be better than 1.0% of the span and the drift shall be not more than 0.1% O_2 per week.
- Programmable auto-calibration devices for zero and span shall be foreseen. Zero and span gas bottles shall be provided.
- In order to keep the sampling line to acceptable limits the analyzers shall be located close to their sampling point. Easy access shall be ensured by provision a sampling platform. The flue gas sampling lines shall be heated to prevent condensation and shall not form a siphon in the case where condensate may be collected during heater failure. Condensate drainage facilities shall be provided at the analyzer side.

A 3.8.15 Analysis of steam and water

- The analyzers shall be arranged in such a way that excessively long probe sampling lines will be avoided. Where possible they shall be arranged in groups at a common analyzer rack.
- If required by the medium to be analyzed, all samples shall be adequately cooled and pressure reducing devices shall be provided where necessary.
- Each automatic analysis sampling point shall be provided with a manual sampling point to permit a sample to be easily taken.
- In order to eliminate the influence of ammonia at conductivity analyzers, cation-filters shall be provided. The cation-filters shall have visible colour indicators to show when they have to be regenerated.
- For all analyzers temperature compensation shall be provided, with the temperature sensor being an integral part of the probe.
- Chlorine residual monitors and hypochlorite concentration meters shall preferably be able to measure concentrations over a wide range. The analysis of hypochlorite concentration shall not be affected by the presence of other oxidizing components in the sample.

A 3.8.16 DTS measurement

To be able to confidently use the 380KV cable under all circumstances up to their design transmission capacity, temperature monitoring systems, a DTS Distributed Temperature Sensing system is installed. A connection to the DCS has to be provided.

A 3.8.17 Cubicles, panels, erection, cabling, wiring

Power supply and fusing
- The supply voltages for the control cubicles shall be 24 V DC and must be arranged as separately fused double infeeds.
- Electrical actuator drives shall be fed by 230 V AC. Actuator drives necessary for the safe operation and shut-down of the plant shall be connected to the UPS.
- Trip of a main fuse shall be indicated in the CCR by means of an alarm.

Cubicles, panels, control desks
- Cubicles, panels, control desks shall be designed in such a way that vibrations of the building will be absorbed to a large extent.

- Cubicles shall be adequately ventilated in order to keep the equipment within the specified limits, even in the case of high ambient temperatures in case of failure of the air-conditioning system. The cubicles shall also be suitable for being equipped with temperature sensors and smoke detection devices.
- All outdoor installed cubicles shall be provided with thermostatically controlled heating elements in order to prevent the formation of condensate which may occur due to large variations of ambient conditions.
- Cable connections to cubicles, panels and desks shall be made via suitable seals so as to prevent the ingress of dust, vermin or the propagation of a possible fire. During installation, a provisional sealing of cable penetrations shall be ensured.
- At least 15% free space shall be available in all cubicles after final commissioning. This free space shall be distributed inside the cubicles in such a way that additional terminals, equipment or modules may be added to any group of controls. At least 15% spare cores shall be provided in each multicore cable. All spare cores have to be terminated.
- Appropriate protection against lightning and overvoltage for cables outside the building has to be provided.

Racks and junction boxes

- Open type marshalling racks constructed of angle steel may be used for the marshalling and termination of low voltage control cables within the Instrument Room. Cubicle type marshalling racks may also be considered.
- For voltages exceeding 60 V, a suitably separated section with isolation cover shall be provided.
- Wherever possible, local instruments and devices, e.g. transmitters, converters, terminal boxes, etc. shall be mounted on instrument racks.
- Junction boxes shall be installed; they shall be of high impact resistant glass reinforced polyester material.
- Junction boxes shall be installed in such a way that they are permanently accessible.
- After commissioning, the marshalling racks, instrument racks, etc. must contain at least 15% of spare space. Junction boxes shall have at least 15% spare capacity of fitted terminals.

Erection cabling and wiring

- Erection, cabling and wiring of all control and monitoring equipment shall comply with the requirements stated under Exhibit A3.7 Electrical systems and work.
- Field mounted apparatus shall be mounted in such a way that under operating conditions excessive vibrations will be avoided. Instruments mounted in racks or cubicles shall be isolated against vibrations by dampers, if appropriate.
- Instrument impulse piping from the tapping point to the transmitters shall be as short as possible and fixed in distances of not more than 2 m. Joints in impulse lines shall be avoided and otherwise be welded. Piping material with minimum size of 12x1.5 mm shall be based on 316 S.S. However, all impulse pipes for live steam measurements shall be of 13 Cr Mo 44 materials.
- Capillary tubing and instrument air tubing from the air sets to the pneumatic apparatus shall be fixed and supported in a suitable manner.
- Sufficient clearance shall be provided for removal of the instrument or for adjustments.
- Labelling of all instruments, tapping points, cabling, cubicles, racks, junction boxes etc. shall be in accordance with the KKS power plant identification system.
- The nameplates shall be fixed to the mounting plate, the mounting brackets or junction box. The design of the nameplates is subject of approval by the Employer.
- For the supplied field cabling all necessary cable routes, supporting tray work and intermediate marshalling shall be provided. All multi core cables shall be routed to/from the DCS via centralized marshalling racks, located in the Instrument room. For the cable connections at the marshalling racks Maxi Termi Point technique

shall be applied.
- For connections outside the marshalling cabinet, preference will be given to screw or clip-type terminals (for the field equipment side of the connection), over all other termination methods. In case of special C&I equipment, plug type or Maxi-Termi-Point connectors may be used.
- The general requirements concerning cabling and cable trays as stated in Section A3.7 Electrical systems and work are to be obeyed.
- In particular, wiring within cubicles and panels shall be suitably supported and shall be segregated according to voltage level. Wiring carrying AC and DC voltage shall also be segregated.
- Cabling and wiring of intrinsically safe circuits (type of protection EEx i) shall be done as stipulated by the corresponding “ATEX”- regulations.
- Spare cores shall be connected at terminal strips.
- After commissioning 15% of the conductors of multi-core cables shall be available.
- Ethernet cabling shall be of Category 6 (CAT 6).
- Systems as DCS, fire alarm system, CCTV-system, etcetera shall make use of the fibre optic cables.

A 3.8.18 Communication systems

General
This part of the Specifications deals with the communication systems for:
- Telephone system with integrated voice over IP functionalities
- Portable Radio System
- Access Security System
- Closed Circuit Television (CCTV)
- Public Address System
- Office LAN/WAN System

The respective system equipment offered shall already be working successfully in power utilities and similar authorities.

The respective equipment shall include provision for expansion of at least 20 % such that the expansion is accomplished by the addition of plug-in modules and cables.

The availability of the respective system equipment shall be 99.95 % or better (including planned down time).

All equipment supplied shall have a minimum expected economic life of 15 years from the date of final acceptance by the Employer if not specified otherwise.

Telephone System
In the building 40 telephones shall be placed at places approved by the Employer. Two of them are DECT telephones for the control room. One phone in the control room shall be suitable for conference calling. One phone in the service room shall be equipped with a loudspeaker.

All telephones shall be connected to a central telephone marshalling rack (with jumpers).

All telephones and associated equipment installed in the process area or in outdoor locations shall have IP 65 weather protection. All telephones and associated equipment installed in hazardous areas shall be certified explosion proof type.

Portable Radio
On the operator desk in the control room a radio base station for portable radios must be placed and approved by the local authorities for release of broadcasting permit.

Portable UHF transceivers with two operating channels and rechargeable batteries with charger units shall be provided. The portable radios must consist of an operator tumble detection function.

The transceivers shall be able to communicate effectively at every parts of the plant including, turbine house, switchgear rooms, offices, water treatment plant, open areas, etc. Repeater station shall be installed when appropriate to achieve total communication within the plant. The minimum squelch sensitivity shall be 10 dB SINAD.

The portable transceivers shall be rugged enough for rough handling and outdoor usage. They shall be weather-sealed against dust and moisture and water to IP 54 standard.

All accessories such as sling, protective casing, carrying attachment etc., shall be provided.

Access Security System
An Access Security System in the plant shall be supplied.

The locations of items are listed as basic requirements needed but not limited to the following:

- At all outside doors of the power plant an automatic access security unit (card reader unit) approved by the Employer shall be installed and connected via an access controller
- If more then one person is entering the door using a single ID Card, it shall be tracked and it shall be visually monitored using a CCTV camera at the entrance

The Access Security System equipment shall be capable of being zoned by area, time and access provided to multiple zones. All failures/faults shall be centrally annunciated. No single component, module or function shall lead to total failure of the Access Security System and the affect of such a failure shall be limited to a maximum of one surveillance site.

The Access Security System shall be modular designed to achieve the maximum flexibility in configuring the system. The Access Security System shall be fully expandable and compatible with all HID proximity readers and ID Cards.

Locations of card readers, control and data gathering panels, push buttons and alarm points etc. have to be determined in accordance with the final access and operation philosophy.

The access control system shall be interfaced with the CCTV system.

Closed Circuit Television (CCTV)
The CCTV shall be fully automatic and shall provide for comprehensive survey of specified locations. The CCTV shall, as a minimum, provide for process area's, access control and CCTV surveillance of specified areas.

The CCTV system shall have facilities of remote control, motion detection, multi-user viewing, real time viewing, pan, tilt, zoom, focus and other latest technology functions. For outdoor cameras humidity precautions shall be provided. Special protections to meet the location conditions shall be provided wherever necessary.

It shall have build in time synchronization facility based on a GPS Clock System.

As a minimum, the following areas of buildings shall be covered by CCTV:

- local control room
- outside doors

As a minimum, following process areas shall be covered:
- The GT burner and GT&ST hydraulic oil system

The CCTV shall mainly consist of a mix of fixed and remotely controlled cameras/ positioning devices located in the specific areas, optimized number of video alarm and control monitors, control system for remote control, video recording equipment, video switching matrices, transmission equipment and interfaces to the Access Security Systems and the Fire Alarm Systems.

The various surveillance sites shall typically use fibre optic based equipment to transmit video and telemetry signals from field to the instrumentation room.

Time division multiplexers (TDM) shall be used to combine the electrical video signals and shall facilitate simultaneous recording on a digital video recorder (DVR) in MPEG4 format and display on a multi-screen display monitor of all allocated camera signals without loss of any video information.
The CCTV's main operator station which shall include a VDU based workstation and an optimized number of LCD monitors shall be located in the control room.

All cameras shall be provided with protective housings. Outdoor cameras shall be provided with sunshades and weatherproof housings per IP65. Indoor cameras shall be as per IP54. Outdoor housings shall be provided with heater and thermostat to prevent the glass window at the front from misting at low temperatures and washers/wipers for cleaning the glass windows.

Camera's shall be equipped with state of art technology for the intended application.

Public Address System
There shall be an evacuate alarm be installed as part of the fire alarm and approved by local authorities and shall be in line with NEN2575.

It must be possible to switch on the following different tone and frequency signals with the appropriate alarm buttons:
- fire alarm
- major, large-scale breakdown
- gas alarm
- all-clear signal (for resetting of alarm)

Office LAN/ WAN system
The LAN/ WAN cabling provide interconnection between telecommunication cabinets, equipment rooms, offices, administration building and all other facilities.

Design Requirements on cabling:
- Main and intermediate cross-connect jumper or patch cord lengths should not exceed 20 meters.
- Avoid installing in areas where sources of high levels of EMI/RFI may exist
- Grounding should meet the requirements as defined in ANSI/TIA/EIA-607
- ANSI/TIA/EIA-568-B1, 2, 3 to be met.

The physical requirements of the network interface are defined in the ANSI/TIA/EIA-569-A standard.
- The laying of star shaped cabling system shall be combined with the cables of the telephone system with combined telephone/ data outlets in the offices. The cabling shall ensure protection against electromagnetic disturbances, which can occur in the Plant.

- For each office / meeting room etc. at least 2 outlets and further outlets one for each 10 m^2 shall be provided (2 outlets for 10 m^2, 3 outlets for 20 m^2, etc.).
- For each workshop, storage etc. (size until 25 m^2) at least 2 outlets and further outlets one for each 25 m^2 shall be provided (2 outlets for 25 m^2, 3 outlets for 50 m^2, etc.).
- The network system shall be according to the Category 6 (CAT 6) or better of the Standard ISI/ IEC with RJ 45 Western type connectors.

The design aspects of the equipment room are specified in the ANSI/TIA/EIA-569-A standard.

- The star shape cabling shall go to common marshalling places containing among others the following equipment:
- Marshalling racks for star shaped telephone system and data network with the connected star shaped cables
- Marshalling racks for multicore telephone cables, included in the scope of the Telephone system

In the control room (operator desk, flex desk, permit desk, printer desk, etc. at least 7x2 data network outlets), in DCS service room (at least 2x2 data network outlets), in open office for engineers/analist/administration (at least 10x2 data network outlets) and in other rooms where people have meetings (at least 2x2 data network outlets per room) data network outlets shall be installed.

The above mentioned data network outlets shall be connected via CAT 6 cable to a patch panel in the data network cabinet in the instrument room. In this data cabinet also the office network switch(es) and fibre optic patch panels for external connection must be installed.

The power supply of the system will be feed in from the external 230 V UPS of the station.

All Design drawings and Diagrams for the LAN/ WAN have to be submitted for approval prior to any implementation.

Minimum 24 Core fiber optic cables shall be used for any route (Out Door/In Door) in the proposed design.