



حديد الإمارات
emirates steel
إحدى شركات صناعات SENAAT company

Integrated Management System

Engineering Standards

Automation Engineering Standards

PRD-AU-GS-001

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1. PURPOSE

The purpose of the ES Engineering Standards is to provide information and guidelines for the design, erection, installation and commissioning of plant and equipment across ES Sites.

2. SCOPE

The standards referenced in this document are issued to all contractors and form an integral part of the contract documentation.

Compliance is mandatory by all Contractors, ES Departments and personnel, whilst designing, erecting, installing and commissioning plant and equipment within ES sites, and any deviations require the explicit written approval of ES.

3. DEFINITIONS / ABBREVIATIONS

ES : Emirates Steel

MOC : Management of Change

4. RESPONSIBILITIES

VP of Marketing & Strategy - Is responsible for approving the Standards, and delegating members of his department to review them on a periodical basis, and / or write new standards when deemed necessary.

Projects Construction Manager - Is responsible for ensuring that all projects undertaken within ES comply with these standards.

Engineering Manager Projects - Is responsible for revising the Standards as requested by the projects and operations departments.

5. DESCRIPTION

5.1 GENERAL REQUIREMENTS

This section covers the basic requirements for engineering and implementation of process automation systems.

5.1.1 OBJECTIVES

The objectives of a process automation system are:

- Control, optimize, automate and supervise production process.
- Provide production information to operators and plant engineers.
- Production planning and control, material tracking and data collection.
- Generate reports
- Supply information to Management Information System.

5.1.2 SYSTEM ARCHITECTURE

- The process automation system shall be a powerful, fully integrated, modular, flexible, expandable, fault tolerant, distributed process control system. The system shall be hierarchical and comprised of the following levels:
- Level 0: Field Equipment -Individual Devices (Sensors, Transducers, Actuators, Push buttons. etc.) Level 1: Basic Automation System (PLC), including intelligent controllers. Level 2: Process Optimization and Supervision. Level 3: Production Planning, Material Tracking and Reporting.
- Level 4: Management Information System.
- Different automation levels shall be connected with fault tolerant networks to ensure high availability of the overall process automation system.

5.2 LEVELS

5.2.1 LEVEL 0 - FIELD EQUIPMENT

Level 0 shall comprise individual field devices (proximity switches, pressure switches, limit switches, temperature switches, transducers and transmitters, push buttons, etc.), actuators (e.g. solenoid valves) and motor drives (variable and fixed speed drives).

5.2.2 LEVEL 1 - BASIC AUTOMATION SYSTEM

- The control, regulation, interlocking and sequence control of process equipment shall be performed by the basic automation system, consisting of programmable controllers (PLCs) or like equipment specifically designed for real time industrial control, and intelligent converter /inverter drives.
- Data communication between Level 0 devices and Level 1 shall be either by discrete digital or analogue signals to input/output (I/O) channels, or by a standard field bus such as Industrial Ethernet, Profibus DP, Profibus PA or ASI bus, as appropriate.
- Connection of field signals may be made directly to a main Level 1 system rack, or to remote I/O racks linked to the main rack by a standard bus system (e.g. Profibus DP).
- The various control systems of the basic automation system belonging to the same production unit (e.g. EAF, LF, CCM, etc.) shall be interconnected with each other and with the Level 2 system via local area network (e.g. Ethernet).
- Human Machine Interface (HMI) systems shall be part of the Basic Automation System. The HMI workstations shall display the operational status of a complete equipment group as mimic diagrams with static and dynamic symbols. A first-up alarm scheme shall be an integrated part of this system.

- For larger automation systems, the visualization system may be realized in the Level 2 system and have a client-server structure.

5.2.3 LEVEL 2 - OPTIMIZATION AND SUPERVISION SYSTEM

- This process control level shall be responsible for process control, optimization and supervision of each production unit of the plant. This system shall receive planning data from production planning system (Level 3) via the area network. Report data for long term data storage are also transmitted to Level 3.
- Level 2 shall receive process data from the basic automation system (Level 1) and download set point values back to Level 1 via the local area network.

5.2.4 LEVEL 3 - PRODUCTION PLANNING AND CONTROL

- The main duty of this automation level shall be production planning for the plant, the adaptation of such production plans due to changing plant situations, the coordination of single plant units, production control, material management and tracking, maintenance scheduling and the generation of reports.
- The relevant production parameters including shift production schedules shall be downloaded to the process control system (Level 2).
- Furthermore, the system shall receive order data and overall production data from the Management Information System (Level 4) and send production data and important events back to the Level 4 via a factory wide area network.

5.2.5 LEVEL 4 - MANAGEMENT INFORMATION SYSTEM

- The main task of this system will be commercial management of orders and overall plant production planning and control. This system is not part of the process automation system and will be described separately in enquiry specification, if required.

5.3 Functional Requirements

5.3.1 AVAILABILITY

- The availability of the process automation system shall be sufficient to exceed all the guaranteed annual production requirements. The expected availability shall be clearly defined by the Supplier.
- The availability shall be included in the performance guarantee of the contract.

5.3.2 PROCESS CONTROL

- The control shall be safe, effective and where possible shall protect process equipment from damage. Processes should be automatic as far as practicable. The potential of the process equipment shall be utilized to the maximum.

- Strict attention must be given to the speed of response of the system to ensure that the integrity of the system is not impaired by data acquisition functions, multiple alarm events, etc. which may cause excessive loading of networks and processors or cause data storage capacity to be exceeded.
- The system shall support a discrete-time simulation of the process equipment, with graphic displays formatted as for the real process.

5.3.3 MODEL CALCULATIONS

- The process automation system shall carry out dynamic model calculations in order to optimize the processes and improve quality of the products. The model calculation shall generate set point values for the individual controllers of the basic automation system. Tools shall be provided for the user's technical staff to access and adjust model parameters. Detail description of model calculations shall be provided for EMIRATES STEEL.

5.3.4 MATERIAL MANAGEMENT AND TRACKING

- A fault-tolerant, auto recovering system shall be provided for tracking product throughout the scope of installation.
- Tracking must be unaffected by the failure of a single instrument in each area. If a sensor is critical for the tracking system, then a redundant sensor should be used
- Anomalies in tracking shall be alarmed. The tracking system must control both normal and abnormal routing of material. The movement of product from one area to another must be accommodated: where necessary communication paths across project boundaries must be established to handle this data.

5.3.5 RECORDING PROCESS PARAMETERS

- Collection and recording of process parameters shall be done in the process automation system so that a detail report can be produced for all finished products including all process phases. This means that, for example a finished coil, the relevant process parameters of melting, ladle treatment, casting, hot strip rolling, and coil finishing are recorded and reported.
- The system computers shall have sufficient hard disk capacity to avoid loss of data at the minimum archiving rate when the archiving device (tape streamer, optical disk etc.) needs to be replaced due to malfunction.

5.3.6 ALARM HANDLING

- The process automation system shall generate alarms, arrange them in chronological order, display them on HMIs and print them out if required using dedicated printer(s). The

alarm reports shall include starting and ending time of an alarm and name of the alarm signal. The alarm printer(s) shall not be used for any other purposes.

5.3.7 EVENT LOGGING AND TRENDING

- A full and extensive event logging system shall be provided. It shall include a data base to hold status data for on-line review of a period of one month and off-line data for a period of one year. Archiving data on suitable media for longer periods shall be included. (See also Section 5). The event logging data shall include, but not be limited to:
 - Parameter settings
 - Instrument status
 - Alarm status
 - Time, date of event
 - Location identification
- Modern data base management systems and tools shall be provided and set up for efficient data retrieval and report creation. Data access, integrity, and protection shall receive thorough consideration.
- Trending shall be provided. It shall be possible for the user to configure trends on any variables and status points within the system. Supplier shall identify the limitations of the facility offered (number of points, number of samples, range of sampling period available).

5.3.8 PRODUCTION PLANNING AND CONTROL

- Facilities for composing, editing and storing production programmes (schedules) shall be provided at Level 3.

5.3.9 MANAGEMENT INFORMATION

- Shift, daily and monthly production data shall be available on HMI screens and as hard copy. The production schedules shall be continuously updated to indicate progress.
- Process parameters, status information, set points and product data shall be available for off-line analysis by the user. Data relating to consumption of energy and utilities shall also be made available. Environmental data including the use of energy and monitoring of emissions shall made stored and made available in suitable format for reporting to regulatory authorities.
- The systems shall support PC-based Statistical Process Control packages acting on real-time data.

5.3.10 MAINTENANCE SCHEDULING

- The systems shall provide preventive maintenance functions based on time and actual duty of the plant equipment; to include (but not be limited to):

- Process plant items (all wearing components, linings, rolling mill stand changes, roll changes, etc.)
- Tools
- Motors (running times and duty cycles)
- Sensors.
- Convenient means of entering data on replacement and refurbishment shall be provided. Progressive deterioration of plant item responses shall be monitored to allow corrective action to be taken before mill operation is impaired.

5.4 Hardware Requirements

5.4.1 BASIC AUTOMATION SYSTEM (LEVEL 1)

- a. PLC's and other on-line control systems shall be installed into metal enclosed panels located into dust free air-conditioned electrical and/or dedicated PLC rooms. The minimum degree of enclosure of the panels shall be minimum IP21.

Each panel shall contain a maximum of three mounting racks. One of the three racks shall be equipped with the central control unit including interface cards and the other two with I/O-cards, or alternatively all three racks of one panel may be equipped with I/O-cards.

The power supply unit and the necessary number of miniature circuit breakers, interposing relays, terminals for the power supply and the 220V 50Hz receptacles for programming units, etc. shall be located in the lower part of the CPU-panel. Where space is limited, a separate panel shall be provided for the equipment noted before.

- b. The total number of inputs/outputs per panel shall not exceed 1024. For the binary input and output circuits, 24 Vdc shall be used. In analogue input/output circuits the standard signal shall be 4 - 20 mA. Other voltages shall be by agreement with EMIRATES STEEL.

When not provided as standard in the design of the module isolation amplifiers shall be used to protect PLC analogue inputs from transients and interference.

Each output for e.g. solenoid valves shall be equipped with a fuse or miniature circuit breaker, including external trip alarm.

For counting purposes high speed input cards or dedicated counter cards shall be used.

The type of input and output modules shall be standardized to be the same as, or compatible with, modules presently in use at the EMIRATES STEEL site are preferred.

- c. All I/O-cards shall be connected with factory made cables over multiple-plugs to the marshalling section of the panel. Connection at the marshalling panel shall be done with screw type connectors.

Each external signal shall be wired to the marshalling panels separately and connected to a separate I/O channel. Each signal lamp shall be allocated a separate output of the PLC. Spare modules shall be wired to spare terminals ready for connection to the field. All internal wiring shall be marked properly with ferrules.

Terminal blocks for all incoming and outgoing control cables shall be provided in the marshalling sections including marshalling between the terminal blocks of the I/O channels. Marshalling panel sections shall have at least 20% extra terminal blocks and space for another 20% to be used in the future.

- d. The power supply source for PLCs and similar equipment shall be taken directly from load centers. Care should be taken to avoid disturbance of the CPU operation caused by e.g. the network harmonics, voltage fluctuations, etc. Filters, isolation transformers, voltage stabilizers, etc. shall be used as appropriate to prevent problems occurring.

A UPS system shall be provided to supply the power for the CPU. For critical process areas it might be required to have an uninterrupted power supply system for the CPU's and all input and output cards.

The uninterruptible supply shall normally be supplied from the central UPS system, where installed but otherwise shall have a capacity of not less than one hour

The power supply to input and output circuits shall be grouped in such a way that one miniature circuit breaker is feeding maximum 8 output channels or 16 input channels respectively. Additionally, the grouping of inputs and outputs shall be made in a logical way as required by the controlled processes.

- e. The PLC equipment presently used at EMIRATES STEEL are:
- Siemens Simatic S7 PLC and PCS7 systems

For standardization reasons the same equipment or their latest upgraded versions are preferred.

- f. Spare / redundant I/O shall be provided at a level of 15% of the quantity of I/O installed originally into each cubical whether centralized or remote As an absolute minimum there should be a minimum of 2 spare I/O of all installed types inside any I/O enclosure The main PLC system shall allow removal and insertion of any I/O module with power on and system running. Such events shall generate alarms. Any deviation from this requirement such as standard PLC systems supplied by package unit sub-suppliers shall be clearly identified
- g. Any limitations in PLC response and cycle time shall not be sufficient to impair the execution of any task. Generally, processor load shall not exceed 70% of the total capacity at any time during operation and cycle time shall not exceed 100ms.
The adequacy of CPU capacity shall be proven using the PLC manufacturer's methods of estimation during the design phase.
The Contractor shall demonstrate shall prove that the complete program of a PLC does not exceed the design limits under a variety of operating conditions over a minimum period of 24 hours.
- h. The basic automation system shall be connected with the electrical systems (e.g. motor starter) in such a way that the number of intermediate relays is minimized. The automatic control functionality shall be provided by the PLC.
For hydraulic power units local control operation and all essential protection and safety devices shall be hardwired to the MCC independently of the PLC to enable maintenance of the PLC in annual shutdowns independently from mechanical/hydraulic activities. In local (maintenance) mode process, interlocks are by-passed, but safety interlocks shall be operational
Additionally, the signals for manual operations and safety and protection devices shall be also wired to the PLC to be utilized as input signals for software interlocking and alarms. The complete wiring philosophy of the circuits shall be agreed in detail with EMIRATES STEEL well before implementation.
Refer also to Electrical Equipment standards.
- i. A redundant HMI system shall be provided for each process unit consisting of two master units. The system shall be equipped with powerful processors to satisfy high performance demands and allow multitasking and real-time operation. The HMI workstation interface devices i.e. pointing device & keyboard shall have a minimum degree of protection of IP65. The system shall be connected direct over a local network

to Level 1 equipment. A minimum of one colour printer and one b/w laser printer shall be provided for each pulpit and electric room, per system.

The generation of a completely new display shall not exceed 1s, and variables shall be updated at intervals of 200 ms maximum.

As minimum the following graphic display screens shall be provided:

- Main menu
- Plant overview
- Interlock status for each group start-up
- Overview of each machine or subsystem
- Detail view of each unit circuit
- Set and actual values of process controllers, allowing setting of parameters
- Graphic masks for display of measured values as trend curves
- Display of trend curves
- Alarm and events log with first-up alarm indication.

Starting of drives shall be supervised by the HMI system. All graphic displays shall be approved by EMIRATES STEEL.

j. PROGRAMMING UNITS

A programming unit shall be provided for each major plant area of the works.

Programming units shall be of compact design, ruggedized and suitable for industrial use - Siemens SIMATIC range, model Field PG M2 or agreed equivalent, with latest available specification.

The software packages supplied with each unit shall include as minimum:

- Windows-based operating system
- Complete application software in accordance with IEC 11131-3 including LAD, STL and FBD.
- Communication software to support network and telephone MODEM operation
- Utility software, diagnostic software and other software tools.
- Standard and customer designed function block libraries.
- Complete user software.

All Software packages shall be installed on the hard disk and shall be supplied separately on disks including manuals.

5.4.2 SUPERVISORY SYSTEM (LEVEL 2)

- a. Level 2 computers shall coordinate and optimise the control of each process unit (e.g., EAF, LF, CCM, etc.) and provide HMI visualization for the processes. The systems shall be located in separate, secure, server rooms. The system shall be implemented in dual-redundant, client-server configuration
- b. Workstations of each control room shall be comprised of workstations including as a minimum the following:
 - Two colour visual display units
 - QWERTY keyboard - key selectable for engineer/operator
 - Dedicated process control keyboard
 - Pointing device (touch screen or tracker ball)
 - Printer(s)
 - Input/output unit
 - Hard disk of sufficient capacity.
- c. The colour visual display units with process/QWERTY keyboards shall be used to provide operator interface with the plant as follows:
 - Plant overviews
 - Production instructions
 - Process set values
 - Data acquisition
 - Material tracking
 - Quality control
 - Alarm information
 - Delay report
 - Production reports
 - Historical database with trending facilities
 - Man-machine communication
 - System communication.

The display refresh rate shall be one second or faster. The updating of dynamic information from a change in a process variable to the screen update shall be less than two seconds. Failure of workstations shall result in no loss of data. On failure of one server the other shall automatically be capable of supporting the information normally supported by the failed unit.

The minimum size of the screen shall be 22". In addition to the keyboards noted below the workstation shall support a pointing device such as a touch screen or tracker ball. A mouse shall not be provided for this purpose.

d. KEYBOARD (QWERTY)

This keyboard shall be to an industrial standard and shall have a separate number keypad. The normal usage shall be by operators to perform process control and monitoring functions, however, via the key switch, this keyboard shall be capable of performing the duties of an engineering keyboard enabling functions like diagnostics, software loading/dumping, configuration changes, etc.

e. DEDICATED PROCESS CONTROL KEYBOARD

This shall be a ruggedized keyboard (e.g. membrane) to enable most of the process control and monitoring functions to be undertaken with a single keystroke for performing most functions including pre-configured functions.

f. INPUT/OUTPUT UNIT

These shall be used for data entry/logging purposes and via the key switch facility enable configuration loading/dumping as a back-up to the standard method of configuration loading/dumping from the level 3 computer system.

g. PRINTERS

The printer(s) shall be laser printers capable of printing graphics. The printers shall use standard paper (sheets or listing paper). They shall have a minimum sheet width of A4 (210mm).

h. CONNECTION WITH LEVEL 1

Connection with the basic automation system (Level 1) shall be implemented via reliable bus interface (e.g. Ethernet).

i. POWER SUPPLY

Uninterruptible power supplies (UPS) shall be used for supply of all hardware at Level 2 or above. The power supply shall be designed to be compatible with the control system to be provided and have sufficient capacity to cope with the future expansion requirements. The uninterruptible supply shall normally be supplied from the central UPS system, where installed.

Otherwise the UPS shall have integral maintenance free sealed batteries and be designed to provide a minimum of one hour back up in the event of total power loss to the relevant system. On the reinstatement of power, the system shall automatically revert to the normal operating mode.

j. EXPANDABILITY

The systems to be provided shall have resources to provide a minimum of 20% spare capacity. Resources shall mean input/output of all types, memory, flags, registers, rack capacity, power supply, etc. The software and data structure shall reflect this requirement. These resources shall be capable of being implemented without affecting unrelated data items and software control structure.

5.4.3 PLANNING AND MATERIAL TRACKING SYSTEM (LEVEL 3)

- a.** The Level 3 process computers are used for production planning and control of each main production area (e.g. DR Plant, Steel Plant, Flexible Mill, Hot Strip Mill, etc.).
- b.** The Level 3 computers shall be located in an air-conditioned computer room adjacent to a central control room associated with each plant area. Workstations shall typically comprise:
- 1 colour LCD high resolution monitor
 - 1 pointing device (tracker ball, touch screen, etc.)
 - 1 keyboard (QWERTY) with separate numerical keypad, key selectable.
 - Laser printer
 - 1 hardcopy colour printer
 - 1 DVD/CD R/W drive
 - 1 archiving device (tape streamer or optical disk).

The hard disk capacity shall be sufficient to enable no loss of data at the maximum archiving rate when the archiving device needs to be replaced due to malfunction.

- c.** It shall be possible to access the data at Level 3 with personal computers and MIS system workstations via the plant wide area network for local data processing and analysis using standard software packages, e.g. Microsoft Office.
- d.** During hardware selection the following items shall be considered:
- The hardware system must support all functional requirements.
 - Computer system must represent the state-of-the-art computer technology.
 - Connection to the Level 4 Management Information System shall be implemented by bus interface (e.g. Ethernet).

- Connection to existing process computer systems shall be implemented either by Ethernet.
- Fibre optic cables should be used for connection of remote computer peripherals (located in control pulpits) to control computers.
- Ruggedized intelligent data entry terminals should be used where necessary for data entry and directing operators in the field. Units shall be provided for crane drivers, etc. to aid tracking.

5.5 Software

5.5.1 SOFTWARE

The software system shall include but not be limited to: -

- Basic automation software
- System software
- Software tools
- Applications software.

All software programming tools shall be compatible with IEC 61131-3 (programming in five different languages).

a. BASIC AUTOMATION SOFTWARE

This software shall consist of: -

- Standard system programs for intelligent controllers.
- Standard communication programs for intelligent controllers.
- Software for standard intelligent controllers' functions.
- Application software for PLC's, Converter/Inverter Drives and Process Automation.
- Interface software.
- Communication software with computer.
- Communication software with intelligent equipment
- Programming methods and documentation shall be compatible with IEC 113/DIN 40719.
- Graphic System for Visualization and Operation of Plant Mimic Displays including user friendly mask generator with text editor in Pixel Graphics.
- Message System for Acquisition, Archiving and Selective Display of Events.
- Reporting System for Output of Messages and User Data
- Data Storage System for Archiving Messages, Measured Values and User Data.

- Graphic Display for Archived Measuring Data including Trend-Facilities.

5.5.2 SYSTEM SOFTWARE

The basic software (system software) shall consist of the real time multi-tasking and multi-user operating system, utilities and programming languages in order to perform the necessary real time process control and dialogue functions according to the respective requirements.

For instance, the following utilities shall be included: -

- Input/output control system.
- File management system.
- Test editor.
- Compiler.
- Database management system.

5.5.3 SOFTWARE TOOLS

The software tools shall consist of programs and library systems which are needed during development and maintenance of application software.

For instance, the following utilities should be included for use of the application and maintenance programmers:

- Pseudo code pre-processor
- Mask system
- Report system
- Basic library.

The software tools shall address the operating system only through standard calls. The intention is to allow installation of future releases of the operating system software without any changes of the software tools and to allow easy portability of software tools.

The software tools shall be delivered as object modules and/or executable images on disc or tape.

5.5.4 APPLICATION SOFTWARE

The application software shall be generally written in ANSI (ISO) – C or C++. Any other languages shall be agreed with EMIRATES STEEL.

Good software engineering practices shall be applied throughout to ensure: -

- Reliability
- Modularity
- Transportability
- Maintainability
- Flexibility
- Extendibility
- Ease of configuration
- Compatibility with future software releases.

and functional integrity of application software. Structured programming techniques shall be used.

The application software components must fulfil the process functions as described in the Requirements Specification.

The application software shall be delivered as source code, object modules and executable images on disc or tape.

5.5.5 APPLICATION SOFTWARE DOCUMENTATION

Application Software documentation shall include at least following:

- System description
 - list of documents -documentation structure with document designation system - general description overview -functional description -man machine communication - communication with process control equipment and external systems -system procedures -application environment -test procedures
- Design documents
 - system overview
 - application database overview
 - system module design
 - extract from program listings
 - system module use description
 - module verification
- Standard software documents
 - basic software manuals -external suppliers standard software manuals

- Standard hardware documents
 - external supplier's hardware manuals
 - Process operation documents
 - process operators' handbooks
- System operation documents
 - system operator's guide
 - error messages
- System database documents
 - database directory
 - database description
 - database population
- Application database documents
 - database directory
 - database description
 - database population
- Source listings
 - program listings -files for generating and starting the application modules - application include files

5.6 PROJECT EXECUTION

5.6.1 PROJECT EXECUTION

The development cycle of the process automation system should be as outlined in the following pages. The sequence of events and scope of work are described as a series of project stages.

- System specification
- System design (basic, detail design)
- System development (programming, test)
- System delivery and installation
- System integration
- Site acceptance test.

Each phase shall be discussed and approved by EMIRATES STEEL before starting the next phase.

5.6.2 TIME SCHEDULE

Proposals for time schedule shall be made in the bid to suit the project installation and commissioning phases of other disciplines.

5.6.3 SYSTEM SPECIFICATION

Detailed specifications of the automation system shall be developed in close co-operation with EMIRATES STEEL. At the end of this phase a Functional Design Specification FDS shall be submitted and agreed with EMIRATES STEEL.

The FDS shall include: -

- Function description:
 - definition of scope of automation
 - definition of control functions
 - definition of models and algorithms
 - definition of emergency functions
 - specification of data

- Operating concept:
 - definition of operator tasks
 - definition of man machine interfaces
 - definition of mask layout
 - definition of report layout.

- Hardware and software description:
 - hardware configuration
 - software configuration
 - signal list (protocols)
 - interface description.

5.6.4 SYSTEM DESIGN

During this phase the automation system to be developed shall be described from the programmer's point of view by using graphical design methods or pseudo code. The necessary work shall be executed by the system supplier with close involvement of EMIRATES STEEL.

There shall be common agreement on the methods and tools used for software design. Documentation shall be prepared as part of the design process rather than retrospectively.

Software design shall include: -

- Design of task structure
- Design of module structure
- Definition of task communication
- Design of data structure
- Definition of alarm processing
- Definition of dialogues
- Design of testing strategy.

5.6.5 SYSTEM DEVELOPMENT AND TEST

Software design shall be followed by coding and module testing. At the end of system development, integrated system testing shall be performed with examples of all hardware & systems connected. After the integration tests have been completed a Factory Acceptance Test (FAT) shall be carried out to demonstrate compliance of the system with the FDS. The FAT shall be carried out to a procedure agreed with EMIRATES STEEL.

During the periods of programming and testing, EMIRATES STEEL engineers shall be given the opportunity of participating and witnessing tests. This will allow EMIRATES STEEL engineers to become thoroughly conversant with the Automation System.

5.6.6 DELIVERY AND INSTALLATION

After completion of system development and successful integration test, the system shall be delivered to EMIRATES STEEL and installed on site.

5.6.7 SYSTEM INTEGRATION The

Integration of the system shall include: -

- Checkout of all cabling
- Basic automation test
- Test of the basic automation interface
- Communication tests
- Functional tests
- Start-up

- Off-line adjustment
- On-line adjustment
- Fine tuning.

It shall be planned to utilize the automation system for all available functions from the beginning of hot commissioning to allow EMIRATES STEEL's personnel to become accustomed to the process computer system at an early stage under realistic production conditions. Remaining problems and errors which have not been discovered during previous test must be detected and rectified immediately. Documentation shall be updated without delay.

5.6.8 SYSTEM ACCEPTANCE

After completion of integration, the Site Acceptance Test of the complete process control and automation system shall be performed, to an agreed programme and procedure. The tests must demonstrate to EMIRATES STEEL that all FDS requirements have been met before the acceptance certificate is signed.

6. SUPPORTING DOCUMENTS

7. REVISION HISTORY

Issue No.	Date	Page/s	Cause of Revision
0	17.11.2019	All	First Issue