INTER PLANT STANDARD – STEEL INDUSTRY		
	SPECIFICATION FOR PROGRAMMABLE LOGIC CONTROLLER (*Third Revision*)	**IPSS:2-07-015-15**
IPSS		*Formerly:* IPSS: 2-07-015-11 (Second Revision)

0. **FOREWORD**

This Interplant Standard (*Second revision*) has been prepared by the Standards Committee on Computerization and Automation, IPSS 2:7 with the active participation of the representatives of steel plants, other concerned organizations and established manufacturers of Automation equipments; and was adopted in May, 2015.

Interplant standards for steel industry primarily aim at achieving rationalization and unification of parts and assemblies used in steel plant equipment and accessories, and provide guidance in indenting stores or equipment (or while placing orders for additional requirements) by individual steel plants. For exercising effective control on inventories, it is advisable to select a fewer number of sizes (or types) from among those mentioned in this standard, for the purpose of company standards of individual steel plants. It is not desirable to make deviations in technical requirements.

This interplant standard was first published in 1987, first revised in 1993 and second time revised in April 2011.

With a view to sort out the problems faced by the steel plants in repairs, maintenance and operation of Programmable Controller, panel discussions were held with the manufacturers of these Programmable Controllers. It was decided to incorporate modifications in the existing Interplant Standards on Programmable Controllers. Second revision incorporated the salient points emerging out from the discussions with the manufacturers in the above workshop and subsequent modifications as decided by the steel plant representatives and other associated organizations.

1.0 **Equipment Specifications: Programmable Controller (PC)**

1.1   Purpose and general Information

The Programmable Controller with built-in microprocessor shall be used to carry out the control & regulatory functions, sequencing, logical switching, alarm, integration of various drives system, process control, real time trending, recording and monitoring of the system. It shall interface with MCC/control desk, field equipment, networking components, peripherals,

other programmable controllers and/ or a host computer/ server through bus based communication.

1.2   Micro and Mini controller shall be beyond the Preview of this standard.

1.3   The Control system shall be designed based on following parameters:

- Redundancy in CPU, Power Supply, Communication Modules and Network
- Control Functions envisaged
- No. of I/Os considered including spares
- Spare CPU memory capacity
- Location of Remote I/Os, if any
- Average CPU loading

1.4   Programmable Logic Controller (PLC)

General Features:

1.0	Power supply system	
2.0	Power supply system	• One source of 240 V AC single phase, 50 Hz for auxiliary power supply e.g fans, panel lamps, power sockets etc. • For each I/O Panel Redundant 24 V DC regulated power supply unit (SMPS) shall be provided for interrogation voltage for digital input and loop power supply for transmitter. SMPS shall be selected with 25% spare rating The SMPS shall be separate for digital and analog inputs. • Separate power supply bus shall be provided for interrogation voltage supply for all inputs and output respectively (even if the input interrogation voltage and output voltage is same) • DP MCBs shall be provided for each rack of the PLC system . • 20 % spare DP MCB of each rating (at least one no. of each rating) shall be provided in each panel. • In case of Foundation Field Bus, Separate redundant power supply modules shall be considered.
2.1	Built-in power supply units	Following minimum features shall be provided in the power supply unit mentioned above. • Protection against surge protection & short circuit • Electronic over current protection with feedback feature. • Over voltage protection. • Fuse protection in the input and output circuit.

		• Diode O'ring shall be envisaged for redundant SMPS
3.0	Central processor unit	• Minimum 32 bit microprocessor based with on board RAM of minimum 8 MB , Battery backup RAM & NV RAM • Execution time 0.3 millisecond per 1K instruction or better. • Provision to latch desired outputs. • Provided with hot redundant standby CPU (with appropriate communication module). • The CPU system shall have facility of bumpless transfer in case of failure of one . Fiber optic link shall be provided in between CPU's for continued mapping of data. In case of failure of working CPU, standby CPU shall takeover and maximum data loss shall be for 100ms. (can be less depending upon process requirement). • The processor shall have in-built provision for software timers , counters , examining input conditions, compare, compute, logical, conversion from/ to BCD, bit manipulation, block memory manipulation, diagnostic, shift, sequencing, conditional jumping, subroutine instructions , high speed counting function, PID functions, mathematical functions. • Maximum CPU loading shall be limited to 50% after commissioning. • CPU shall be capable of handling at least 4000 I/p and 4000 output (any mix) unless and otherwise specified.
4.0	Input Units	- Modular, hot swappable and from the same family as the CPU - Insulation level of 500V DC - Input interrogation voltage 24 V DC.
4.1	Digital Input Modules	Digital input units shall have the following features :- • 16 / 32 inputs per module. • Optocoupler/ galvanic isolation • LED status indication for each channel. • BCD input units suitable for four digit input • Pulse inputs (Incremental encoder / digital tacho) • Absolute / incremental encoder inputs. • High speed counter type inputs

		- All the cards shall be compatible of receiving digital signals from field sensors and switches directly . - All the control modules / cards shall be lacquered . - All the Digital inputs with fused terminal with LED indication for fuse blown. - LED status indication in the front of I/O cards. - SSI i/p shall be provided if required
4.2	Analog input Modules	Analog input units shall have the following features: - Shall be 4 / 8 / 16 channels, - Suitable for 4-20 mA/4-20 mA HART / 0-10V DC / RTD/ thermocouple / weighing signal inputs / 0-20 mA / 1 - 5 volt. - Differential input shall be provided when specified. - Provided with internal temperature compensation for TC Input - With necessary A/D converter having at least 12 / 14 bit resolution based on application. - Suitable for J/K/S/E/N/B/R/T type thermocouples & for PT1000/ PT100, 2- wire / 3 wire /4 wire - Galvanically isolated with insulation level of 500V DC. - For 4 – 20 mA analog inputs, fused TB with LED for fuse blown . - Healthiness of every input shall be monitored & diagonostic LED indication provided. - Analog module shall have the facility to be configured in voltage or current mode and differential, input mode.
5.0	Output units	- Modular. - Insulation level of 500V DC .
5.1	Digital Output modules	Digital output units shall have the following features: 16 / 32 digital outputs per module. - Rated for 24 V DC/ 110 V AC - With insulation level of 500V DC - The output module shall be able to drive interposing relays BCD output units shall be as follows: - - Suitable for four-digit output. - Rated to drive seven segment LED displays

5.2	Analog output modules	Analog outputs shall have the following features: • Shall be of 4 / 8 analog output channels. • Suitable for 4-20 mA / 0-20 mA / +/- 20 mA / 0-10V DC / +/-10V DC, 1-5 V dc outputs as per requirement • With necessary D/A converters having 12 bit resolution • With insulation level of 500V dc. • Each output shall be galvanically isolated and differential type. • With short circuit protection

6.0	Additional features	• Network shall be 100 MBPS/ 1GBPS. However switch to switch connectivity shall be 1GBPS. Network switch shall be at least layer 2 managed switches.
		- Communication with computer in distributed hierarchical control system and operator consoles / display units.
		- High speed communication among Programmable Controller and operator consoles/ display units shall be provided through dual redundant TCP/IP Ethernet using Ethernet cards on HMI station .
		- The Controller system shall be immune to the following:
		  -
		  • Radio frequency interference
		  • Electromagnetic interference (EMC compatible)
		
		The methods and standards followed for these features shall be furnished by the supplier.

7.0	Mounted spares	- Min of 20 % of spare I/Os prewired and at least one spare module of each type. - Provision shall be provided with empty slots/ space for future expansion for 20% I/O modules.
8.0	Self Diagnostic features	- Parity errors, cycle errors and under voltage - Failure in central processor unit, memory and power supply. - Indication of type of failure - Automatic turning OFF of all outputs or optionally holding of all outputs in their last state on failure detection. - Fault detection up to card level. - Communication failures – all types - Fuse failure indication for outputs
9.0	Monitoring functions	- Monitoring of internal voltages - CPU Status monitoring - Memory status monitoring

		- I/O Status monitoring - Address monitoring - Bus & communication signal monitoring - Broken sensor detection A milliammeter with selector switch shall be provided on panel facia to monitor the earth leakage current.
10.0	Terminations	- All inputs and output wired up to easily accessible terminal blocks rated for 660V - Suitable for terminating up to 2.5 sq. mm. copper conductor industrial control cables. - Fuse terminals for all input & output signals (with LED indication). - For different type of terminal input different suitable terminal blocks to be used. - Colour coding shall be used for different type of voltage levels.
11.0	Earthing	- Separate earthing bus for power / panel earthing and electronic earthing shall be provided. - Electronic earthing bus shall be suitably insulated.
12.0	Enclosure	• Conforming to IP-42 class in Programmable Controller room/control room. • Conforming to IP-54 class for remote I/O cubicles located in Plant/field. • The case of the panel located outside control room, built –in panel AC shall be provided • Colour Code shall be RAL 7035, however, it shall be matched with existing panel. • Programmable controllers RIO Panel, shall be suitable for normal industrial environment and ambient temperature up-to 50°C. • Relative humidity • Daily average 80 to 90% (8 hrs.) and 65 to 90% (16 hrs.) • Maximum 98%, not occurring simultaneously with maximum temperature.

1.5   __Programming Station__

1.0	Type	- Shall be console / Table top type PC based/ Laptop based/ colour graphic Work Station - Configuration shall be latest available in the market.
2.0	Programming Facilities	-- Programming language shall be as per IEC-61131/ Ladder/ logic/ functional Block / Structure Text/ Instruction

		list/ SFC - The programming terminal shall be capable of developing multiple programs offline without connecting to the programmable controller. - Engineering station shall have an integrated and development and configuration setup for all the drives, instruments, PLC, HMI etc. - Facility to view from any of the HMI terminal in the network with password

3.0	System Functions	- Error detection and reporting.
		- Fail safe / broken sensor information and alarm and their reset.
		- Selection of highest / lowest signal from a group of accepted inputs and displaying the same
		- Linearisation and other arithmetic calculation. Provision shall be kept for pressure and temperature correction to be computed for flow measuring loops.
		- Built-in ambient temperature compensation for thermocouple inputs from field.
		- Trending real time and historical (Trending shall be provided for all analog inputs).
		- Fault logging
		- Report generation and periodic logging.
		- Developing of graphic symbol library as per ISA – 5.1 and 5.3. in addition to standard industrial symbols.
		- Printing of alarm conditions with parameter identification.
		- Online editing of :-
		   • Scan sequence
		   • Identification number
		   • Engineering units
		   • High and low alarm limits
		   • Alarm dead bands
		   • Addition / Deletion signals
		   • Removal / introduction of analog and digital points in scanning.

4.0	Printer	Latest appropriate model of Laser Printer to get hard copy of the program dump / data logging / alarm logging / event logging / data trending etc.

1.6 **PLC Software**

1.0	Software (Windows Programming)	**The PLC programming software shall be latest, Windows based, menu driven and shall support the following minimum : -**
		- Cyclic, Time Controlled, Interrupt controls.
		- Retentive / Non Retentive Timers, Bi- Directional counters, latches, etc.,
		- Internal Flag generated by the Programmable Controller.
		- All Boolean Logic Functions
		- Data Transfer, Block Transfer
		- Sub Routines
		- Arithmetic functions & formula Calculations
		- Communication functions with Remote I/O as well as Work stations
		- Closed loop PID control functions including nested and cascaded loops.
		- Floating point arithmetic functions, Conversion of real to integer, integer to binary etc.
		- Output of PID controllers shall be 4-20 mA DC.
		- Control valve position (in 4 – 20 mA) shall be made available in Programmable Controller.
		- PID Controller shall have auto tuning facility
		- Totalisation of flow inputs.
		- Linearisation function blocks and other useful function libraries
		- Linearisation function block shall be such that a table of values (X against Y) can be entered in a menu driven manner and for any particular field input X, the value of Y can be calculated using the values of table by interpolation method. Maximum 30 point linearisation function block shall be considered. Below 30, point of linearisation shall be user selectable.
		- Built-in ambient temperature compensation for thermocouple inputs from field.
		- Broken sensor detection etc.
		- Simulation facility / software shall be supplied for program testing without disturbing the working Programmable Controller.
		- The complete PID blocks shall be transferred to HMI work station in place of split bits .
		- The Software shall be suitable for PC based Programming Unit .

2.0	**Application Programme software**	- Shall be as per process control requirement. - Online programme editing and bit forcing facility shall be available.

1.7 Human Machine Interface (HMI) Work Station & Engineering Station

1. Depending upon application one out of following configuration shall be adopted.
   - Stand alone Work Stations
   - Client – server based architecture (with hot standby server)

2. It shall be console type PC based color graphic with latest configuration available in the market.

3. Other Technical Specifications
   - Color monitor with Antiglare & Touch Screen facility with minimum 22" LED.

   - Dual Ethernet interface with LAN accessories for all PC based operator station.

   - Server shall be INTEL XEON based hot standby type with RAID 1 configuration and redundant power supply unit.

1.8 HMI Software

   - Window based, latest version (at the time of implementation) of HMI software.

   - HMI software package shall have the facility to perform multitasking, data acquisition, supervisory control, monitoring, control development and routine software.

   - HMI software shall also have the features for alarming, trending, data logging, production backup history, operator action list , creation of shift reports after every shift, online printing of events.

   - Number of graphic pages shall not be a limit .

   - HMI software shall have the facility of handling unlimited tags (Digital as well as analog).

   - HMI software shall be capable of curve fitting, co-relation & regression functions.

- In the engineering workstation & servers, development version of HMI software & Foundation Field bus system software (licensed versions) shall be provided.

- In the operator workstations, runtime version of HMI software & Foundation field bus system software (licensed versions) shall be provided.