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Instrumentation Detailed Engineering

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Abstract: Instrumentation Detailed Engineering (IDE) is a study which defines every technical and non technical aspects of project development. IDE follows Basic Engineering (BE) and Front End Engineering Design (FEED). It contains in detail diagrams and drawings for construction, civil works, Instrumentation, Control System, Electrical Facilities, Management of Suppliers, Schedule of Activities, Costs, Procurement of Equipment, Economic Evaluation and also Environmental Impacts before starting of construction of a project. Instruementation detailed engineering found to be the best method for plant commissioning and plant maintainence.

Keywords: Instrumentation Detailed Engineering, Front End Engineering

1. Introduction

Every industrial sector there is requirements of number of instruments and control systems for automation. But every instrument has its life-period, once it crossed the instrument starts giving faulty readings which results in hazardous situations. For this we need to be in process of continuous maintenance activities or need to manufacture a new one and install. So, either to begin a new project or to make changes in existing one basic design steps are followed which includes design of Instrumentation Index Sheet (IDS), Data Sheet (DS) also know as Specification Sheets, Loop Wiring Diagram (LD), Hook-up Drawing(HD) also known as Installation Drawing.

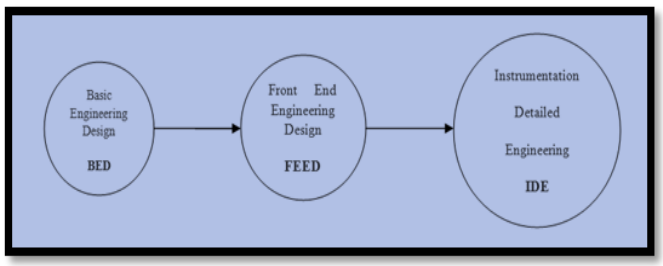

Figure 1: Project Execution Flow

Keywords: Automation, Instruments and control systems

2. Design Concepts

2.1 Piping and Instrumentation Diagram

This is complete overview of the plant where information of instruments installed on pipelines and their connections to control systems are shown. It has technical information as plant number, instrument tag numbers, line numbers, line elevation details, pipe line numbers are shown.

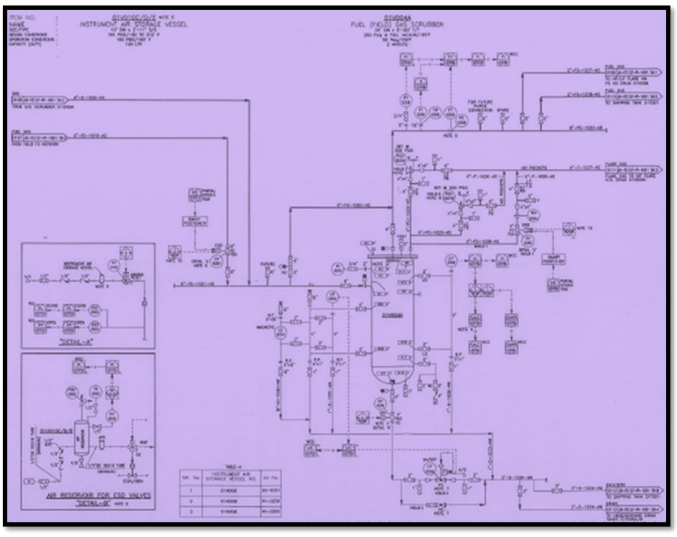

Figure 2: P&ID

2.2 Instrument Index Sheet

It is a list of instruments within a plat. It is designed at the start of the project and consider as live document which should kept updated even though the plant has been operated. This sheet is revised if there is any modification which impact to additional, removal or resetting of the instrument. In this sheet information is listed as Tag Number, Loop Number, Type of instrument,

Location, Service Description, P&ID Number, Line number and Equipment number, I/O types, Control System details.

Sr.	Line no & equip no	P &ID no	Tag no.	Inst type	Service Description	Process fluid	Qty.	Location	I/O type	Calibration	Units	Spec. no 1235-IN-DS	PO no	PO Date	Loop wiring diagram no 1235-IN-LW-001-	Hook up no 1235-IN-HD-001-	Remark
1	01V004A	1235-PR-001	LIT-0255	RADAR	Transmits and Indicate the level of 01V004A	Water & oil	1	Field	AI		mm	001			SHEET-1		
2	—	1235-PR-001	LIC-0255A	INDICA-TING CTRL	Controller the level of 01V004A	—	1	Main DCS	—			002A			SHEET-1		
3	01V004A	1235-PR-001	LG-0254	MAGNE-TIC	Controller the level of 01V004A	Water & oil	1	Field	AI		mm	003			—		
4	3"-D-1034-AW	1235-PR-001	LV-0255	GLOBE	Controller the	Water & oil	1	Field	AO			004			SHEET-1	SHEET-04	
5	01V004A	1235-PR-001	PI-0253	BOURDON	Indicate the press. inside the 01V004A	Gas	1	Field	—		Psi	005			—	SHEET-01	
6	—	1235-PR-001	LIC-0255B	INDICA-TING	Controller the	—	1	WCC DCS	SOFT			002B			SHEET-1		

Figure 3: Index Sheet

2.2 Instrument Data Sheet

This is design with specification and information of instrument device. Process data as fluid type, fluid state, design pressure, design temperature, operating temperature, flow rate, density, viscosity, and specific gravity are listed. Process Data can be obtained from Heat and Material Balance document. Once Data sheets are designed it is attached to requisition which to be sent to several vendors. Vendors will offer their quotation with various model and manufacturer among the offers. It is instrumentation engineer's responsibility to evaluate all quotation and determine which order is technically accurate.

GENERAL	Transmitter type	Conventional	Hart	Fielf bus	Level
	Measurement	Diff. Presure	Gaure pressure	Abs.pressure	Extended
	Seal type	Flush	Remote	pancake	
	Fill fluid	Silicon			
	Integral meter	Not required	Analogue	LCD	Extended
	Meter scale	Linear	Sqaure root	0-100%	Eng. Unit
CONNS.	process HP	1/2 inch NPT (bottom)			
	process LP	N/A			
	Electric	1/2 inch NPT (F)	ISO M20		
	Flushing	1/4 inch NPT (F)			
Material	Electronic housing (body)	Carbon steel	SS-316	Die-cast AL,eoxy coated	
	Upper housing and flange	Carbon steel	SS-316	SCS 14A	
	Diaphragm	SS-316L	Hastelloy-C	Monel	tantalum
	Lower housing/Flushing	SS-316L	SS-316	Monel	tantalum
	Capilliary type	Armoured	Plain	N/A	
	Capilliary material	SS-316	N/A		
	Cappiliary coating	PVC	N/A		
	Mouting bolts and nuts	Carbon steel	SS-316	SCM-43S	
physical	Ingressed protection	WP IP65			
	Enclosure classification	Explosion proof	IS		
	Area classification	Zone	Class 1	Division 2	Group C&D
	Body rating	Mfr. Standard	1500 fsig		
	Mounting	2 inch pipe	Surface	flush	
Functional	Power supply	2 wire @ 24V DC			
	output	4-20 mA DC	Digital comm. Foundation field bus		
	Max.load @ 24 V DC	600 ohm			
	Min accuracy	0.25%	0.065% span		
	Certificate	FM	Cenelec	foundation Fieldbus	SIL 2

Figure 4 : Data Sheet

2.3 Hook-up Drawing

It shows typical installation of instrument in a correct manner so that instrument operates properly. Is indicates tubing slope, position of instrument in reference to process tapping point, scope break between instrument vs. piping. There are two types of hook-up drawings, one is process hook-up and second is pneumatic hook-up. Requirement of Bulk material could be summarized and tabulated in a document called Material Take Off.

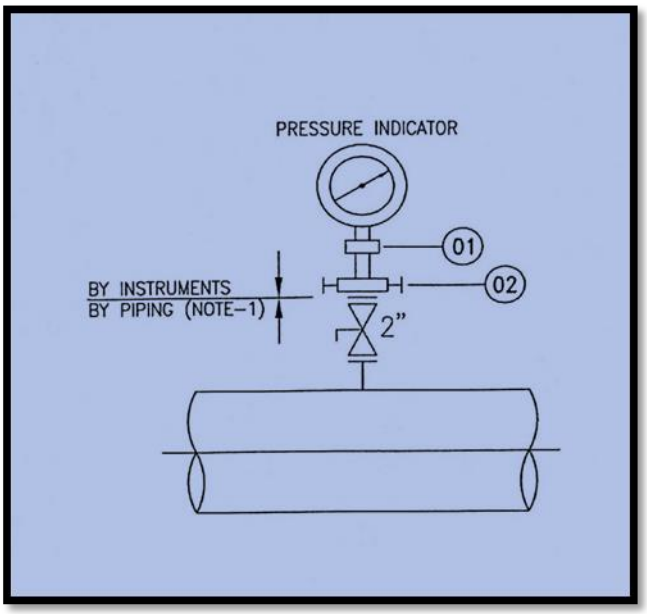

Figure 5: Hook-up drawing of pressure gauge

2.4 Loop Wiring Diagram

Loop wiring diagram shows detailed information of instrument connections from one point to control system. It could be connection between, Field instrument to control system, Signal from control panel to control system, Signal from MCC to control system, Signal from one control system to another.

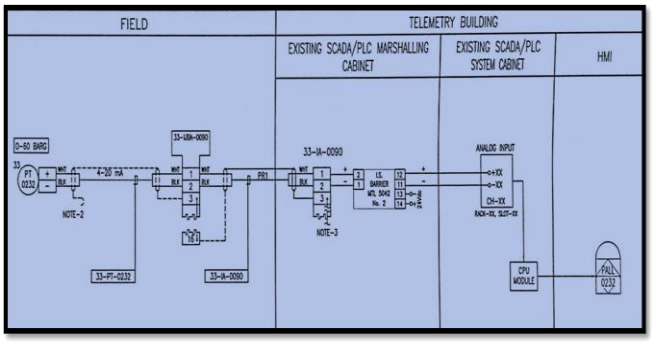

Figure 6: Loop Wiring

3. Safety

3.1 Interlock

As per hazardous conditions signal is given to Programmable Logic Controller (PLC). These signals are categorized as High / Low or High-High / Low-Low.

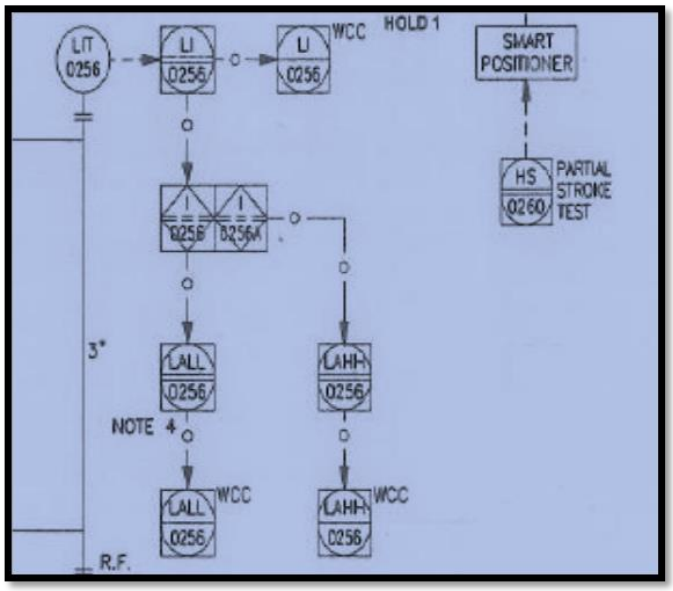

Figure 7: Safety Interlock

3.2 Emergency shutdown valve (ESD)

It is an actuated valve designed to stop the flow of hazardous fluid upon the detection of dangerous event. This provides protection against possible harm to people, equipment or the environment. Shutdown valves form part of safety instrument system.

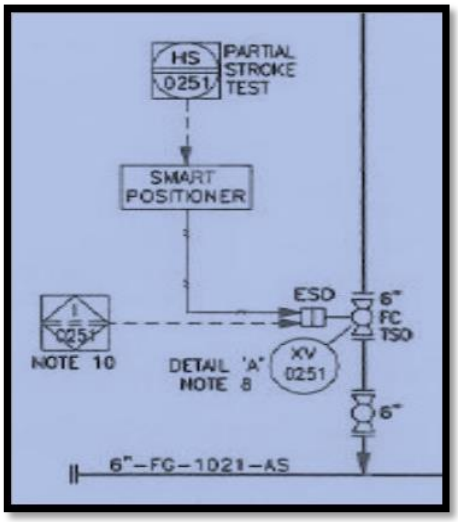

Figure 8: ESD

3.3 Pressure safety valve

It is it term used to describe relief device on a compressible fluid vessel. For such valve the oppening is sudden. When the set pressure of the valve is reached, the valve opens almost fully. It is purposely installed in bypass lines for safety.

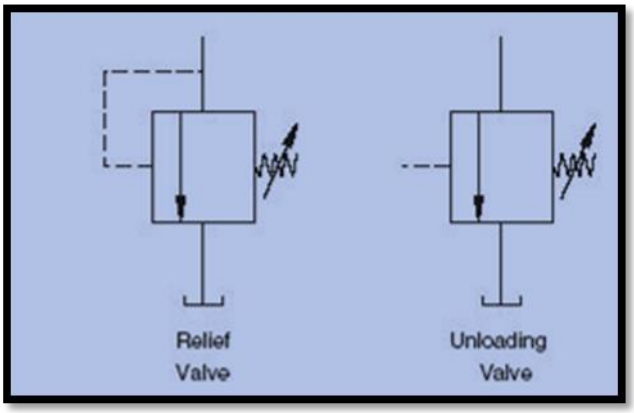

Figure 9: Pressure safety valve

4. Results and Discussion

Instrumentation Detailed Engineering (IDE) found to be best method for plant commissioning and maintenance activities. IDE provides great platform to each project department like mechanical, civil, electrical, instrumentation, computers (for analysis) to execute project effectively with strong interactions within them. IDE has strong impact on the overall project cost. IDE ensures optimum quantities, work-volumes, constructability, operability and maintainability and safety of power and process industry plant.

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Prof. (Dr.) Girish Santosh Bagale did his BE Automobile from DME at Govt.Poly. in 2001. After that he completed his M. tech. in Production Engineering at VJTI in 2006 and did his PhD in Management at Bundelkhand University in 2011. He has various research publications in international journals and conferences. He is currently employed as an Assistant Professor in the department of Mechanical / Mechatronic of MPSTME, NMIMS University since 2006.

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