Engineers India Limited

इंजीनियर्स इंडिया लिमिटेड
(भारत सरकार का उपक्रम)
ENGINEERS INDIA LIMITED
(A Govt. of India Undertaking)

Instrumentation Engineering, Standards & Practices used in Refinery & Petrochemicals Industries

EIL - All Services Under One Roof

Process Design services

- Conceptual designs and feasibility reports
- Basic design packages for
  - Open art process units for gas-processing and refineries
  - Integrated utilities and offsite facilities
- Offers a portfolio of more than 30 process technologies for application in oil and gas processing sector
- Residual basic engineering for licensed process units

Certification services

- Certification and re-certification services through EIL subsidiary - Certification Engineers International Ltd

Engineering services

- Expertise ranges for all engineering services such as piping, mechanical, electrical, control systems, civil, structural and architectural, including advanced engineering analysis
- Specialized services for
  - Heat and mass transfer
  - Environment engineering
  - Materials and maintenance services

Project Management services

- Integrated project management services with focus on cost, quality and schedule
- Services include developing project execution plans, detailed schedules, cost forecasts, progress tracking and reporting, and the integration of the engineering, procurement, logistics, construction and commissioning

Procurement services

- Comprehensive procurement services such as strategic sourcing, materials management, contracts management, purchase, expediting, inspection services and logistics

Commissioning services

- Services include audit of plant readiness, start-up and commissioning, as well as conducting performance guarantee tests
- Includes pre-commissioning and commissioning assistance for projects
- Safety audit, hazard and operability studies, Hazard identification studies, risk and consequence analysis services

Construction Management services

- Comprehensive services at site including warehouse management, quality control and assurance, health safety and environment (HSE), progress monitoring and scheduling
- Undertakes total site responsibility from survey and soil investigation to mechanical completion of project.

Instrumentation Engineering for Refineries & Petrochemicals

- Conceptual Design
- Basic Engineering
- Engineering for Procurement
- Control System Engineering
- ESD System Engineering
- Security, Fire & Gas System
- SCADA & Telecom Systems
- QA, Inspection & Factory Acceptance
- Construction management, Commissioning and Site Acceptance
- Logistic & Technical Services

SOFTWARE TOOLS

Conceptual Design

- Conceptual study & development of Control strategy and Design Basis for the project.
- Evaluation & recommendation for Selection of type of Field Instrumentation & Control system.
- Preliminary Safety System study.
- Conceptual Analytical Data Monitoring philosophy.
- Package Unit operating Philosophy.
- Alarm Management philosophy.
- Cabling Philosophy.
- Power Supply estimation & distribution philosophy.

Basic Engineering

- Development of Control scheme during P&ID preparation, Type of instruments and signals, type of Control systems, Type and Size of Control valves & Flow Elements, Hardwired instruments , Battery limits for packages etc.
- Central Control Room (CCR), Satellite Rack Room (SRR) and Local Control Room (LCR) sizing, cable entry and layouts.
- Control System Configuration for DCS/PLC system considering the operational and control philosophy of packages and integration of Package PLC/Proprietary Control Systems.
- Sizing & Selection of Flow Meters, Control Valves, Safety Valves.

Basic Engineering (Continued)

- Nozzle elevation for instruments on vessels/columns/tanks
- Preparation of Technical specification of Field Instruments & Control System (DCS/PLC)
- Preparation of technical specifications for Analyzers, Gas Chromatographs & Analyzer Shelters including utility requirements, sample take off and fast loop sample return
- Instrument Cable Duct/Trench Layout
- Instrumentation specification for various packages
- Preparation of Technical specification for common systems like CCTV, Large screen display unit, Access control system etc.
- Preparation of Logic Diagram & Functional Schematic
- Power consumption and UPS sizing
- Heat load & HVAC requirements

INSTRUMENTATION DESIGN

FINAL CONTROL ELEMENT

- Control valves normally be Globe type single seated & top and cage guiding type. For highly viscous services, cage guiding not used.
- Characteristic ball valves for services where solids in suspension, high rangeability, low pressure drops, and tight shut-off are required.
- Butterfly valves for services where solids in suspension, low pressure drops and high capacities are required.
- Angle valves for services where flashing, coking, solids in suspension or very large pressure drops are encountered.
- Bellow seal type valve for H2S service and H2 service.
- Control valve actuator with smart positioners (FF/HART) for advance diagnostics.
- In general ball type on-off valves used for shutdown application. Fire Safe actuator provided for fire safe application. Partial Stroke testing (PST) for On-off valve.

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INSTRUMENTATION DESIGN (Continued)

FLOW INSTRUMENT

- Orifice plates in general however with rangeability above 1:4 (for closed loops)/ 1:5 (for open loops) and upto 1:8/1:10 (1:8 for closed loops and 1:10 for open loops) - Dual Transmitters are used.
- Fuel oil and high viscosity applications : Coriolis mass flow meter.
- Large diameter lines with high viscous service application : Ultrasonic flow meter.
- Custody measurement - Mass/ultrasonic flow meters
- VHP/HP steam and MP steam with continuous service - Flow nozzles
- For flare header - Ultrasonic flow meter
- Above 1:8/1:10 (1:8 for closed loops and 1:10 for open loops) rangeability, special flow meters like vortex, ultrasonic flow meter for gas and coriolis mass flow meter for liquid application are considered.

INSTRUMENTATION DESIGN (Continued)

LEVEL INSTRUMENT

- Generally Guided Wave Radar type instruments is considered for level measurement up to 2400mm
- Differential pressure transmitter is considered for level measurement above 2400mm and for service requiring purge or where liquid might boil in external portion.
- For interface applications, Guided wave radar type is considered.
- For custody applications non-contact type radar level instrument is considered with accuracy of ±1 mm.
- For sump levels, Guided wave radar or non-contact type radar level instrument is considered depending on the application with accuracy of ±3 mm.
- Special instruments like Nucleonic level instrument & tuning fork type level switch for difficult service like highly viscous solids & powder.

INSTRUMENTATION DESIGN (Continued)

PRESSURE INSTRUMENT

- Pressure gauge sensing element elastic element like bourdon tube, bellow, diaphragm etc. of SS316 and movement of Stainless steel, as a minimum. Diaphragm seal element with capillary is considered for corrosive/viscous services. Remote surface mounting pressure gauges is considered for services of higher operating temperature greater(typically more than 120 Deg C).

TEMPERATURE INSTRUMENT

- RTD up to 400 Deg C (operating) and ‘K’ type thermocouple above 400 Deg C (operating). For all temperature transmitters-field-mounted transmitters.

Skin thermocouple for reactors. Temperature gauge bimetallic type.

PRESSURE RELIEF VALVES

- Generally spring operated pressure relief valves (Conventional & Bellows type) are considered.Pilot operated relief valves used for special services and where set pressure is closer to the operating pressure by 10% of set pressure or back pressure is above 50% of set pressure.

INSTRUMENTATION DESIGN (Continued)

ANALYSERS

Analysers are most critical, complex & high value item. Analysers system with shelters for gas chromatographs and special analyzers are provided for ease of operation & maintenance. Analyser shelters are also provided in hazardous area with HVAC and pressurized system to prevent the entry of flammable gases & vapors.

Process Stream Analyser

- Moisture
- O_2-Zirconia
- PH / Conductivity
- O_2-Paramagnetic
- TDLS

Stack Gas Analyser System

- SOX/NOX
- CO
- SPM & HC

Analyser System

Gas Chromatograph
Viscosity
IR analyser
TOC analysers
Specific Gravity
Wobbe Index

Product Quality Analyser (Sulphur)

- Sulphur Analyser
- H2S Analyser
- Air Demand

Engineering For Procurement

- Preparation of Material requisition (MR) for instrument items & various systems.
- Vendor enlistment and generation of project vendor list.
- Technical evaluation of vendor offers for various instrumentation items and packages.
- Preparation of Purchase Requisition (PR) and Input for Purchase of various package.
- Post order engineering review of vendor document & approval .
- Factory Acceptance Tests (FAT) For Instruments and Analyzers Systems

Control System Engineering

- Overall System configuration and integration of subsystems.
- DCS system specifications.
- Functional Schematics.
- Instrument details ; Control narratives.
- Dynamic Graphics display.
- Alarm Management System.
- Asset Management System.
- Machine Monitoring System for predictive maintenance.
- Blending and Offsite Automation.
- Tank Farm Management System.
- Utility monitoring and overall monitoring.
- Power distribution, system earthing, surge protection.
- Factory Acceptance Test for DCS system.

Safety Studies & ESD System Engineering

- Overall System configuration.
- ESD system specifications.
- SIL verification study as per IEC 61508/6151.
- Instrument details ,Cause & Effect.
- Sequence of Events (SOE).
- Functional Schematics.
- Logic diagram.
- Graphics display.
- Power distribution, system earthing, surge protection
- Factory Acceptance Test for ESD system

Fire & Gas System Engineering

- F&G System configuration
- Gas detectors, Fire detectors & detection system specifications
- Cause & Effect Matrix
- Detector location layouts
- Graphic displays for detector locations.
- Integration with DCS and Fire Stations
- Power distribution, earthing , surge protection
- Factory Acceptance Test for F&G system

Security System Engineering

- Overall System configuration
- CCTV system
- Access Control System (ACS)
- Perimeter monitoring, & Intrusion detection system
- Control & Command Centre layout

Construction Management

- Instrument Index
- Cable Schedules & Cable routing drawings
- Instrument Location Plans, Gas detector & CCTV Layouts
- Bill Of Material/ MTO For Instrument Installations
- Erection Tender
- Engineering assistance to construction Site, Field Engineering & Commissioning Assistance
- Site Acceptance Test
- Logistic Support and Technical assistance

Software Tools

- Complete automated well evolved work flow for all Instrumentation deliverables encompassing basic engineering to construction engineering.
- This workflow utilizes in-house software I-Online
- Also use commercially available software based on specific client's requirements such as Smart Plant Instrumentation(SPI/Intools) & Instrucalc.

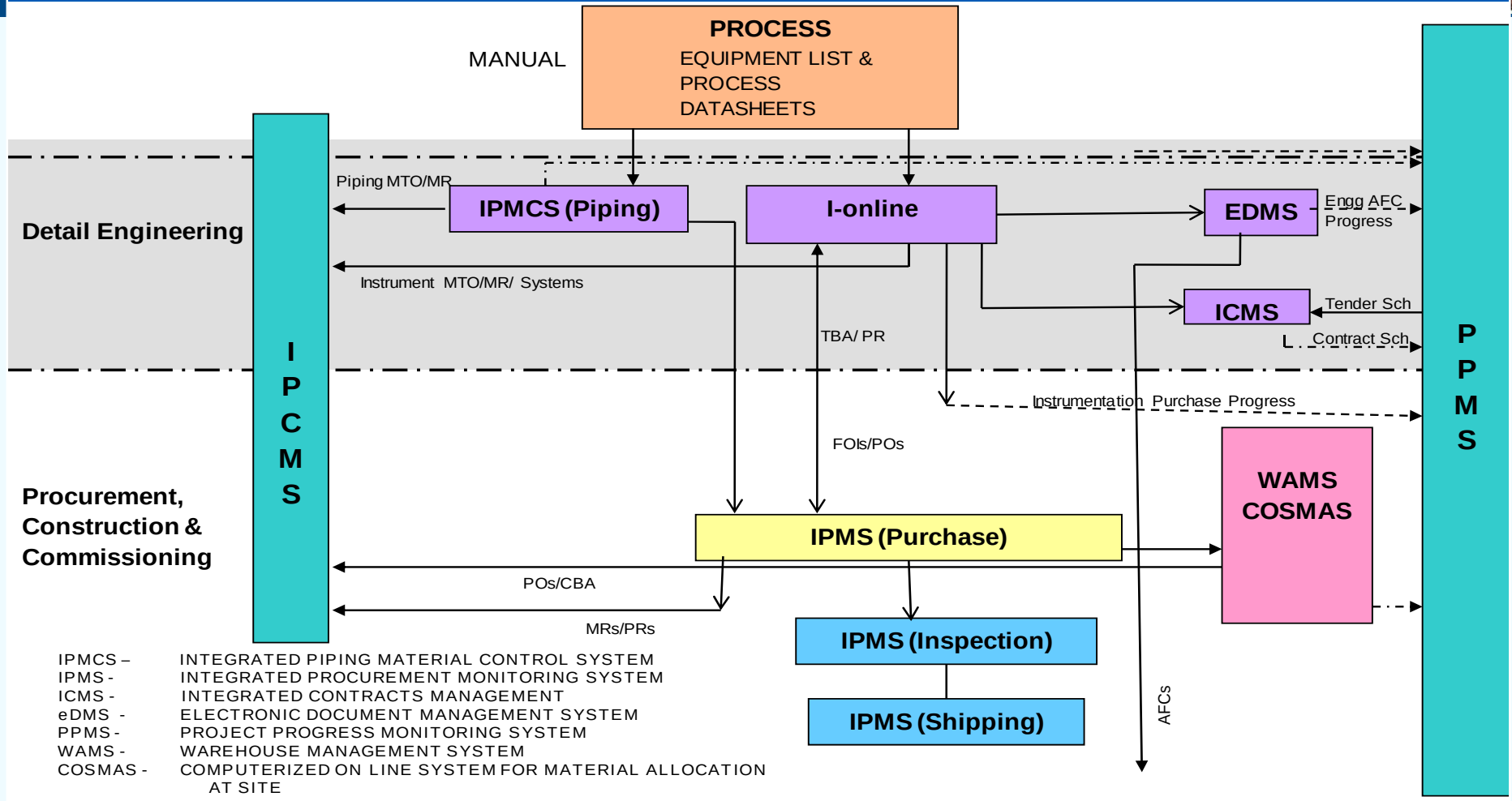
  However preferred mode remains to be our in-house software.

i-online

I-online is in-house developed module based software for generation of instrumentation engineering deliverables:

- Instrument Index Database
- Instrument Sizing Module
- Datasheets & MR Preparation
- Bill of Material
- Cable Schedule
- Instrument Location Plan

Integrated Engineering Software Work Flow



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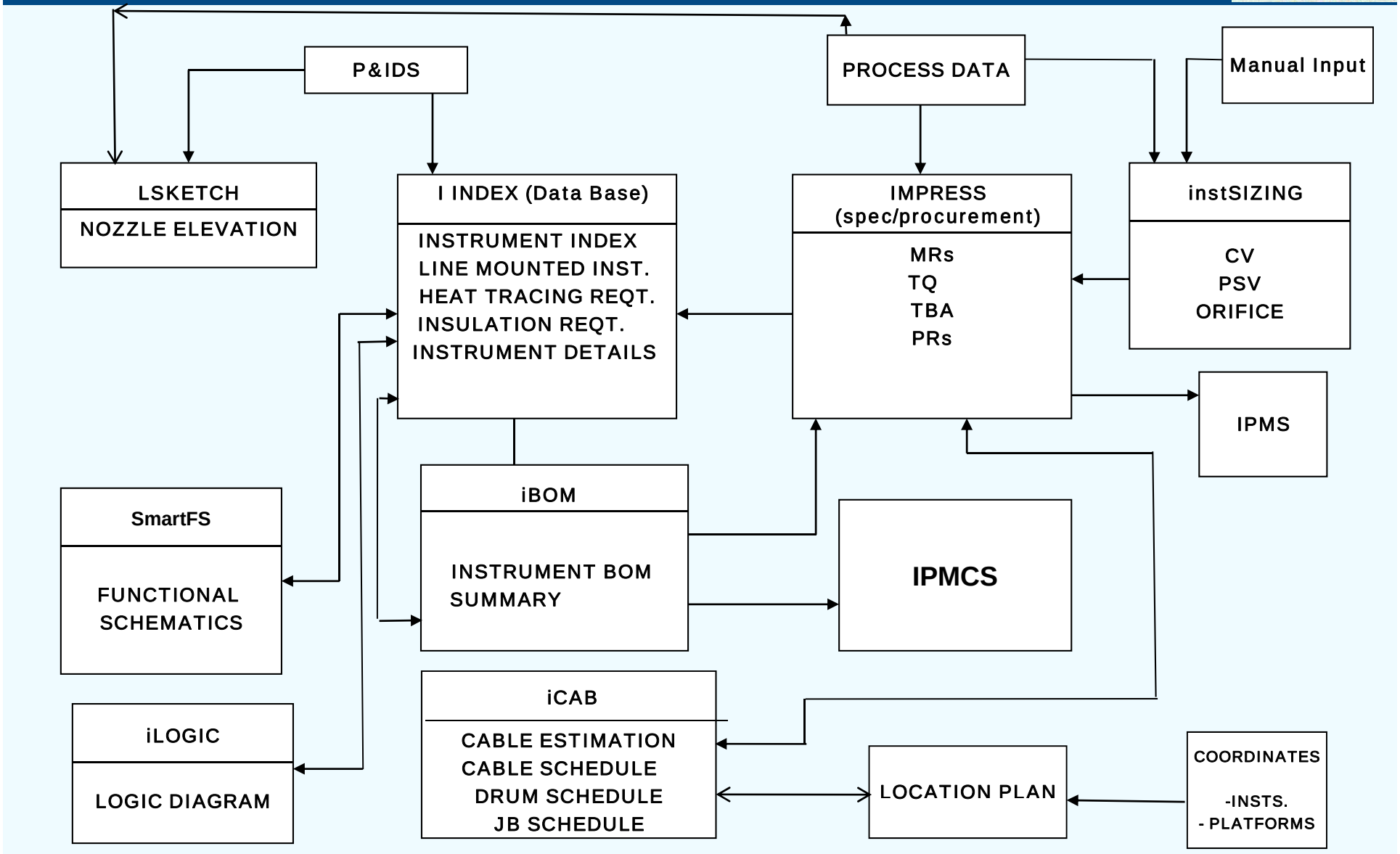
Instrumentation Software i-online Data flow



Quantity of instrumentation items procured for Refinery (Typical)

List of Items	Quantity
Control Valves	1200
On-off valves	650
PSV	1025
Field Instruments (4800 FF & 2500 NFF)	7300
Averaging Pitot Tubes	35
Magnetic Flow meters	5
Mass Flow meters	90
Ultrasonic flow meter	25
Vortex Flow meter	40
Spl. Level Instruments-Guided Wave Radar	232
Temperature elements	2500
Nucleonic Level Instruments	9 lot
Orifice plates and assemblies	2900
Gas detectors	700
Desuperhaetrs	32
Cables	3000km

I/O Summary for Refinery (Typical)

	UNITS IN REFINERY PROJECT												
	CDU/VDU	HGU	VGO-HDT	DHDT	PPU	DCU	LPG/FUEL GAS, TREATER, MEROX	FCC-PC & PRU	UTILITY & OFFSITE	NHT-ISOM	CCR-HEXANE	MCR	SRU
DCS													
CLOSED LOOP													
Analog Input	136	228	195	155	135	150	26	65	100	190	225	5	180
Analog Output	118	244	195	155	135	100	28	65	100	217	232	5	180
OPEN LOOP													
Analog Input	35	470	290	165	375	80	65	100	140	160	395	20	300
Analog Output	0	60	20	15	20	0	0	20	0	15	15	0	30
Digital Input	358	631	238	228	630	425	130	320	635	114	134	70	540
Digital Ouput	10	305	50	30	80	80	50	50	0	45	35	0	90
Total I/Os	**657**	**1938**	**988**	**748**	**1375**	**835**	**299**	**620**	**975**	**741**	**1036**	**100**	**1320**
Total DCS I/O count 11632													
Emergency Shutdown System													
Analog Input	85	580	280	180	160	260	70	130	120	188	255	0	240
Digital Input	252	920	330	401	295	465	125	325	85	372	385	0	600
Digital Ouput	199	855	320	209	270	480	110	295	280	390	350	0	540
Total I/Os	536	2355	930	790	725	1205	305	750	485	950	990		1380
Total ESD I/O count 11401													
Fire & Gas system													
Analog Input	30	140			66	80		100		130		20	100
Digital Input	15	45			15	30		37		35		15	15
Digital Ouput	10	40			39	20		37		20		10	20
Total I/Os	**55**	**225**			**120**	**130**		**174**		**185**		**45**	**135**
Total Fire & Gas I/O count 1069													

CODES & STANDARDS

AGA	American Gas Association
AGA Report	Orifice Metering of Natural Gas and Other Related AGA- American Gas Association and Uncertainty Guidelines. Measurement of Natural Gas by Turbine Meter. Measurement of Gas by Multipath Ultrasonic Meters.
ASME	American Society of Mechanical Engineer.s
	Thermowells Performance Test Codes PTC 19.3 TW :2010 & ERTA 2012.
ANSI	American National Standards Institute.
	FCI 70-2 - Control valve seat Leakage classification.
ISA	Instrumentation Society of Automation.
	S 50.1 Compatibility of Analog Signals for Electronic Industrial Process Instruments.
	S-75.01 Flow equations for sizing control valves.

CODES & STANDARDS (Continued)

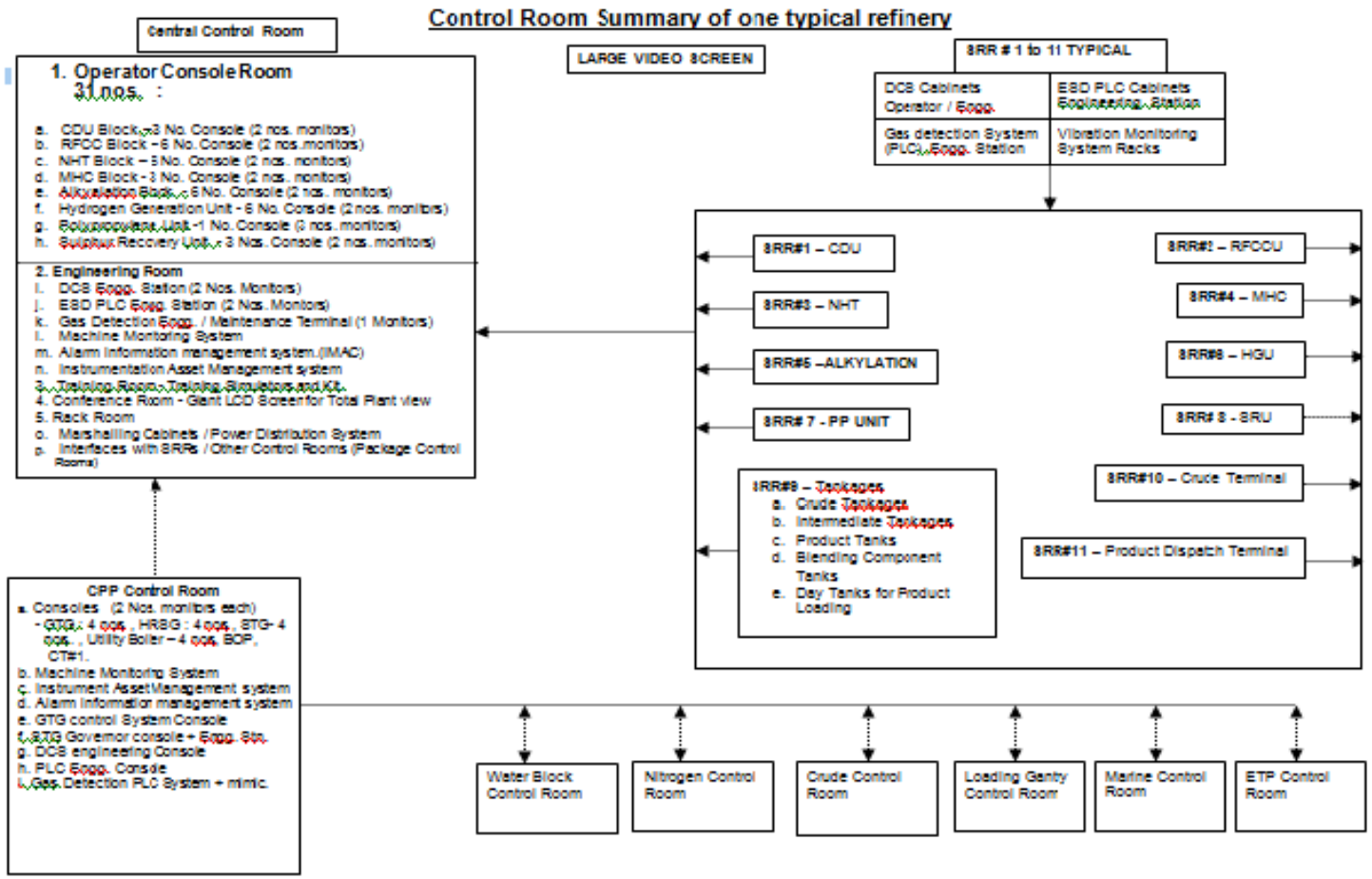
API	American Petroleum Institute
API RP 520	Sizing, Selection and Installation of Pressure Relieving Devices in Refineries. Part-I -Sizing and selection Part-II -Installation
API RP 526	Flanged Steel Pressure Relief Valves.
API RP 551	Process Measurement Instrumentation
API RP 555	Process Analysers
API 607-4	Fire test for soft seated valves
IEC 61508	Functional safety of E/E/PE safety related system
IEC 61511	Functional Safety – Safety Instrumented Systems for the Process Industry Sector.
NACE	National Association of Corrosion Engineers - MR-01-03.
NFPA	National Fire Protection Association.

CODES & STANDARDS (Continued)

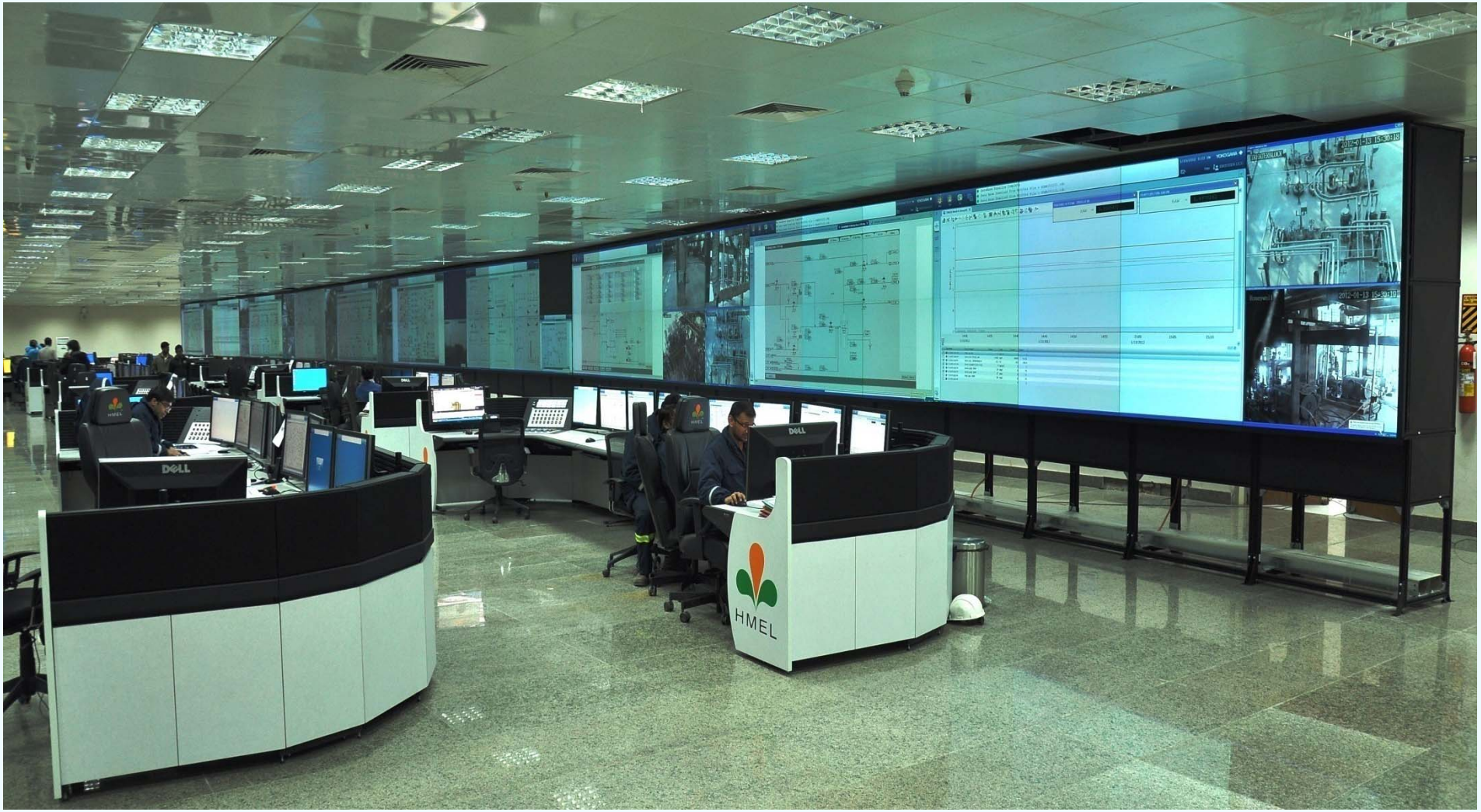
IEC	International Electrotechnical Commission
IEC 60079	Electrical Apparatus for Explosive Gas Atmosphere.
IEC 60529	Degree of protection provided by enclosures (IP Code).
IEC 60584-2	Thermocouples - Tolerances
IEC-61285	Industrial Process Control Safety of Analyzer Houses.
IEC 61000-4	Electromagnetic compatibility for Industrial Process measurement and Control equipment.
IEC-61131	Programmable Logic controllers
IEC 61158	Foundation Fieldbus Specifications

CONTROL ROOM SUMMARY (TYPICAL)

Typical Control Room Summary



Main Control Room (MCR)



Implementation of new technology

Foundation Field Bus technology

- For normal open loop & closed loop.

Increasing use of Wireless Technology

Wireless instruments considered in :

- Utilities
- Pump Seal and machine monitoring of non-critical machines.
- Open loop pressure and temp. measurements in Utility Boiler.
- Temperature measurement in columns and heaters of Cracker.

Tunable Diode Laser Spectroscopy (TDLS)

- Fast response time, interference free, low maintenance and multi component analysis
- Used for furnace in CDU/VDU.
- Product quality analysis in FCCU.

Prefab Hookup

For all services (except steam), standard bought out Pre-fabricated (with 5 valve manifold for flow and 2 valve manifold for PT) & pretested (at manufacturer's works) hook-up for all flow (DP) transmitters and pressure transmitters. These hook-ups are basically close coupled instrument hook-up.(integral type) used for better installation.

- EIL instrumentation department with 100 + professional involved in Design of Instrument & Control System and Telecommunication for plants from concept to commissioning.
- EIL has vast experience from conceptual design till commissioning for large variety of projects in all activities related to I&C systems.

Thank you!